Toward a more “useful” model: Population projection, 1920-1955

Emily Klancher Merchant, Dartmouth College

September 25, 2015

All models are wrong, but some are useful.
—George E.P. Box, *Empirical Model-Building and Response Surfaces*

For nearly 100 years, the cohort component model has been the preferred method of population projection for demographers working in academia, government, and industry. Demographers and historians alike have examined how this method achieved preeminence between the world wars in relation to its major competitor, the logistic projection method developed by Raymond Pearl. In the existing literature, the two methods are compared in terms of their scientificity and in relation to boundary work, or territorial skirmishes between natural and social scientists over who would have the authority to analyze human population dynamics. Invariably, these stories end prior to World War II with the decisive victory of the cohort component method and the complete rejection of the logistic method.

In this paper, I begin with the premise, famously stated by George E.P. Box, that “all models are wrong, but some are useful.” I argue that the cohort component model gained

---

predominance over the logistic model because the former was more “useful” than the latter for the types of population engineering desired by scientists and policy makers during the majority of the twentieth century. I argue further that early users of the cohort component method increased its usefulness by importing elements of the logistic method, and demonstrate that, even after the cohort component model was accepted as superior by the demographic community, the logistic method was briefly revived at a key moment when its usefulness outstripped that of the cohort component method.

The paper begins with a description of the two projection methods. In the second section, I discuss the relative utility of the two during the period of their development — the decade immediately following World War I. I argue that utility is a function of both what the model actually does — how it works — and what needs to be done. The first question is a scientific one, the second a political one. In the third section, I examine how the articulation of demographic transition theory and its use in conjunction with the cohort component method brought elements of the logistic model into the cohort component model, and how demographers briefly increased their reliance on the logistic model during the first few years after World War II, when global data constraints temporarily increased the model’s utility relative to the cohort component model. This paper revises the existing narrative of the history of population projection by demonstrating that the cohort component method’s victory over the logistic method was neither decisive nor complete. Rather, the two continued to co-exist into the postwar period, and the cohort component model gained preeminence by adopting elements of the logistic model. Looking beyond the field of demography, this paper builds on Box’s contention that “all models are wrong, but some are useful,” to argue further that the utility of a model depends on what the model needs to do, and that this question is inescapably political.
1 Interwar Methods of Population Projection

Population projection was not new between the wars. Observers had made calculations and estimates of future population long before 1920, but had used a motley assortment of methods, chosen for the purpose and population in question. There was no universally agreed-upon method, and projection was mainly carried out in government offices for municipal planning purposes. Following World War I, scientists working in universities, research centers, and industry began to develop systematic methods of estimating population change and future population size, and claimed universal applicability of these methods. In the 1920s, Metropolitan Life Insurance statistician Alfred Lotka developed the stable population model and Brookings Institution economist Robert Rene Kuczynski introduced the net reproduction rate, both of which summarized the long-term implications of current age-specific rates of mortality and fertility, allowing for the comparison of potential growth between populations. Also in the 1920s, Johns Hopkins biologist Raymond Pearl and Scripps Foundation agricultural economist Pascal Whelpton developed computational methods of estimating the future size of any given population at a specific date. It is this activity that has come to be known as population projection and is the topic of this paper.

1.1 The Logistic Law of Population Growth

Pearl introduced his logistic projection method — which was based on what he called a “logistic law” of population growth — in a 1920 article in the Proceedings of the National Academy of Sciences. This article described a procedure that, Pearl claimed, could accurately and scientifically predict the size of any population — defined in administrative terms (national, state, city, etc.) — at any date in the past or future.\footnote{Raymond Pearl and Lowell J. Reed, “On the Rate of Growth of the Population of the United States since 1790 and its Mathematical Representation,” Proceedings of the National Academy of Sciences 6, no. 6 (June 15, 1920): 275–288.} Co-authored with his junior colleague Lowell Reed, the article began with two premises that Pearl and Reed attributed to Thomas Robert Malthus, author of An Essay on the Principle of Population, published...
originally in 1798 and revised and expanded five times before 1826. The first premise was that populations are always constrained by the limits of subsistence. The second premise was that subsistence is the only force limiting population growth; that is, all factors that increase mortality or reduce fertility can ultimately be traced to limits on food availability. Pearl and Reed suggested that, governed by these natural constraints, human populations must grow along a regular trajectory that can be described by a mathematical equation, similar to the trajectories of heavenly bodies identified by astronomers.

