ALPHA SOURCES

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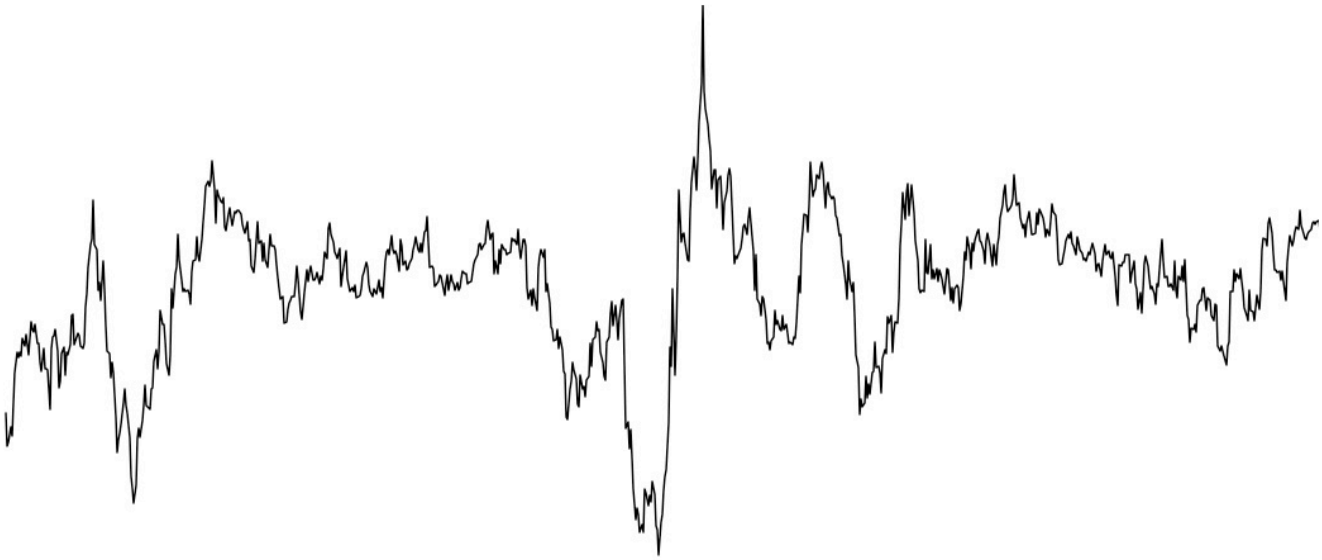

THE DEMOGRAPHIC TRANSITION

The study of demographics is a scientific chimera. In its crude form, it is nothing but a rudimentary scaffold providing a simple prism through which to view the evolution of human population since the onset of the Industrial Revolution. Keyfitz (1984) laments that demography…

"…has withdrawn from its borders and left a no–man's land which other disciplines have infiltrated"

This work is an attempt to step into this no-man's land and chart a course through it. In doing so, the aim is to unearth and give life to a multidisciplinary inquiry drawing on evolutionary theory, economics and sociology seeking to explain the progression of the human race over the past 200 years. I will

start with a description and analysis of the demographic transition (DT) in its simple form, before breaking this process down into its two key components, mortality and fertility. The study of demographics is partly a story of how and why the human population got to where it is today, but it is also a story of where we are going in the future, and whether we can influence where we end up. It is a field investigating topics such the relationship between the sexes, women's control over their own reproduction and the difference in realised economic outcomes between genders and ethnicities.

It's not entirely clear who holds the claim to the invention of the demographic transition as an analytical concept. According to Frejka (2016), the notion was born in 1909 by Adolph Landry, a French demographer and politician. Landry's paper entitled, *Les trois theories de la population*, formed the basis of a more extensive study in 1934, *La révolution démographique*, though by then other scholars had already done work on the same topic. A few years before, in 1929, American demographer Warren Thompson published his version of the same theory in an article published in the American Journal of Sociology, called *Population*. Whatever Landry's claim to the title of the first scholar to analyse the shifts in the human population as a process in phases, his work is rarely cited.

The widely cited Caldwell (1976), for example, doesn't mention Landry's contributions, choosing instead to credit Thompson with the first attempt to describe human population development as a transition through distinct phases. He does agree with Frejka (2016), however, that the 1945 paper by American

Demographer, and founding director of the Office of Population Research at Princeton University, Frank Notestein titled, *Population–The Long View* is the genesis of DT as we know it today. Building on his own work at Princeton, and a 1936 compilation by British demographer Alexander Carr-Saunders, *World Population: Past Growth and Present Trends*, Notestein identifies three stages of the demographic transition.

