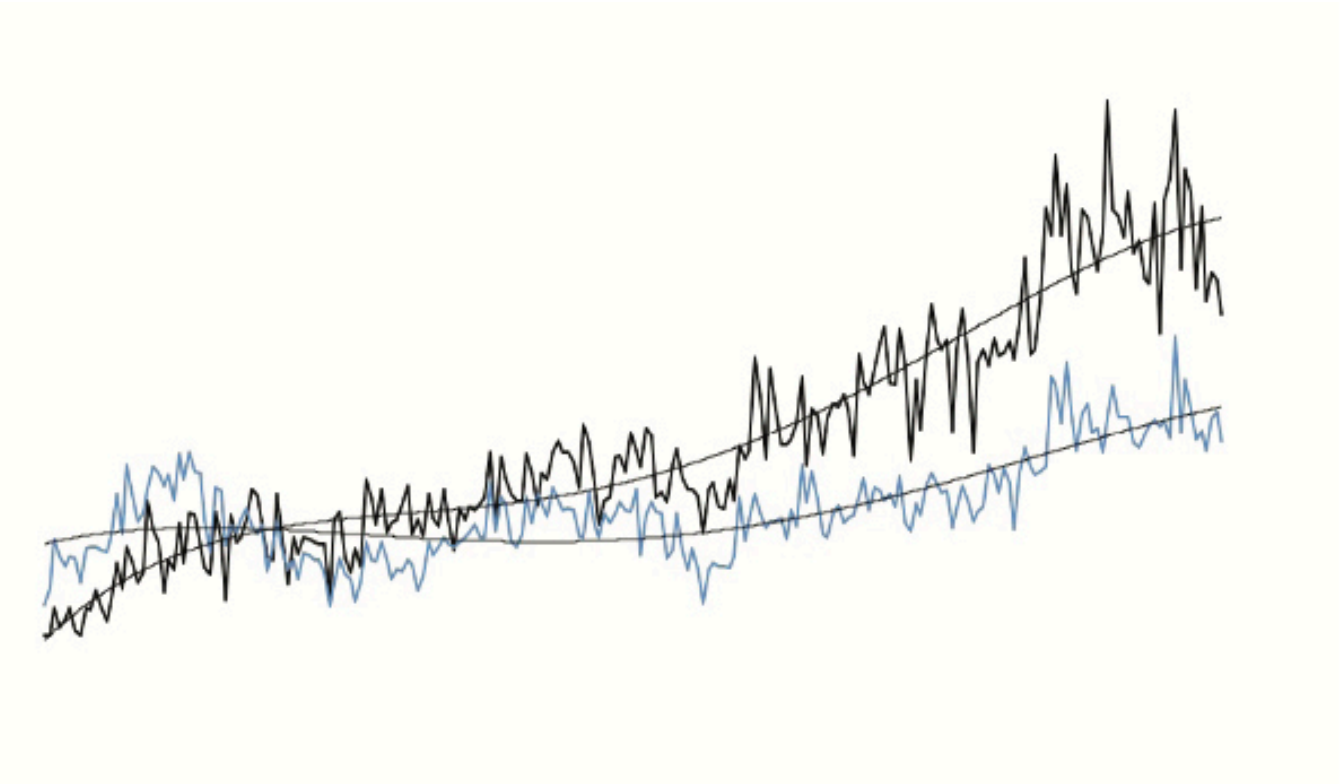
ALPHA SOURCES

JANUARY 2022



BABIES AT A PREMIUM

The evolution of population growth and structure is intimately tied to the most important decisions individual humans make through their life; when to have children and how many to have. The analysis of reproductive behaviour in humans draws on evolutionary theory and biology, cultural and social sciences, psychology and economics. It is a daunting task to collect all these threads into a coherent framework, but this is what I attempt to do in what follows, all the same. Broadly speaking, the literature treats human reproduction in three ways. In the **first**, which comes from formal evolutionary theory, reproduction occurs as a result of sexual selection, or more specifically the competition within the human species for a mate.

This initial condition then gives rise to the **second**, and main, framework in which the decision on the number of offspring is treated as a resource

allocation problem, giving rise to a trade-off between how many children to have, and how much to invest in each child. This model is widely explored in economics and evolutionary biology and theory. In the standard framework, families—or often women alone—solve this allocation problem given a set of external conditions. Generally, in this framework, an increase in resources leads to more children in a traditional society, but not necessarily in a modern post-transition economy.

The **third** framework emphasises shifts in norms and culture to explain why fertility trends shift over time. Given that such changes often can be tied back to the same fundamental resource allocation problem mentioned above, it can be difficult to separate the second and third framework. That said, it is possible to imagine forces working independently through culture and norms to affect fertility decisions, a point emphasised by the softer social sciences and evolutionary psychology.

Before diving into the deep end, I want to define a few important concepts, often used interchangeably and sloppily in the literature.

Fertility rate(s) - There are at least three different concepts of fertility used in the literature, and they're all distinct. The total fertility rate, TFR, is the number of children born per woman in a given population in a given period. It is often compared and contrasted to total cohort fertility, which is the rate of children born per women in a given cohort. In the latter case it is often assumed that the women in question have completed their fertility career—in effect entered menopause—in which case we speak of total completed cohort fertility. TFR and cohort fertility are correlated, but a significant divergences arise in the context of tempo effects—birth postponement—which is key to the analysis of fertility in modern economies. Another measure is the crude birth rate, the number of children born per 1000 members in a given population, often compared to the crude infant mortality rate, which is the number of children born that die during labour, or shortly after being born.