Pearl and Reed took an organic view of human populations, conceptualizing them as objects of analysis with emergent properties — properties that apply only to the population as a whole and can’t be reduced to the properties of its individual members, as is the case with an organism, which has an existence beyond simply a collection of cells. On the basis of this analogy, they contended that the trajectory of population growth was none other than the S-shaped curve of autocatalysis — a chemical reaction in which the reaction product is also the catalyst for the reaction — which had already been identified by biologist T. Brailsford Robertson as the growth pattern of individual organisms.

Pearl and Reed were not the first to suggest that human population growth followed an S-shaped trajectory. As early as 1838, Pierre-François Verhulst, a student of renowned Belgian astronomer-statistician Adolphe Quetelet, had considered and rejected a similar curve to describe population growth, naming this curve the “logistique.” Although Pearl and Reed developed their “autocatalytic” theory of population growth independently, by 1927 Pearl had become familiar with Verhulst’s work and had begun to refer to his own equation for population growth as a “logistic” curve. For Pearl and Reed, the logistic was not just a law of population growth, but also a method of population projection: they contended that

---


6 Pearl and Reed, see n. 280; Pearl had earlier been a harsh critic of Robertson’s theory that the growth of organisms followed the curve of autocatalysis. Sharon Kingsland, “The Refractory Model: The Logistic Curve and the History of Population Ecology,” *Quarterly Review of Biology* 57, no. 1 (1982): 29–52.
the size of a given population at any point in time could be calculated by fitting the known
history of growth of the population in question to the general equation for a logistic curve,
given in Equation (1).

\[ y = \frac{b}{e^{-ax} + c} \]  

(1)

Figure 1: Pearl’s Logistic Curve

The curve described by Equation (1) and illustrated in Figure 1 is shaped like the letter S
and traces what Pearl and Reed called a “complete cycle of population growth.” The x-axis
represents calendar time and the y-axis represents population size at any given date. The
lower asymptote represents the starting population — the population size at the beginning
of the growth cycle — and the upper asymptote \( \left( \frac{b}{c} \right) \) represents the saturation population.
The letter \( a \) is a constant to be fitted empirically, as are \( b \) and \( c \). With population data from
three different points in time, an analyst can solve for the three unknown constants \( (a, b,
and c) \), thereby determining — in theory, at least — the size of the population in question
at any date in the past or future.

\[ ^{7}\text{Pearl and Reed, see n. 4} 282. \]
The beauty of the logistic curve is that it can be fit to any three data points, and will always show a population growing with increasing rapidity to its mid-point, with growth slowing down thereafter and ultimately leveling off. With this equation, Pearl argued, “it is now possible to forecast with a reasonable degree of accuracy not only what the maximum population for any given area will be, but when it will be, and also when will be the period of most rapid growth.”

Pearl and Reed attributed the logistic law to Malthus, describing it as a mathematical formalization of Malthus’s population principle.

Although Pearl’s logistic law of population growth treated human populations as biological organisms, Pearl defined populations administratively, as the people counted by a given national census, or a subset of them for whom data were collected. Such a definition was necessary, as censuses were (and still are) the main source of population data. According to the logistic law and projection method, populations grow inexorably toward their saturation point — that is, the largest number of people that can be supported on the territory controlled by the administrative unit that defines the population. However, the saturation population is not given in advance of carrying out the projection, nor is it calculated with any reference to the territory itself; rather it is determined by past population growth through the curve-fitting process.