High growth potential populations – These populations are pre-transitional characterised by both high mortality and high fertility, which is common for societies with relatively low technological development, and stationary living standards.

Transitional growth populations – These are growing populations, characterised by rapidly falling mortality—due to advances in technology and health—but still high fertility.

Populations facing "incipient decline" – In these populations mortality is still falling, but at a much slower pace and fertility is now also declining rapidly, approaching replacement levels, or even.

Notestein (1945) is not explicit about the equilibrium that is initial broken, and later re-created, by these stages though the account in Frejka (2016) implies that the founding fathers of demographic transition theory assumed steady states in either end.

Pre-transitional populations can remain so for a long a time, while populations who have completed their transition eventu-

ally settles in an equilibrium of low fertility and low mortality. This latter point was controversial even in the contemporary setting in which Notestein was writing. Fertility in many developed economies showed signs of dropping far below two in the inter-war period, defying the more theoretically palatable idea of stabilisation at replacement levels. Notestein (1945) makes a clear distinction between the components of the DT, falling mortality and fertility, drawing a line that is still a red thread for the study of population dynamics today.

"[T]he reduction of mortality is a universally acceptable goal and faces no substantial social obstacles. But the reduction of fertility requires a shift in social goals from those directed toward survival of the group to those directed toward the welfare and development of the individual."

Researchers tend to still assume a more-or-less linear relationship between advances in health and technology and falling mortality, while fertility is seen as an altogether more complicated, and endogenous, process. It's quite possible that this distinction is unfair, though it is easy to see why empirical evidence would lead researchers to draw that conclusion, as I try to explain below. Summarising his view in 1953 on the broad strokes of modernisation and fertility, Notestein concludes:

"The new ideal of the small family arose typically in the urban industrial society. (...) As a consequence the cost of child-rearing grew and the possibilities for economic contributions by children declined. Falling death-rates at once increased the size of the family to be supported and lowered the inducements to have

many births. Women, moreover, found new independence from household obligations and new economic roles less compatible with child-rearing."

The themes sketched in Notestein's outline of the demographic transition have survived to this day. Ronald Lee's 2003 paper, *The Demographic Transition: Three Centuries of Fundamental Change*, is a seminal contribution in the modern parthenon, and it is worth quoting the paper's introduction in its entirety.

"Before the start of the demographic transition, life was short, births were many, growth was slow and the population was young. During the transition, first mortality and then fertility declined, causing population growth rates first to accelerate and then to slow again, moving toward low fertility, long life and an old population. The transition began around 1800 with declining mortality in Europe. It has now spread to all parts of the world and is projected to be completed by 2100. This global demographic transition has brought momentous changes, reshaping the economic and demographic life cycles of individuals and restructuring populations. Since 1800, global population size has already increased by a factor of six and by 2100 will have risen by a factor of ten. There will then be 50 times as many elderly, but only five times as many children; thus, the ratio of elders to children will have risen by a factor of ten.

Both Notestein and Lee uses the DT as a dividing line between two regimes; a stationary equilibrium before, and a dynamic process after.

The world before the DT is immortalized by Thomas R. Malthus' description of the human condition. In his 1798 essay, *An Essay on the Principle of Population*, Malthus described a world in which human life is governed by the irreconcilable realities of man's reproductive instinct and the scarcity of resources to feed him. In this world, population growth is tied down by powerful forces. Malthus famously contends that population growth is at all times "superior to the power of the earth to produce subsistence for man", famously proclaiming;

"I say, that the power of population is indefinitely greater than the power in the earth to produce subsistence for man."

In such an equilibrium, inspired by the laws of diminishing returns—David Ricardo's famous theory developed in 1821 but predicted, according to Bonditti (2017) by Turgot in 1768—premature death is the only effective mechanism by which equilibrium between the size of the population, and earth's ability to sustain it, is achieved. Malthus was agnostic on whether such fate is visited on humans by war, plague or famine, or a combination of all three.

What is clear, however, is that in Malthus' world, human life is Hobbesian; nasty, brutish and short. For Malthus, the limited ability to feed a growing population was written into the fabric of economic life and the laws that govern it.

"Man is necessarily confined in room. When acre has been added to acre till all the fertile land is occupied, the yearly increase of food must depend upon the amelioration of the land already in

possession. This is a stream which, from the nature of all soils, instead of increasing, must be gradually diminishing.

(…)

The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction, and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague advance in terrific array, and sweep off their thousands and tens of thousands. Should success be still incomplete, gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world."

Faced with this unmovable reality, the only way to break out is to a curb reproduction. Malthus's worldview combines conservatism and a disdain for the poor working class whom he considered to be wholly subject to their reproductive instincts.