Fecundity – This term covers the biological ability to produce offspring. The higher fecundity, the more positively endowed the individual, here the female, with the ability to

▶▶

have children. The C.J.A. Bradshaw and C.R. McMahon, Encyclopedia of Ecology from 2008 defines it as;

"The physiological maximum potential reproductive output of an individual (usually female) over its lifetime"

The Wikipedia entry distinguishes between two definitions;

1) In human demography, it [fecundity] is the potential for reproduction of a recorded population.

2) in population biology, it is considered similar to fertility, the natural capability to produce offspring, measured by the number of gametes (eggs), seed set, or asexual propagules.

The point I want to get across is that fecundity ostensibly is a biological parameter describing women's capability to successfully produce offspring. Fecundity is partly determined by external conditions—the environment, access to resources etc.—but the health of the individual, primarily the woman, plays a key role too. The man's ability to fertilise the egg also plays in, for example via the quality of his sperm. Indeed, the two—the external environment and the individual's ability to reproduce—are linked in that the latter depends on, and responds to, the former. The key point is that fecundity can be high, but fertility low—an equilibrium arguably found in many modern societies—and vice versa, in societies with high child mortality.

Sex and gender – Men and women are different, and on a biological level, it is these differences that allow for reproduction to occur in the first place. The distinction between men's relatively small and mobile gametes—sperm cells—and women's large and immobile gametes—eggs—is established science, even if social media is sometimes trying to convince you otherwise. This distinction is what delineates the male and female sex. It is also at the core of the theory of sexual selection, and the reproductive strategies that follow.

As for gender, I am happy to subscribe to the distinction put forward by evolutionary biologists Bret Weinstein and Heather Heying that if sex covers the differences in hardware between men and women, gender is the equivalent for the difference in software, implying that gender is more fluid than sex. That said, in the context of reproduction, it is clear that it is the difference between men and women—both in terms of sex and gender—that generates the intricate web of incentives and behaviours, which determine the timing, frequency and success of reproduction. Most importantly, the optimal reproductive strategy for men and women have evolved differently, giving rise to a delicate interplay, even competition, between sexes to achieve the optimal reproductive path.

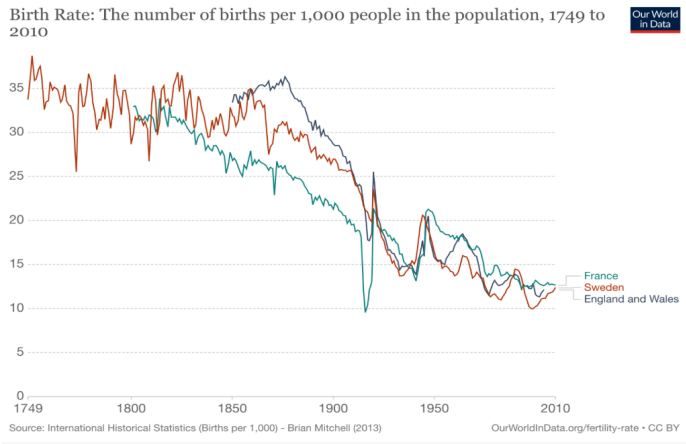
WHERE ARE WE NOW?

To my knowledge, we don't have a time series for global fertility that covers the entire demographic transition, though we can get an idea by looking at select data. Chart 01 below plots data from the International Historical Statistics from Sweden, France and England & Wales with the best coverage across time. All three lines point to a structural break in birth rates in the 19th century, broadly consistent with the idea that the onset of the demographic transition coincided with the industrial revolution, consistent with the message from the mortality literature; see here. More generally, the idea that the industrial revolution was at the center of the early phases of the demographic transition is at the heart of the study in economics of the history of fertility and mortality. As I explained in my introductory chapter on the demographic transition—see here—a recent study, Delventhal et al. (2021) shows that the onset of the fertility transitions across

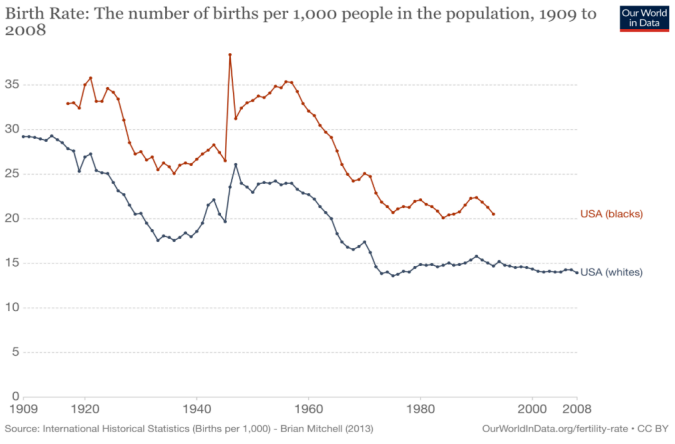
countries is relatively concentrated compared to the onset of the mortality transition, which is relatively dispersed. Specifically, their results point to a significant concentration of countries initiating their fertility transitions in the years between 1960 and 1990, and to a lesser extent in the period 1900 to 1960. Very few countries began their fertility transitions in the 19th century, and after 1990. They also provide evidence to suggest that the later the transition, the quicker it is, consistent with the very rapid fall in birth rates in some so-called emerging economies in the 1970s and 1980s.