Figure 2: Observed and Projected U.S. Population, 1700-2100

In their 1920 article, Pearl and Reed fit a logistic curve to the U.S. population as an

example to illustrate the logistic projection method. By fitting this curve, they “discovered” a saturation population of 197 million, which would be reached in the year 2100. This projection is illustrated in Figure 2 (gray line), along with observed U.S. population growth from 1790 to 1920 (black line).\(^9\) Pearl and Reed’s application of the logistic law to the population of the United States highlights some of the more controversial features of their theory. The territory occupied by the United States had changed considerably between 1790 and 1920, as had Census rules for counting inhabitants (for example, “Indians not taxed” were omitted from censuses prior to 1890). Nonetheless, Pearl’s theory held that the rate of population growth was biologically determined by the ratio between the current population at a given moment and the ultimate saturation population. Therefore, according to Pearl, the population of the United States — even as early as 1790 — was growing along a logistic trajectory toward the maximum population that could be supported in the year 2100, after more than three centuries of territorial expansion and technological innovation. Moreover, the population before 1790 was taken to be rising asymptotically from zero, not because nobody was living in the territory that would become the United States, but because there was not yet a census to count them.

Social scientists throughout the English-speaking world strongly critiqued the assumption that human population growth was governed solely by biological factors. Economist Victor von Szeliski, for example, pointed out the absurdity of Pearl’s contention that, as early as 1790, the U.S. population was growing toward its capacity in the year 2100. He argued, it is impossible to read in economic history how population movements were conditioned by the geographical knowledge, the highways and the state of the arts of the time, how births and deaths were affected by the contemporaneous state of medicine and sanitary engineering and how large cities were made possible by the development of agricultural machinery, high speed transportation, electric power, steel frame buildings, refrigeration, and canning, and believe that in earlier periods the population was growing towards an upper limit governed by physical factors and inventions which were not to come into being for fifty years.\(^10\)

---

\(^9\)Graph created by author using data from: Pearl and Reed, see n. \(^1\) Susan B. Carter et al., eds., *Historical Statistics of the United States, Millennial Edition* (n.d.), URL: [http://hsus.cambridge.org](http://hsus.cambridge.org).

\(^10\)Victor von Szeliski, “Population Growth Due to Immigration and Natural Increase,” *Human Biology* 8,
Other social scientists pointed to social, economic, and political factors affecting population growth, including war (particularly the recently-concluded Great War), sanitation, and birth control. George Knibbs, an Australian statistician, made a mathematical critique of Pearl’s logistic law of population growth, demonstrating that, although a logistic curve could be empirically fit to historical U.S. Census data, intercensal growth rates did not conform to those predicted by the logistic equation. British economist A.L. Bowley pointed out that, although the logistic curve appeared to describe past population growth reasonably well, other curves also fit past growth patterns, throwing doubt on the authority of the logistic to uniquely describe the future course of growth on the basis of its fit to past growth.

Bowley’s critique notwithstanding, Pearl attempted to prove his theory by fitting logistic curves to historical census data for an additional 15 countries, and to historical estimates of the population of the world as a whole. However, while logistic curves could be fit to any three data points, no human population had experienced a full logistic growth cycle during the period for which data had been collected. The observed growth of the population of the United States, for example, appeared to trace the bottom part of the curve, while that of France appeared to trace the top, and that of England and Wales the middle. In 1924, Pearl’s admirer, British statistician George Udny Yule, in his presidential address to the Royal Statistical Association, brilliantly finessed this fact by superimposing population data for the three countries onto a single graph to produce the full logistic, shown in Figure 3. Pearl declared “the dodge” to be “extremely clever” and remarked, “how beautifully the thing comes out!”

---

16 Raymond Pearl to G. Udny Yule, Dec. 9, 1934, Raymond Pearl Papers, American Philosophical Society, Philadelphia, PA, box 31; Although Yule had not manipulated the data in any way, fellow statistician A.M.
Arguing that human populations simply grew too slowly for an entire “cycle of growth” to have been recorded by periodic censuses, Pearl also took an experimental approach, contending that “a real understanding of the problem to which Malthus addressed himself is going to come more from the intensive study of lower forms of life in the laboratory, under physically and chemically controlled conditions, than from the manipulation of never quite satisfactory demographic statistics.”

He attempted to bolster his theory by breeding populations of yeast and drosophila (fruit flies) in his laboratory and presenting their logistic growth patterns, shown in Figure 4, as evidence “that certain natural laws of growth appear to control population as definitely as they control an individual.”

