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Can Population Growth Rule Out Reincarnation? A Model of Circular Migration

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Abstract—Many have tried to draw scientific inferences about the existence or nonexistence of an afterlife from observations undertaken in the natural world. A leading example of these attempts is the common refutation of the hypothesis of reincarnation as being inconsistent with human population growth. This paper demonstrates that the demographic refutation of reincarnation only holds if supplemented by substantial metaphysical assumptions. A simple Markov model of circular migration can account for population growth and remain consistent with a reincarnation hypothesis. Though the chief attraction of the circular migration model is its simplicity, the model also has implications about how long people would have to remain discarnate. Because multiple conflicting theories about the existence and nonexistence of an afterlife are consistent with the currently available data, there can be no conclusion regarding which is correct. An incorrect assessment of the limits to what can verifiably be known about an afterlife has plagued our predecessors with schisms, wars, and intolerance. It need not plague our successors.

Keywords: reincarnation—population

Introduction

Edwards (1996) credits the early church father, Tertullian, for originating the notion that human population growth automatically invalidates the hypothesis of reincarnation. It is argued that a growing population of human bodies would somehow "run out" of souls with which to be incarnated. To accept such a claim would be to accept that one can observe the world and its population of living creatures and thereby make testable claims about the existence or nonexistence of an afterlife. The general answer to this question is of some interest, because the media has begun to feature several clips of professional scientists expressing "scientific" opinions about supernatural phenomenon. Can science really shed light on realms that are void of data? Despite the interest of these more general questions, this paper will be confined to examining the claim that the observed growth of the human population is inconsistent with the reincarnation hypothesis. The paper begins with a discussion of the facts of human population growth followed by two simple theoretical models to ac-

count for these facts. The two theories are compared. Finally, the reader will be left to judge whether the demographic refutation of reincarnation is as simple as has been commonly thought.

Facts

The facts of life are clear. Each human lifespan has a beginning and an end. Each lifespan can be measured as the interval between birth and death.

Another unassailable fact is that the planet's human population is completing a phase of more than 500 years of unprecedented population growth. Our population's history can be divided into three phases. The modern phase dates to the middle of the second millennium and is characterized both by the highest growth rates and the best quality demographic data. The world's current population is approximately 6 billion and is sustained by an annual birth cohort of 135 million—85 million more than the annual death toll of 50 million. A sustained global decline in the fertility rate began over 20 years ago and shows no sign of reversing. Barring significant unforeseen economic or epidemiological setbacks, world population should peak at roughly 10 billion about the year 2050 (United Nations, 1998).

Data on the historical size of the world's population is more sparse. The Roman empire, from Spain to the Near East, was estimated to be between 45 and 90 million persons during the reign of Augustus in 14 A.D. A very rough estimate of the world's population around 1 A.D. is about 300 million people (Haub, 1995). Historians of the Eastern hemisphere record at least two large fluctuations in population growth in this era. One fluctuation was caused by the Black Plague in which about one third of the population of Europe is thought to have perished (McNeill, 1976; Ziegler, 1969). The other population shock during this period can be attributed to the Asian Expansion led by Temujin of Mongolia. Without these two fluctuations, the historical era may have seen much larger population growth rates. As it was, overall population growth between 1 A.D. and 1650 A.D. was lower than for the period between 8000 B.C. and 1 A.D.

There is even less data on the size of human populations prior to the development of writing. The current consensus is that the size of the world's human population in 8000 B.C. was about 5 million (U.S. Bureau of the Census, 1997). This implies a sustained growth rate of .05% per year between 8000 B.C and 1 A.D. Barely sustained growth would be a more apt description—given child mortality rates of roughly 30%, every woman would have been required to have at least six children for the population to fend off extinction.