As ever, the U.S. experience looms large in the literature both in terms of overall coverage and an interesting case study in itself. We need to know the basics. Chart 02 shows that U.S. birth rates dropped sharply during the First World War, rebounded sharply, only then to fall thereafter. The sharp drop in birth rates during the Great War, and the decline through the 1930s led many contemporary demographers to voice the same concerns over economic growth that researchers are worried about in the context falling populations and ageing today. The postwar baby boom turned this story on its head, however, as the second chart above shows in the U.S. Birth rates gradually began climbing in the 1940s, dipped late in the WWII effort, before shooting higher in 1946, remaining elevated until the beginning of the 1960s. This much publicised baby-boom, covering babies born between 1946 and 1964, has given rise to a

fig. 01 / The big shift - **fig. 02** / U.S. fertility in the 20th century



Source: OurWorldinData and Mitchell (2013)

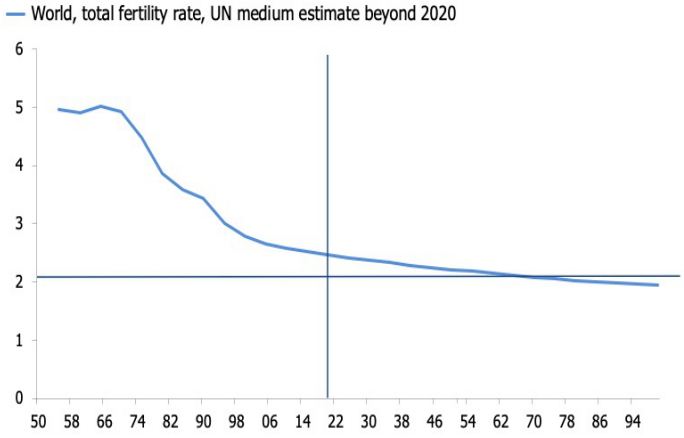


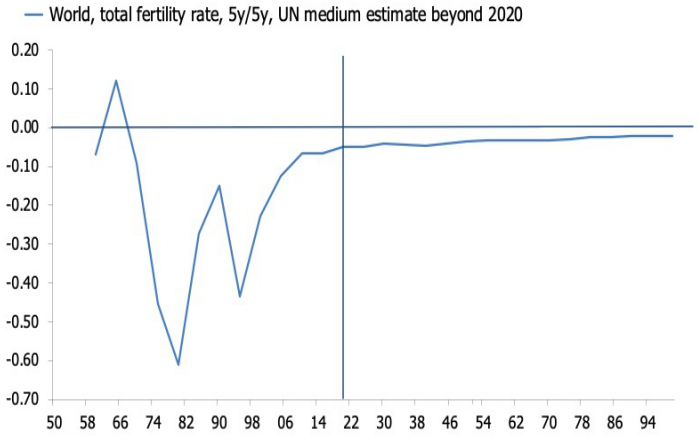
Source: OurWorldinData and Mitchell (2013)

whole research programs in economics and social sciences, attempting to quantity the economic and social effect of various generations moving through the life cycle and life course, creating humps and dips in the aggregate age structure. Diane Macunovich's 2003 book, Birth Quake, is one of the more prominent examples. It applies the Easterlin hypothesis—the idea that relative incomes between cohorts are a key driver of living standards and economic decisions—to explain fertility in the U.S. in a post World War II era.

In a contemporary global context, the UN's detailed data begin in the 1950s, which is as good a starting point as any to zoom in on contemporary trends in birth rates. Chart 03 below plots the evolution in global fertility since 1950, which broadly suggests that the demographic transition—here defined as a fall in fertility rates towards replacement levels—accelerated sharply in the 1970s, halving the TFR from 5 to 2.5 at the end of the 2010s, consistent with the findings by Delventhal et al. (2021). Extrapolate this trend, and global fertility will hit replacement levels by 2060-to-2070, with the UN's median estimate indicating that it will then continue its decline, reaching 1.9 in the year 2100. This "forecast" almost certainly is not worth the paper it is written on, but claiming that the reality will look different is one thing, making an assumption about how and why fertility will evolve over the next 80 years is quite another. For better or worse, the UN's prediction is not necessarily a bad

fig. 03 / When does it end? - **fig. 04** / Falling through the 21st century?





prediction, given our priors, which really tells us how little we know.

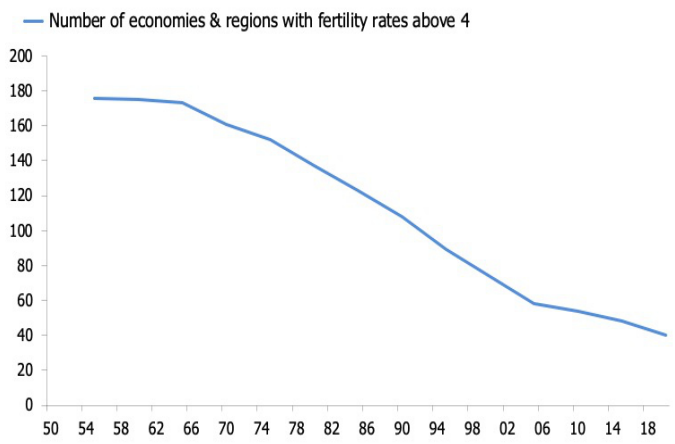
Creating a descriptive narrative around fertility in a post-war context is more art than science. Fertility was stable at around 5 through the 1950s and 1960s before the beginning of a rapid decline in the 1970s. The decline eased in the 1980s, before re-accelerating in the 1990s. As of 2020, fertility is still falling, and not surprisingly, the UN is betting on a happy ending with a convergence towards replacement levels in this century.