With these experiments, Pearl compared human population growth within a given territory — subject to immigration and emigration, as well as territorial expansion and contraction — to the population of drosophila in a sealed bottle or yeast in a closed petri dish. Utilizing this comparison, he argued further that it was not necessary to observe a full cycle of human population growth in order to know that it took the shape of the logistic curve, drawing an analogy

---

18 Pearl, “Forecasting the Growth of Nations,” see n. 8, 704, image 708.
to astronomy, where it was possible “to calculate the path of a comet from a relatively few observations, and tell a century in advance exactly when Halley’s comet, for instance, should be visible from a given point.”

---

Figure 4: Growth Pattern of Pearl’s Drosophila Population

By the mid-1920s, Pearl had found one human population for which a full logistic cycle of growth could be observed: the indigenous population of Algeria between 1886 and 1921. Unlike the other populations Pearl projected — the U.S., France, etc. — this one was defined ethnically rather than politically, though of course the decision by the French colonial government in Algeria to subdivide the population by ethnicity in its census — and the definition of ethnic categories — were political ones. Pearl described this Arab and Berber population as being midway between experimental (yeast, drosophila, etc.) and European or Euro-American populations — a human population whose growth Pearl assumed to be uninfluenced by social, economic, and political forces and thereby determined solely by biological factors. Pearl proposed that the Algerian population had been at its biological maximum prior to French colonization in the mid-nineteenth century, and that colonization had initiated a new logistic cycle of growth by linking Algeria to new markets and introducing methods of agricultural production that increased yields, thereby expanding the territory’s carrying capacity. He then presented the subsequent population growth and its leveling off

---

19Pearl, “Forecasting the Growth of Nations,” see n. 8, 704.
as biological responses to the rising population ceiling, rather than as the result of such social projects and technological developments as public health, sanitation, and birth control.

Pearl drew on popular racist and colonialist tropes to argue that population growth among indigenous Algerians was controlled exclusively by biological factors — mortality unaffected by public health measures and fertility unaffected by contraceptive practice. He denied that the mortality decline that produced recent Algerian population growth could have resulted from improved health practices, averring that “the fruits of European public health doctrines and education can scarcely be thought to play any large or direct part in the folkways and mores of the Arab or Berber. His notions of sanitation, cleanliness, personal hygiene, and medicine are all his own.”

In terms of the fertility decline that had caused the growth to level off, producing the S-shaped trajectory, Pearl denied the practice of birth control on the basis of his assumption that “the Arabs and Berbers are notoriously much less concerned about the remote consequences of sexual activity than they are about its immediate pleasures,” again calling on familiar colonial tropes about nonwhite hypersexuality to “prove” the absence of contraceptive practices.

Pearl drew an analogy to experimental evidence that demonstrated a decline in egg production among hens in response to increasing population density, claiming that human fertility was similarly biologically determined.

Pearl’s racist attempt to present indigenous Algerians as midway between experimental and European populations reveals inconsistencies in his logistic law of population growth. First, it raises the question of how populations are to be defined. Pearl’s analysis of the indigenous population separately from the foreign-born population of Algeria suggested a definition based on nativity, ethnicity, or biology, but the assertion that population growth was governed by a territory’s carrying capacity suggested a territorial definition. After all, if territories have fixed carrying capacities, then the carrying capacity for indigenous Algerians would be influenced by the number of Europeans and other immigrants. Second, the fact

---

21 Ibid., 107.
that Pearl went to such great lengths to “prove” that population growth among indigenous Algerians had not been affected by social, political, economic, or technological factors suggests that population growth among Europeans or Euro-Americans was influenced by these factors, and therefore should not be predictable using the logistic projection method. However, Pearl argued just the opposite — he cited the observed logistic growth trajectory among indigenous Algerians as “proof” that all human populations grow along logistic trajectories and therefore could be predicted by fitting logistic curves, even supposedly more “advanced” populations whose members practiced sanitation and birth control. Pearl pressed this assertion even further, arguing that “all the complexities of human behavior, social organization, economic structure, and political activity, seem to alter much less than would have been expected the results of the operation of those biological forces which basically determine the course of the growth of populations of men.”