A common question to be asked in the context of observations on the history of human population growth is, "How many people have ever lived on earth?" Any answer must be as arbitrary as selecting the starting point for our species based on the fossil record. At what historical point does one wish to accord the title "person" to the beings who animated the primate fossils that have been unearthed in the last 150 years. Although there is unassailable consensus that

the Cro-Magnon who painted the walls of caves in 30,000 B.C. were "people", it becomes murkier to assign this status to earlier primates whose only remaining artifacts are stone tools.

It is unlikely that there will ever be an unassailable answer. Furthermore, as new fossils are unearthed, we will certainly learn more about which ancestor did what and when. For now, I suggest that the evidence of ritualized burials that show the intentional combination of artifacts with human remains offers as good a starting point as any for our species. The capacity to grieve, as evidenced by a ritualized burial, almost certainly requires the cognitive capacity to retain a mental representation of the counterfactual–an imagined world still animated by the dead loved one. The site bearing the earliest fossils with modern Homo sapiens morphology in a ritualized burial are from Qafzeh in modern Israel. It dates to the Mousterian era of the Middle Paleolithic, which is roughly 50,000 B.C. (Mellars, 1989). The skeleton was found in the fetal position, embraced by a large deer antler.

With this arbitrary starting point, one may integrate the area under a series of exponential population growth curves to determine the number of human beings ever born. Using a starting date of 50,000 B.C., Haub (1995) offers an estimate of 105 billion human beings ever born. If these historical human lifespans conformed to the United Nations' high mortality pattern (United Nations, 1982), roughly 17 billion human lives would have ended before age 1, and 30 billion lives would have terminated before age 15. Those who see some religious significance to a cycle of human rebirth seldom grapple with the fact that nearly one in six human rebirths would have been followed by a "redeath" in less than a year.

Theories

As evidenced by the burial sites of our ancestors, theories to explain the facts of life are as old as man. A theory that appears to have been espoused by the vast majority of the 70 billion human beings who ever survived to adulthood is that there is a human soul that has some existence after the body has died. Accounts of the state of the disembodied human soul are many and varied. East and West differ over whether the soul returns to inhabit another living body or whether the soul goes on to some ethereal state of reward or punishment.

Another theory is that there is no soul, only bodies made of atoms and molecules. Although this theory is sometimes called the scientific view, reflection shows that this theory is neither more nor less amenable to the publicly verifiable empirical tests required of scientific theories than are the more ancient religious teachings on the afterlife. To support their opinion, people that do not believe there are souls point to a lack of verifiable cases of reincarnation.

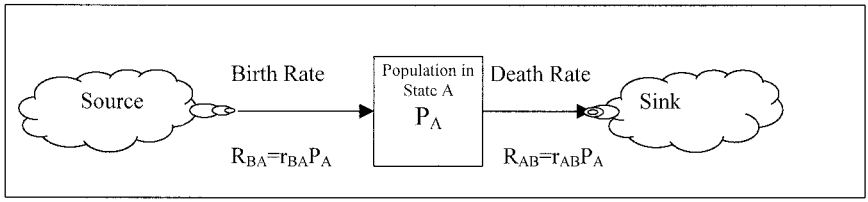

Fig. 1. Linear migration model.

Materials and Methods

Computer Simulation

A computer simulation of the last 52,000 years of human population growth was programmed using Excel software under two different models of the nature of the afterlife. The models and the equations that represent them are discussed below.

Models of the Human Population

This paper will sketch out two competing accounts of the metaphysical implications of human population growth using Markov models. Markov models are a common tool in demography, epidemiology, and engineering and are used to model processes where there are transitions between states. In this application, the state of interest is the state of membership in the population of living human beings. Let us call this state A.

Model 1. The linear migration model. The linear migration model (LMM) depicts the Markov process as shown in Figure 1. Individuals enter state A from an undefined source through a process called birth at a rate R_{BA}. They exit state A to an undefined sink through a process called death at a rate R_{AB}. The model predicts that human population growth will be accompanied by birth rates in excess of death rates. Mathematically, the prediction is $dP_A/dt > 0 \leftrightarrow R_{BA} > R_{AB}$. The assumptions required by the LMM are that human souls are continuously created from an undefined source and continuously destroyed in an undefined sink.