On their own, these data invite one key conclusion, and raise at least one central question. First, they show that the demographic transition is an ongoing phenomenon, and to my mind, it is worth asking whether we will ever be in a position to claim that it has ended. Secondly, the post-war numbers raises the question of what exactly happened to drive fertility rates down sharply, starting in the 1970s. The dinner table answer is that the U.S. baby boom, by then, had fizzled out, the birth control pill was becoming increasingly available in modern economies, and women began their second, and still ongoing, march towards equal standing with men in the labour force, at least in terms of participation. As my detailed analysis below shows, this simple story just about survives a closer look at evidence. But, when it comes to the drivers the sustained fall in birth rates to below replacement level, the picture gets murky. Many explanations are offered, but most of them are unconvincing on their own.

My next four charts plot the key shifts in global birth rates. Chart 06 shows that the number of countries with a TFR above 4 was still falling by the end of the 2010s, while the chart 07 shows that the number of countries with a TFR below 2 was still rising. This chart also reveals that the number of countries with a very low TFR, here below 1.5, seems to have peaked.

That the number of countries with high fertility is still falling at the same time as the number of those with sub-replacement fertility is rising rams home the point that the demographic transition is not yet over. This, in turn, means that there is no justification for the assumption that fertility rates will converge to replacement levels across countries.

fig. 06 / The DT is still spreading… - **fig. 07** / …and it doesn't end with TFR at 2.1



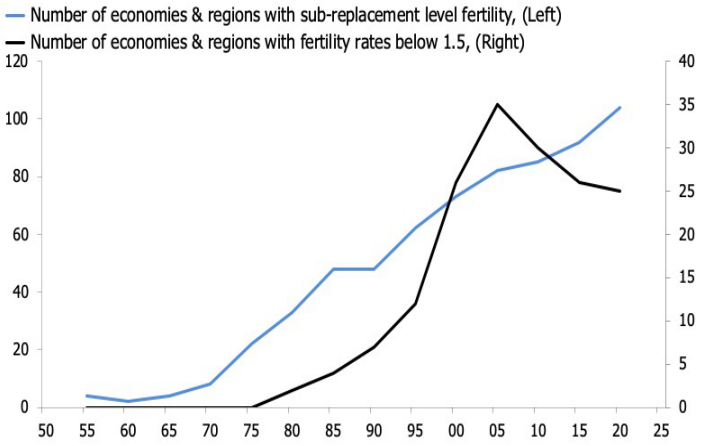
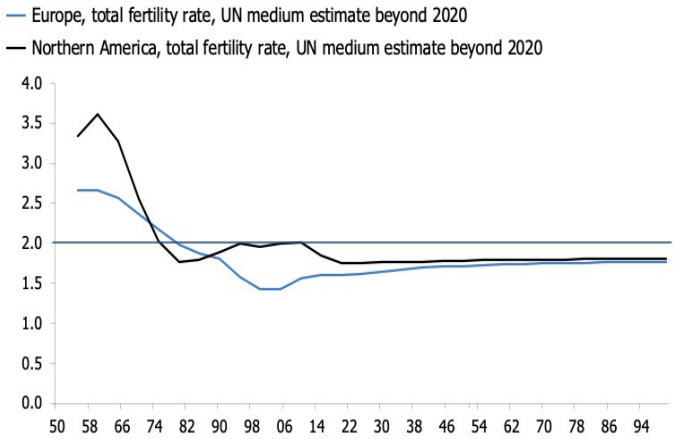
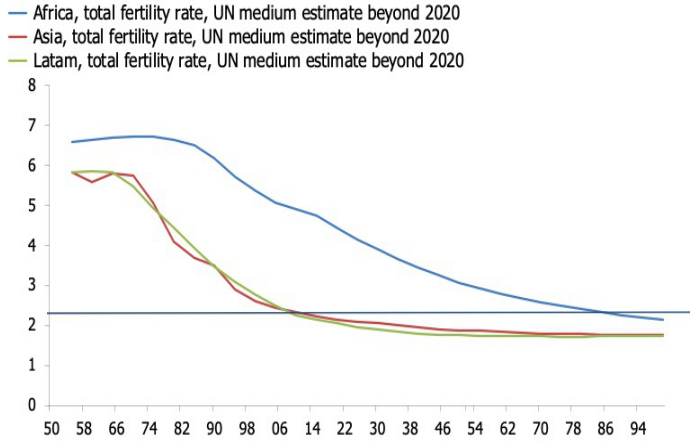


fig. 06 / Different paths in Europe and America - **fig. 07** / The great fall





The evidence that the rise in the number of countries with very low fertility, below 1.5, seems to be reversing—having peaked between 2005 and 2010—is an important point in the context of the tempo effect of fertility, birth postponement, described and analysed later. It suggests that a long period of birth postponement, mainly in Europe, is now giving way to catch-up. It also suggests that warnings at the start of the 2000s of a low fertility trap, especially in Europe, could well be unfounded, though we need more evidence to be sure.