"Man is by nature "inert, sluggish, and averse from labour, unless compelled by necessity."

Virtue, on the other hand, was found in chastity and reproductive moderation. Malthus' law of population is, in the words of Bonditti (2017) "lodged in a kind of enduring contradiction" between man's instinct to procreate, and the inability of the land's resources to support this instinct.

According to Lee (2003) Malthus' description of the world was broadly correct in pre-transitional society, though we have few

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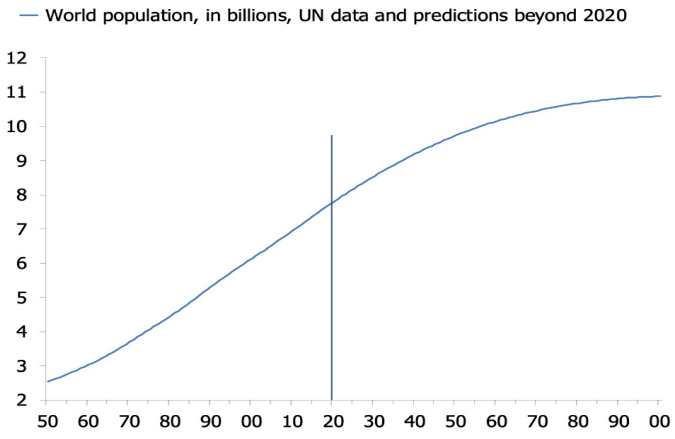
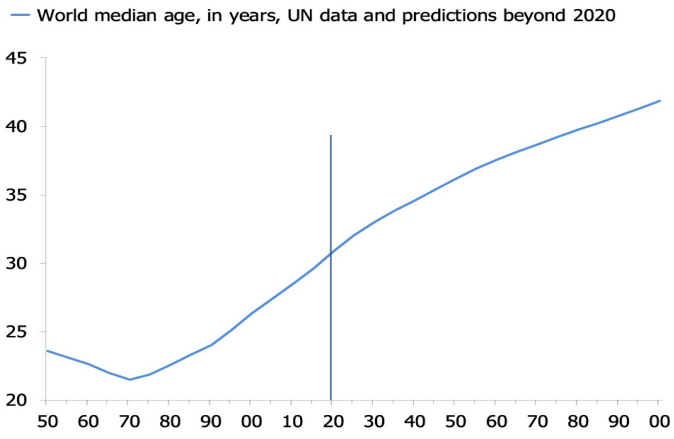
data to verify this for certain, and many regions will have experienced long periods of prosperity and population growth, especially in the context of people migrating to larger areas with uncultivated land. The grim end-point in Malthus' story on the human condition is just that, an end in an ongoing cycle. It is not a permanent condition.

In Europe, population growth is believed to have averaged 0.3% per annum before 1700, rising to around 1% in some cases during the 19th century. The equilibrium described by Lee (2003) rests on a total fertility rate—presumably per cohort—of two-to-four children, skewed towards higher fertility within marriage unions. Population growth was higher in North America, at least during early colonial rule, due to the abundance of land. But it t fed after the Revolutionary Wars and into the 19th century, following a Malthusian playbook.

Drawing conclusions based on history is one thing, predicting the future is another. Malthus' ominous warnings of a human

fig. 01 / The world population is growing… - **fig. 02** / …and aging





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population locked forever between these two opposing forces set the stage for an unfortunate trend in demographics research. The discipline's main hypotheses, tend to be proven wrong by empirical observations shortly after after having been accepted as canonical.

The ink had barely dried on Malthus' 1798 essay before the otherwise unbreakable chains on population growth in his theoretical universe were shattered. In the classic model, the demographic transition has four phases, excluding a theoretical "first" Malthusian period, which follows Notestein's definitions.
1. The demographic transition is kicked off by a decline in mortality, driven primarily by improvements in healthcare and technology. The victory over contagious diseases, especially those spreading through air and water, is a major driver of this process. Lee (2003) highlights the development of the smallpox vaccine as a specific milestone. Better nutrition and hygiene also play an important role. In this phase, population growth takes off, and will remain high for an extended period, breaking the Malthusian chains, as fertility stays high.

2. In this phase, fertility begins to decline usually linked to the quantum effect of fertility, split into two distinct drivers. First, falling child mortality means that fertility can be reduced without a subsequent "loss" of surviving offspring, and secondly, the tendency to invest relatively more resources in the quality of offspring rather than in the quantity. The population is still growing in this phase, but less so because the rate of decline in mortality is easing.