Model 2. The circular migration model. An alternative model of the human population will be called the circular migration model (CMM). In the CMM, there are no ill-defined sources or sinks. Souls enter state A from state B through a process called incarnation at rate R_{BA}.[1] Souls depart state A and re-

[1] The notational use of subscripts A and B may be made more useful by recalling that the Sanskrit "Atman" refers to the subjectively observable earthly soul and that the word "Bardo" is Tibetan for the afterworld.

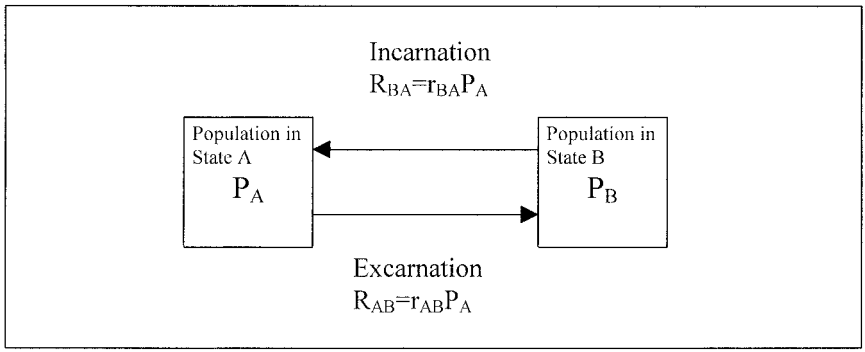

Fig. 2. Circular migration model.

turn to state B through a process called excarnation at rate R_{AB}. Both incarnation and excarnation are observable processes documented publicly through birth and death certificates and recorded in vital registration databases. The model predicts that $dP_A/dt > 0 \leftrightarrow R_{BA} > R_{AB}$. In its simplest form, it assumes that human souls are neither created nor destroyed. More complex versions of the CMM not discussed here could accommodate the relaxation of this assumption.

For simplicity, this paper invokes the assumption that the sum of incarnated and unincarnated human souls has been constant throughout history ($P_A + P_B = K$, where K is constant). This is not a necessary feature of the reincarnation hypothesis, nor is it a necessary feature of the CMM.

Many religious traditions hold that there are multiple states of heavens, hells, and purgatories in their accounts of an afterlife. The basic CMM, however, would gain little by incorporating such states. Indeed, Edwards (1996) singles out for scorn the multiple variants of the CMM with what he terms "noxious ad hoc assumptions" governing transitions of souls to astral planes, other galaxies, and animals. If there ever were census data or vital registration data available for these realms, the CMM could easily be enlarged to encompass them. Another feature that is not in the basic CMM is the creation or destruction of souls as depicted by the source and sink in LMM. The CMM could be enlarged to accommodate such features by grafting sources and sinks linked to state B. However, despite multiple conjectures by both spiritual and scientific scholars, there are no preliminary data on which to base such a hypothesis.

We will use the available demographic data to assess both the LMM and the CMM. According to both models, all of the observers and all of the observations occur in state A. Indeed, it is with respect to data on the living human population that the models will be assessed.

Table 1 summarizes the assumptions and predictions of the two models. Both models require strong assumptions about the eternity of the human soul.

TABLE 1
Summary of the Models of Human Population

Model	Predictions	Assumptions	Implication
Linear migration model	$dP_A/dt > 0 \leftrightarrow R_{BA} > R_{AB}$	Human souls continuously created and destroyed	Undefined sources and sinks for human population
Circular migration model (simple version)	$dP_A/dt > 0 \leftrightarrow R_{BA} > R_{AB}$	Human souls neither created nor destroyed	Simple version requires that $P_A + P_B = \text{Constant}$

The LMM requires one to assume that the soul is ephemeral and finite. The basic CMM requires one to assume that each human soul is eternal. Both models predict the equivalence of population growth with disequilibrium in entry and exit to state A. The CMM is thought to be vulnerable in its simplifying assumption that $P_A + P_B = K$ where K is constant (Edwards, 1996), but relaxing that assumption does not lead to a fundamental change in the dynamics of the model.