Across regions, both Europe and North America experienced a shift in fertility trends in the 1960s, kickstarting a sustained decline. While fertility in North America initially fell faster than in Europe it did so from a higher level, in part due to a lagged effect of a stronger post-war baby boom. More importantly, by 1980, fertility in North America was

rising again, while it kept falling in Europe. Indeed, combining the European numbers with the collapse in fertility in Eastern Europe and Russia after the fall of the Soviet Union, it is fair to say that the drop in birth rates in Eurasia has been nothing short of dramatic since the Second World War. As I will show later, whole research paradigms have emerged in an attempt to explain why fertility in Europe fell so far, so fast, and have stayed low. From the other side of this argument, the difference in birth rates between Europe and North America is part of broader tale of Anglo-Saxon exceptionalism.

The U.S., the U.K., New Zealand and Australia all experienced rapid fertility declines from the 1960s onwards, but contrary to Europe, the TFR was rising towards 2 by the beginning of the 1990s. It has since, in all of these countries, fluctuated between 1.8 and 2, significantly higher, and more stable than most other developed economies. Interestingly, birth rates in the major Anglo-Saxon economies have been falling rapidly through the 2010s, and if they drop much further, we have to re-examine this idea of Anglo-Saxon exceptionalism.

The second chart above plots the rapid fall in birth rates in developed economies. By the beginning of the 1970s, fertility in Latin America and Asia was comfortably locked above 5. A mere 30 years later, the average fertility in these regions had plunged to just over 2, and by the beginning of the 2010s, it was still falling. At the current rate, birth rates in these erstwhile high-fertility countries will soon fall below that in the traditional developed world. This trend masks fascinating idiosyncratic case studies, most notably of which are China, and the effect of the one-child policy, Japan and South Korea. Rapidly falling fertility in Thailand and Singapore stand out too, as do the question of whether fertility in Malaysia and Vietnam is stabilising at replacement levels, or whether a further fall is in store. In LatAm, the onset of sub-replacement level fertility in Brazil, Chile and Colombia stand out. The key point, from the perspective of view of economic analysis, is that many so-called emerging economies suddenly look a lot like developed economies, demographically speaking. The experience of these economies also effectively is what leads Delventhal et al. (2021) to conclude that the later a coun-

try starts its DT, the quicker the fall in birth rates. This research recently the Economist, a news magazine, to conclude that the demographic transition is speeding up.

If that's true, we might soon have to tell a dramatically different story about birth rates in Africa, where many countries are yet to start their DT. For now, however, abnormally high fertility still dominate the picture in Africa, which is invariably correlated with lower and more unstable living standards. South Africa and Botswana are the two only countries where fertility appear to undergoing something resembling the transition observed in the rest of the world.

In summary, I'd emphasise two broad points about contemporary fertility trends that readers should carry with them as we progress. The first is a contradiction. From a bird's eye perspective, the decline in fertility across countries as part of the demographic transitions looks relatively tidy, but look closer and significant variance in tempo and end-point emerges. Convergence across countries and time to replacement level fertility is an unreasonable expectation. Secondly, it is impossible to know ex-ante whether shifts in fertility, even across five-to-ten year periods, mark the beginning of more sustained multi-decade changes. We don't, in my view, have a good methodology to separate signal from noise, at least not until significantly after the fact.

THE GREAT GAME

Before a child is born, man and woman have to form a partnership, and procreate. This, at least, is the state of affairs for the time being. The theory describing this interplay between the men and women is sexual selection, and we need to know about it. Richard Dawkins' seminal *The Selfish Gene* relies heavily on Trivers (1972), which sets out the relationship between parental investment, sexual selection, and ultimately sexual success, and failure. Trivers (1972), leaning on Darwin', defines sexual selection through two broad concepts; first, it is the competition within on sex for the opportunity to mate with the other, and secondly, it denotes the differential choice by members of one sex for members of the other sex to mate with. In all but a few cases, the sex doing the competing is the male, and the sex doing the choosing is female.

Trivers (1972) relies on a study with the common fruit fly—Bateman (1948)—to identify three broad characteristics of the reproductive game between male and female. First, male reproductive success varies much more than female success. A relatively large share of males don't get to reproduce at all, whereas most female do. Secondly, the failure to reproduce for females has nothing to do with their inability to attract a mate, while the failure to reproduce for males is overwhelmingly associated with the inability to attract a mate. Thirdly, females' reproductive success does not increase substantially after the first mating, and not at all after the second. By contrast, for males, success begets success. The reproductive success of males increases substantially for those who are able keep attracting a female mate.

The question which will be ringing in readers' ears at this point is whether a study from 1948 on fruit flies can be generalised to humans. As it turns out, it can, via the idea that sexual selection is a function of relative parental investment in their offspring.

Trivers (1972) says;

"What governs the operation of sexual selection is the relative investment of the sexes in their offspring."

The study goes on to generalise that in most species, males, with relatively small and easily produced sex cells—sperm—tend to invest much less in the reproductive effort than do females with relatively large sex cells, or eggs. In science parlance; males have small gametes and females have large ones. This distinction is hard-wired into evolution, giving rise to the very definition of male and female. Starting, presumably at some point in the primordial ooze, with a world in which sex cells are undifferentiated, strong selection pressures will have worked to generate two types of cells, or gametes, over time; small mobile ones and large less mobile ones.