As evidence of this assertion, he argued that “neither the most destructive war in all history, nor the most serious epidemic since the Middle Ages (the influenza scourge), caused more than a momentary hesitation in the steady onward march of population growth” along a logistic trajectory toward Malthusian saturation.

Pearl’s claims reflect his view that populations had emergent and organic properties that superseded the actions of any individual, with growth determined only by subsistence availability and not by individual decisions regarding migration and childbearing. According to these principles, Pearl understood population growth as an independent variable, and the components of that growth — fertility, mortality, and migration — as dependent variables. His theory held that populations always grew along a pre-determined logistic trajectory. Therefore, if fertility were to decline, mortality would decline as well, or migration would increase, to keep population growth on that trajectory. Growth could therefore be predicted but not controlled, and it could be predicted precisely because it could not be controlled. For this reason, Pearl argued that human population growth should be a topic for analysis.

---

22 Pearl, The Biology of Population Growth, see n. 17, 18.
23 Pearl, “Forecasting the Growth of Nations,” see n. 8, 711.
by biologists rather than economists or sociologists.

1.2 The Cohort Component Projection Method

In 1928, Scripps Foundation agricultural economist Pascal Whelpton published a competing population projection for the United States in the *American Journal of Sociology*. Whelpton’s projection went only to the year 1975, in contrast to Pearl’s, which continued for another 125 years. However, the population numbers Whelpton estimated were remarkably similar to those projected by Pearl, as was his projected trajectory of population growth. Figure 5 illustrates Pearl’s 1920 projection along with Whelpton’s 1928 projection and observed U.S. Census data for 1790 to 1930. Table 1 demonstrates that, at each date, Whelpton’s figures were just slightly higher than Pearl’s, which, as Whelpton explained, “from a popular standpoint seem too low.” Whelpton’s projection also traced an S-shaped curve, with growth slowing and population ultimately becoming stationary. He even remarked on “the similarity in trend and absolute size between these population estimates and those of Pearl and Reed (up to 1940), in spite of the entirely different methods by which they were obtained.”

Table 1: U.S. Population, as Projected by Raymond Pearl and Pascal Whelpton, 1930-1970

<table>
<thead>
<tr>
<th>Year</th>
<th>Pearl</th>
<th>Whelpton</th>
</tr>
</thead>
<tbody>
<tr>
<td>1930</td>
<td>122,397,000</td>
<td>123,600,000</td>
</tr>
<tr>
<td>1940</td>
<td>136,318,000</td>
<td>138,250,000</td>
</tr>
<tr>
<td>1950</td>
<td>148,678,000</td>
<td>151,620,000</td>
</tr>
<tr>
<td>1960</td>
<td>159,230,000</td>
<td>162,670,000</td>
</tr>
<tr>
<td>1970</td>
<td>167,945,000</td>
<td>171,460,000</td>
</tr>
</tbody>
</table>

The final section will address the strikingly similar outcome of Pearl and Whelpton’s pro-

---

24 Graph created by the author using data from: Pearl and Reed, see n. 4; Pascal K. Whelpton, “Population of the United States, 1925 to 1975,” *American Journal of Sociology* 34, no. 2 (1928): 253–270; Carter et al., see n. 9.
25 Whelpton, see n. 24, 255; Pearl and Reed, see n. 4.
26 Whelpton, see n. 24, 267.
Projections. Here I describe the “entirely different methods” to which Whelpton alluded, which are now known as the cohort component population model or cohort component projection method. The cohort component method involves dividing a population into age-sex cohorts — usually by five-year age groups — and applying to those cohorts pre-determined rates of mortality, fertility, and migration. That is, over the period of an arbitrary time step — usually five years — the cohort component method “ages” the current population, applying future age-specific mortality rates to each age group, moving the survivors into the next age group, applying future age-specific fertility rates to each female age group between 15 and 49, and inserting the expected births into the 0-4 age category. The analyst must also account for expected future immigration and emigration (or simply net migration) within each age category, as well as the expected mortality and fertility of immigrants.