Results

What do the Models Imply About the Dwell Time in Each State?

In any first-order process, the reciprocal of the rate of outflow per inhabitant per unit time is a good approximation to the average dwell time of each inhabitant in a state. In both models, the rate of outflow from state A is characterized by r_{AB}, which has the demographic interpretation of the crude death rate (deaths per 1,000 living persons per year). As an illustration, suppose one takes $r_{AB} = 0.014$, a number close to the crude death rate of the United States. The average duration of life then is 1/0.014, or roughly 70 years. Table 2 presents the average human lifespans (or dwell times in state A), implied by applying both of these models to modern and historical crude death rates for the human population.

Because observations are taken from state A, demographers have found it most natural to calculate crude birth rates, r_{BA}, (births per 1,000 living persons per year) relative to state A, such that $R_{BA} = r_{BA} \times P_A$ = number of births into A per year. In order to apply the time constant approximation to the CMM, it is necessary to transform r_{BA} such that it mediates an outflow and is expressed as births divided by the population in state B. Simple algebra shows that such a transformation would be $r_{BA}' = r_{BA}\,(P_A/P_B)$. Using the renormalized rate, the expression, $R_{BA} = r_{BA}' \times P_B$, is equal to the number of emigrants flowing out of B each year. The reciprocal of r_{BA}', or $(K - P_A)/(PA \times r_{BA})$ is the formula used in the computer simulation to compute the state-B dwell times shown in

Table 2. However, there is no obvious value for K to use. A reasonable minimum value for K would be 10 billion souls. This figure is the projected peak of the human earthly population that will be alive at the end of the next century (United Nations, 1998). A reasonable maximum would be the number of humans who have ever lived (e.g., roughly 100 billion souls), because this figure would exhaust all of the human bodies into which the population of state B could possibly incarnate.

Table 2 charts the implied mean dwell time in state B as a function of modern and historical crude birth rates under various assumptions for the constant sum of $P_A + P_B$. The basic result is that changes in the dwell time of the unobserved state can reconcile reincarnation with population growth. This hypothesis was initially proposed by Stevenson (1974). Table 2 helps to formalize the implications of this earlier conjecture. Table 2 shows that historical fluctuations in the duration of stay in the unobserved state are consistent with historical changes in the observed human population. Although the dwell time in state A (e.g., life expectancy) has changed by a factor of 2 throughout human history, Table 2 shows that the simple CMM requires that the state-B dwell time change by a factor of as much as 2,000 over the same period to maintain population balance. The model predicts that the minimum possible average dwell time in state B in the year 2,000 would be around 30 years. Shorter dwell times for state B in the year 2,000 would require a smaller value of K and would be inconsistent with United Nation predictions that the world population will peak at around 10 billion. It should be stressed that the dwell time is a population average. Individual persons might experience either shorter or longer state-B dwell times, just as individuals might expect to live longer and shorter terrestrial lifespans than average.

Discussion

There are demographic methods to estimate the population dynamics of a population whose members migrate into an unobservable setting; however, these methods rely on interviewing immigrants about their transit time in the unobserved state. One could consider interviewing a sample of recent immigrants from state B to determine the average duration of stay in B. Because the reciprocal of the duration approximates r_{BA}', this information together with a count of the annual number of immigrants from B to A (RBA) would be sufficient grounds for an estimate of P_B (Laska, Lin, & Meisner, 1997).