The gist in the context of sexual selection is two fold; firstly, the small, male, sex cells have evolved to compete with each other for the opportunity to fertilise the large, female, cells. Secondly, the initial, and often ongoing, investment in the success of the individual offspring is

smaller than the relatively large investment required by the female cells. Trivers (1972) argues that this evolutionary trend exerts strong pressure on parental investment to fall on the female. Competition between males for the opportunity to reproduce means that any additional investment in the offspring decreases the chance of the male of out-competing other males for the chance to reproduce with other females. The female's initial relatively high investment in the offspring commits her to stick with it via future investment, than the male, who initially invests very little.

These two propositions face a number of hurdles at the offset. In the context of the latter, Richard Dawkins relies on the sunk cost fallacy in economics to argue that it isn't appropriate to assume that a female's future investment in her offspring is a direct, and rising, function of her past investment. This may be true in a general sense, but the intuition from Trivers (1972) seems relevant in the context of humans, where women's ability to successfully reproduce is subject to time constraints. In particular, abandoning a child—writing off the investment in a given offspring— becomes very costly over time, because no matter how attractive the female is, she will eventually run out of time to reproduce.

As far as male-male competition is concerned, the most obvious objection to this in humans is that monogamy is an evolved trait in humans, presumably in part because raising children is costly and requires the help from both parents. Initially in his analysis Trivers (1972) notes:

"If the net reproductive success of a male investing in the offspring of one female is larger than that gained from the investment in two, then the male will be selected to invest in the offspring of one female."

This intuitively seems to apply for humans, but fundamental differences remain. Even in monogamous species, male sex cells are small, numerous and easy to produce, while female sex cells remain large, and costly to produce and maintain. Put differently, the initial investment in the offspring is much larger for women than for men, a reality which has profound consequences for the sexual selection in humans.

In Trivers' universe, the relative burden placed on women during pregnancy, and in the early period of childrearing, is part of a broader game. **According to this model evolved reproductive strategies of men and women are the result of a long-run adversarial contest between the sexes, revolving around "horse trading" over investment in the successful survival of offspring.** This situation arises from the fundamental initial mismatch in the reproductive strategies, even in monogamous species, driven by the different size of male and female gametes. It means that female reproductive strategies have evolved to increase the probability that men can be persuaded, coerced or tricked to invest their fair share in the female's offspring. Conversely for men, their reproductive strategies have evolved to increase the probability of investing as little as possible, while maximising the chance that their offspring survives.

This framework is powerful because it ties the analysis of sexual selection to an easily identifiable evolutionary framework, but this is also its weakness. It is easy to imagine this type of analysis becoming overly determinist and reductionist, especially in the context of analysing modern fertility and reproductive trends. To that end, the key question is whether it is possible to derive from Trivers (1972) a number of testable hypotheses for fertility and reproductive behaviour today. As it turns out, we can.

The opportunity cost of having children – Trivers (1972) easily provides a foundation for one of the most controversial topics in social science and economics; the effect of giving birth and motherhood on women's relative earnings in the labour market. It is important to distinguish between two concepts, both of which follow from Trivers (1972).

The gender pay gap, which is a general term for the tendency of men to out-earn women, and whether this gap is related to the relatively high investment burden incurred by women during pregnancy and childrearing.

The motherhood penalty, which denotes the wage penalty incurred by mothers compared to childless women. The two overlap, and are often treated poorly in the literature as indistinguishable, but they are separate, all the same.

►►

We can talk about two potential wage penalties for women due to childrearing. The one mothers incur relative to men, and the one they incur relative to childless women.

Why is this?

In a context where women do not, in any meaningful way, engage in labour market- and productive activity, the opportunity cost of having to invest heavily in the offspring early in the reproductive stage is small. This was the social context in which women lived at least up until the beginning of the 20th century, and perhaps even in some cases until the 1960s and 1970s. Once women entered the labour market, however, the largely biologically-determined investment mismatch early in the reproductive process becomes a sizeable opportunity cost, see for example Galor and Weil (1993). A key prediction from this analysis is that the entry of women into the labour force is correlated with lower fertility, a key pillar in the analysis of the demographic transition as a whole, especially its later stages in the 20th century.
The gender pay gap is without a doubt one of the most hotly debated topics in politics and society at large, but what is it is, and what drives it? The answer to the first question depends on the country and time frame, but the headline numbers from the EU and the OECD provide some idea. Data from Eurostat shows that the difference in gross hourly earnings between men and women in the EU-27 was 14.1% in 2019, split between a low of 1.3% in Luxembourg and a high of 21,7% in Latvia. In the OECD, the average in 2017 was 13.5%, using the difference in median earnings between men and women.

What drives the gender gap? The literature is vast, and the associated political discourse is clouded by normative perceptions of is fair or, more specifically, un-just, and what governments can do to close the gap, ostensibly to make sure that no gender pay gap ever exists. Taking the gap as given, however, a key prediction from Trivers (1972) is that birth rates should be able to explain the gender pay gap, at least in part.