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3. In the the third phase, the rate of decline in fertility eases as it closes in on replacement levels—though in many countries the decline has continued well past this point—and the rate of increase in life expectancy settles too. This phase is generally characterised by a very slowly rising, or slightly declining population, depending on the evolution in fertility.

4. In the fourth, and final, phase the population is in equilibrium with stable fertility and mortality, signalling the end of the transition. Generally speaking, the demographic transition writ large drives two overall shifts in the global economy; firstly, it leads to a significantly larger population than pre-transition, and secondly, it rapidly alters the age structure towards a higher median age, and a rising old-age dependency ratio.

Marking these predictions to market with the data, and near-term predictions from the UN, checks out. 2.5 billion people inhabited the earth in 1950, a number that had swelled to 6 billion in 2000. By 2025, the number is expected to be just under 8 billion, before a slow advance towards just over 10 billion by the year 2100. In truth, we can't accurately predict the size of the world's population by the end of the 21st century, but the general trend is clear enough, even if we assume that we are currently in the middle of a process. The world's population has become significantly larger in the past 50 years, and it will get larger still, in the next 50.

The second broad consequence of a stylised demographic transition, population aging, is also visible in the data. The global median age fell slightly from 1950 to 1970, but it has in-

creased steadily since, reaching just over 30 by 2020, and is expected to advance to about 42 by 2100.

A recently-published NBER working paper, Delventhal et al. (2021), updates our view on the the demographic transition with four stylised facts about across time and countries. The initial stage of the transition characterised by a fall in mortality was generally widely dispersed across countries. The study presents data to suggest that the number of countries which began their mortality transitions in the middle of the 20th century was the same as those which started in the later part of the 19th century. The largest group is found in the period 1930-to-1930.

By contrast, the onset for the fall in birth rates across countries is relatively concentrated. Notwithstanding the early movers towards the end of the 19th century, the start of the fertility transition is heavily concentrated in the middle and latter part of the 20th century, with a peak in the period 1960-to-1990.

Delvanthal et al. (2021) also shows that the later the decline in mortality and fertility begins, the quicker they are. Specifically, in the authors' model, countries who began their transitions in the 20th century are moving through their DT twice as fast as countries whose transitions started in the 19th century. This fits the empirical evidence that so-called emerging markets have experienced very quick shifts in their demographic profile since the 1970s and 1980s. We should keep a close eye on whether this acceleration profile is extended into the 21st century in the context of transitions in sub-Saharan Africa.

The paper's results also suggests that the level of GDP per capita which triggers the transitions in mortality and fertility is the same across countries. This gives rise to a simple, albeit crude, prediction rule for countries that are yet to start their transitions. Once counties, mainly in Africa, pass a pre-set level of GDP per capita, their transitions should begin. Unfortunately, a closer look at this result suggests that the trigger-GDP level for transitions in the 20th century varies more than the average perspective would suggest.

Finally, Delvanthal et al. (2021) finds evidence of "contagion", or more specifically the idea that the onset of a transition in one country tends to spread to neighbors. This effect was recently highlighted by the Economist, a news magazine, in its coverage of the Delvanthal et al. (2021).

The DT as described above is not a theory as much as it is a rudimentary scaffold for the analysis of population dynamics. To the extent that it is a framework for charting the evolution in the global human population towards one larger and older than 200 years ago, it does its job.

Look closer, however, and significant nuance is missed. Firstly, the DT is deterministic model, but in reality there is little evidence of a homeostatic equilibrium in the level of population in the latter stages, evidenced by an increasing number of countries with fertility falling well below replacement levels. It's possible that such an equilibrium will be obtained eventually, but it seems unreasonable to use this hypothesis as basis for analysis of current dynamics. Secondly, countries are moving

through their respective demographic transitions in different tempi, giving rise to crucial interaction effects—capital flows, migration, growth and wealth divergence—especially in a global economy with a free flow of factors. In other words, there is not just one DT, there are many. Thirdly, the transition is not so much a transition in population growth as it is one in age structure, offering a richer framework for the discussion of economic consequences of demographic changes.

In the analysis that follows, I will do a deep dive into the first of these by breaking down the DT into its component parts; mortality and fertility. I will investigate the underlying drivers of these two processes, and lay bare the questions that have been answered, and those that haven't. The aim is to take the stylised version of the DT and transform it into the patchwork of different theoretical disciplines that it really is.

If successful, the framework that emerges will be programmatic in two ways. First, it will show why and how economics, evolutionary science and sociology combine to create a more credible and effective framework through which to study population dynamics. Second, it will inspire researchers to pose new questions, and draw connections, that any of the individual disciplines wouldn't have done on their own.

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