Perhaps someday the database of interviews with children who recall past lives will be widely regarded as a suitable means of estimating the size and duration of stay of the discarnate population. Such return migrants would need to be asked how long they spent in the discarnate state to see if their responses accord with any of the predictions in Table 2. If nothing else, the database of interviews with children who recall past lives currently suffers from sample selection bias by all accounts. The children who recall past lives offer accounts

TABLE 2
Population and Dwell Time in State A and B throughout History

Stylized facts	50,000 B.C.	4000 B.C.	1650 A.D.	2000 A.D.
Crude birth rate (births per living person/year)	35/1000	35/1000	35/1000	22/1000
Crude death rate (deaths per living person/year)	35/1000	34/1000	30/1000	14/1000
Circular migration model				
State A population in persons	5,000,000	7,000,000	500,000,000	6,000,000,000
State A dwell time in years	29	29	33	71
K = 10 Billion				
State B population in persons	9,995,000,000	9,993,000,000	9,500,000,000	4,000,000,000
State B dwell time in years	57,114	40,788	543	30
K = 20 Billion				
State B population in persons	19,995,000,000	19,993,000,000	19,500,000,000	14,000,000,000
State B dwell time in years	114,257	81,604	1,114	106
K = 100 Billion				
State B population in persons	99,995,000,000	99,993,000,000	99,500,000,000	94,000,000,000
State B dwell time in years	571,400	408,135	5,686	712
Linear migration model				
State A population in persons	5,000,000	7,000,000	500,000,000	6,000,000,000
State A dwell time in years	29	29	33	71
State B population in persons	NA	NA	NA	NA

Note: State A and state B can be identified respectively with incarnate and discarnate states. The variable K denotes the sum of population in state A + population in state B and is assumed constant in the variants of the simple circular migration model presented here.

of lives that are not a representative sample of all of the decedents in the world (Keil & Stevenson, 1999).

The fundamental feature of CMM is that it carries implications about the size of the unobservable population of state B. Lacking such observations, can we say anything about the size and dynamics of state B? Can one prove or disprove the requirement that $P_A + P_B = \text{Constant}$? It turns out that one can disprove the implication only if one is willing to assume much more about the nature of an afterworld than most skeptics are willing.

The simplest way for a skeptic to counter the hypothesis of reincarnation is to reject it out of hand. Such a skeptic could simply state a leap of faith in the continuous creation and destruction of human souls, and that would end the discussion. However, to sustain the claim that human population growth offers proof that the reincarnation hypothesis is false requires the skeptic to assume that some sort of physical laws governing the afterlife require that the mean duration of stay in the afterlife has been constant throughout human history. Indeed, Edwards (1996, p. 227) appears to rely on the claim that the mean duration of stay in the afterlife is instantaneous, reckoning this a "less fanciful" assumption upon which to hinge his argument. Even the objection that a 2,000-fold change in the state-B dwell time is impossible would require the skeptic to explain just how they came to possess the supernatural knowledge of what is possible in the hereafter. It would be difficult to imagine a skeptic making such a metaphysical leap.

Conclusion

This paper explores the assumptions and implications behind two simple accounts of human population. A model of circular migration in which human lives end with excarnation to an unobserved state followed by reincarnation is reconciled to the historical record about the size of the human population on earth. Even if one assumes that the sum of the total number of inhabitants of both the human population and the population of the unobserved state is constant, a reincarnation model can be reconciled to the historical facts of human population growth by invoking a changing duration of stay in the unobserved state. The paper shows that individuals who claim that population growth is inconsistent with reincarnation must somehow have access to transcendental knowledge that the duration of stay in the unobserved state has been constant. Given the limitations of the current set of verified facts of life, inferences regarding the nonexistence or existence of an afterlife appear to be based on assumptions or unverified information. Demography's greatest contribution to knowledge about the afterlife is to acknowledge that demographic observations are presently unable to settle the matter. The results here conform to the adage "No metaphysics in, no metaphysics out" in that the demographic refutation of reincarnation derives its ontological "finding" only through the unnoticed initial insertion of strong metaphysical assumptions.

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