In a cross-sectional country sample from 1970 to 2002 of Polachek & Xiang (2009) shows that the gender gap is positively related to fertility—using an instrument variable approach—, the age-gap

between husband and wife at marriage, and the marginal tax rate. Another strong result in the literature, see for example Blau and Kahn (2001), is that the gender pay gap across countries is negatively correlated with the degree of collective bargaining.

It is beyond this essay to unearth the multitude of drivers of the gender pay gap. Trivers (1972), however, hints at a controversial conclusion. No matter how hard we try, we will never be able to eradicate the earnings penalty incurred by mothers. This is because we will never be able to neutralise the excess investment needed by women during pregnancy, which invariably will be a drag on earnings.

This position is unacceptably defeatist, even male chauvinist, in the context of the current political discourse. But it is an entirely neutral statement when viewed through the lens of a world in which women have limited resources at their disposal that they have to allocate between different types of activity. As I will show later, this is the world of Life History Theory. For now, however, it is interesting to consider two implications from the excess investment incurred by women during pregnancy and early child-rearing, beyond the hotly debated issue of women losing unrecoverable ground to men in the labour force.

The first is that the seemingly paradoxical result that even as inequality of opportunity between the genders are reduced over time through changes in norms and regulation, a fertility driven wage gap could easily increase. This is because of the accelerated return on investment in education, training and ultimately labour market participation. Put differently, whatever measures put in place to compensate women for the cost of having children, they are diluted by the accelerating rewards to labour in a skilled labour market, especially in high value added activities.

The second implication, which follows from the first, is that the biggest relative difference in earnings will be between single women and mothers. Specifically, the relative increase in income and wealth that a woman with no children can achieve relative to her peer choosing motherhood is larger than the difference between the earnings of men and women. Trivers (1972)

►►

implies that this holds in both relative and absolute terms.

So, how big is this motherhood penalty? This is a bit like asking for the length of a piece of string, but at least the literature is reasonably clear. It exists. Cukrowska and Matysiaka (2020), a meta-analysis, finds that the average motherhood wage penalty is just under 4%, spread across studies which investigate the reduction in income from the first child, implying that the loss of income from more than one child is subject to either diminishing or accelerating costs of scale.

The paper finds, in line with relative investment hypothesis put forward by Trivers (1972), that the loss of relative wages from having multiple children is mainly driven by the reduction in human capital during child-related career breaks. By contrast, the loss of income associated with having only one child is driven by mothers actually choosing occupations that pay less, in effect jobs that offer more time to invest in childrearing, for example part-time. Finally, the paper finds that the motherhood wage penalty is relatively small in Scandinavia, Belgium and France, all of which are regions with public support for gender equality and the reconciliation of work and family. Budig and England (2001) finds a 7% wage penalty for mothers in sample of U.S. data spanning 1982 to 1993, a general result also seen in Gough and Noonan (2013). Interestingly, a freshly published paper, Andersen and Nix (2021), cite research to suggest that this motherhood penalty—or child penalty—now accounts for 80% of the *gender* wage gap, up from 40% in 1980.

The idea that women choose less time-intensive and lower paying jobs—often part-time—once they become mothers generally sits poorly with the political correct view that mothers are unfairly prevented from maximising their earnings potential in the labour market, even discriminated against. Notwithstanding the presumably harmless idea that many women simply like to spend more time with their children than working, it could in fact, a perfectly rational response in a context where increasing returns to investment in somatic labour market activity and investment in motherhood. As I mentioned above, Richard Dawkins is skeptical about the idea that

▶▶

the initial excess investment in procreation commits the women to future investment, referring to the economic theory of sunk cost. But I am not so sure this intuition is right in a context where women's ability to procreate is governed by menstruation and menopause, and where, arguably, investment in children and labour market activity both exhibit positive returns. In such an environment, it makes sense for mothers to devote more time with their children. This, in turn, would also support the idea that it is the difference between women—specifically between mothers and childless women—that maximise in modern labour market, as oppose to the difference between genders, which can, in any case, be mitigated, in part.

Women choose their men – Another key prediction in Trivers (1972) is that men will forever be doomed to compete for the chance to procreate, while women will have more suitors than they need. This observation seems to me so trivial and obvious that it doesn't merit much thought. But it is worthwhile pinning down in a modern context.

The first thing we have to get out of the way is the profound change in the evolutionary landscape due to the arrival of contraception; especially the pill. In effect, this allows women to "offer" sex to men without running the risk of being stuck with a child they have to either abort, or raise on their own. The availability of contraception seems to insert two countervailing wedges into the otherwise neat framework in Trivers (1972).

For men, which are assumed here to be evolutionarily disposed to want sex earlier and more frequently than women, contraception offers a relative cheap way to achieve this. By contrast, you could also argue that contraception affords women more time to decide whether to actually procreate with a partner, because they can engage in sexual relations—increasing the chance that the right partner sticks around—without pregnancy.

These qualifiers notwithstanding, we see clear evidence in the literature that male sexual success is heavily concentrated, while women have the luxury of choice, in line with the prediction in Trivers (1972). The most striking modern example of this reality is the chasm between men and women on dating sites.

On Tinder, for example, data show that women "swipe right" only 5% of the time, while men give the nod just over half the time. The same research also shows that successfully matching with a profile—the case where both man and woman swipe right—is more unevenly distributed for men. Even relatively unsuccessful women get some matches, but the men at the bottom get almost none.

The implication of this data is confirmation of the assertion by Trivers (1972) that sexual success among men is heavily stacked at the top. This result is supported by the academic literature starting with the seminal Perusse (1993). This study sets out of to prove that even with modern inventions such as strict monogamy and contraception, wealthy and powerful men have more sex than their less-endowed brethren. In other words, the old rules of sexual selection still applies, even if monogamy and contraception have changed the field of play.

The sample size in Perusse (1993), is small and confined to an isolated ethnic minority in Canada, but other studies have replicated his results. Kanazawa (2003), for example, finds a statistically significant relationship between men's income and their sexual success in a sample of 13,409 respondents in a General Social Survey—GSS—from the University of Chicago, spanning the years 1988 to 1996. Hopcroft (2014, 2019 and 2021) similarly finds a positive relationship between men's wealth and income and reproductive success in a modern context. Importantly, this empirical regularity stands in opposition to the inverse empirical observation that higher income and wealth is negatively correlated with fertility among women. This follows from the idea of a motherhood penalty, the inverse of which stipulates that women who forego reproduction, will enjoy an income premium, relatively speaking, over time.

Do married men with kids cheat more often than women? – A final interesting prediction from Trivers (1972) is that married men with kids should be more inclined to cheat. This is because men should be evolutionary inclined towards a "mixed strategy"—a partner with which he invests a lot raising their joint children and a promiscuous relationship with multiple women in which he doesn't invest much

in his offspring—even in environments where monogamy is the norm. This follows from the reality that men incur a relatively small cost of reproducing, and the non-zero probability that even if they leave the woman immediately or shortly after procreation, she will still raise their joint child.

For anyone living in the 21st, a number of obvious normative and institutional obstacles immediately spring to mind to make such a strategy difficult to pursue, or at least more costly than assumed in the most crudest of evolutionary frameworks. One interesting one is the legal requirements in many societies for men to pay alimony to the mother even if he is not, in any way part of her and the child's life. Iterated over many partners, this effectively raises the cost of pursuing a mixed strategy, assuming that the identity of the father can be legally ascertained for the purpose of demanding alimony. Another, more general evolutionary, qualifier is that the ability of a male to pursue an aggressive mixed strategy almost surely will be a function of his attributes. This is to say, he needs to be a bit of a hunk.

What does the literature say? In a review article, Zare (2011) presents results to suggest that men are more likely exhibit traits of infidelity than women—12% compared to 7% for women—but the study also suggests that the gap is shrinking. Atkins et al (2001) also show, in a sample of U.S. data from 1991-to-1996, that men are more likely to have had extra-marital sex, especially for men aged 50-to-70. By contrast, infidelity for women peak in the 40s, and the difference in infidelity in young cohorts is small across genders.

The modern observation that men tend to cheat more often than women is related to one of the most widely described, and debated, features of sexual selection by Trivers (1972); mate desertion, and why this is most commonly observed by men. The theory offers two explanations for this. First, the opportunity cost for men in sticking with one partner, inherently a limiting factor for the ability to reproduce, is higher for men and than for women. After all, the former has an ability, under the right circumstances, to father several offspring with multiple partners.

Second, and following directly from Trivers (1972), the excess investment incurred by women early in the reproductive and child-rearing period incentivises men to desert. In other words, a mate has an incentive to desert at the point at which it has incurred the lowest possible cost while at the same time being reasonably certain that the partner will be forced to stick with the offspring. This situation, often coined as the "cruel bind" or Trivers' Dilemma, arises when the cost of raising the child for the mother is less than the cost to start over with another mate.

The two other female responses to desertions are to abandon the offspring or to trick another member of the opposite sex to care for the offspring as it it was his own. Both seem impossibly unrealistic to imagine in a modern context, but just because these behaviours are rarely observed in the modern human ecology, in their pure form, a shadow of them might still be visible in the behaviour of men and women in relationship.

CONCLUSION

This first chapter on fertility homes in on two topics; first the transition itself and second, the theory of sexual selection and how it might explain a number of observed modern social phenomena related to fertility.

I am happy to subscribe to the two stylised facts about the fertility transition postulated by Delvanthal et al. (2021). First that the starting point of the fall in birth rates are more dispersed than than starting point for the fall in mortality. Secondly, that those countries who start their transition late also tend to experience quicker and sharper falls in fertility. I would add a third characteristic; namely that the transition in fertility doesn't end with replacement level fertility, and because it doesn't, it is worthwhile asking whether it is ever ends at all.

To the extent that I am interested primarily in the fertility as a *macro–phenomena*, it would seem odd to spend so much time on Richard Dawkin's *Selfish Genes*, and Trivers (1972). This perspective is important, however, for two reasons. First,

▶▶

the theory of sexual selection is key to understand human reproduction, and it would be a shame to move on to a an inquiry about the trends and drivers of fertility without an introduction to that knowledge. In short, the basics matter. Secondly, the idea that modern trends in fertility are underpinned by important, and ostensibly timeless, evolutionary processes is a key insight to understand the economics and wider social sciences literature. I mean something very specific here. We should be able to hold two seemingly contradictory positions at the same time. We must be Careful assuming that every social phenomena we observe is the result of some millennia old evolutionary process. At the same time, however, we must recognise that in the study of fertility, even seemingly modern phenomena are, almost by definition, evolved characteristics, to one extent or the other.

This space has intentionally been left blank

Find the landing page for this piece, and an overview of the project as a whole, here.