On the face of it, Whelpton’s projection method was strikingly simple: it calculated future population by adding expected births and immigrations to the current population and subtracting expected deaths and emigrations. That is, it represented population change as the sum of its components — fertility, mortality, and migration — as described by Equation (2).
\[ Pt+x = Pt + (b_x + i_x) - (d_x + e_x) \]  

In this equation, \( Pt+x \) represents population at time \( t+x \), \( Pt \) represents population at time \( t \). \( b_x \), \( d_x \), \( i_x \), and \( e_x \) represent births, deaths, immigrations, and emigrations (respectively) occurring during the period from \( t \) to \( t + x \). The cohort component method did not specify how those future births, deaths, immigrations, and emigrations were to be determined, an issue to which I will return in the third section.

1.3 Comparing the Logistic and Cohort Component Methods

The ontology of population underlying the cohort component method was completely opposite that underlying the logistic method, and the two methods reflect different definitions of scientific explanation. In contrast to the logistic method, which conceived of populations as organisms that grew along a given trajectory independently of fertility, mortality, and migration, the cohort component method conceived of populations in additive terms, as nothing more nor less than the sum of their component individuals and the independent processes of fertility, mortality, and migration. That is, fertility, mortality, and migration were the independent variables and overall population change was the dependent variable. In the logistic model, population growth itself was the independent variable; mortality, fertility, and migration changed in response to changes in population density and changes in each of the other components of growth to preserve the overall growth trajectory. The effects of the components were therefore interactive rather than additive in the sense that a change in one would affect the others so as to maintain the logistic growth pattern. The cohort component method, in contrast, specified no pre-determined pattern of population growth, and allowed for decline as well as increase.

Recent scholars have disagreed over which projection method — the logistic or the cohort component — was more “scientific.” Henk de Gans asks why the cohort component method,
which was based on “speculation” about future vital rates, so quickly displaced the logistic law, which was based on a mathematical function.\(^{27}\) On the other side, Edmund Ramsden argues that, after the publication of Whelpton’s article, the cohort component method was rapidly accepted and institutionalized as the standard for population projection because it was more analytical and empirical than was the logistic method. The same debate raged between the wars among Pearl, Reed, and Whelpton. In his 1928 article, Whelpton presented his projection method as an explicit alternative to Pearl and Reed’s method. Whelpton derided Pearl and Reed as “curve artists” — the term “artist” suggesting a lack of scientificity in their work — and carefully distinguished his method from theirs, stating that “no claim is made that the Scripps Foundation estimates represent a law of population growth.”\(^{28}\) In contrast, Whelpton described his projections as “simply the results of an empirical process,” suggesting that this “empirical process” was more scientific than the “law of population growth” embedded in Pearl and Reed’s logistic method. On the other side, Reed emphasized the role of judgment in the cohort component model (discussed in greater detail below) to characterize it as subjective. In contrast to the subjectivity of the cohort component method, he compared the logistic law to the methods used in the natural sciences, arguing that

> in using the logistic law we are, therefore, following the line of thought that is applied in the field of physics or chemistry when any empirical equation is found to fit an observed set of facts and then is used for purposes of extrapolation beyond the range of observation. When we consider the procedures used by Thompson and Whelpton, we see that they exercise their judgment to state directly what the future birth and death rates will be and their population forecasts, being the direct arithmetic consequences of these rates, have therefore the values to be ascribed to the judgment of these workers.\(^{29}\)

These ongoing disputes, with de Gans’s current claims echoing Reed’s and Ramsden echoing Whelpton’s, suggest that the meaning of “science” is neither fixed nor universal, but rather

---


\(^{28}\) Whelpton, see n. 24, 267.

is established through continual negotiation and is specific to the science in question.

What may be more appropriate than comparing the relative “scientificity” of the models is recognizing that they embodied different modes of scientific explanation. Drawing on Charles Morris’s aspects of symbolic systems, Andrew Abbott in *Methods of Discovery* presents three styles of social explanation: pragmatic (allowing intervention), semantic (translating from one analytic field to another), and syntactic (providing a logical formulation). The cohort component model offered a pragmatic explanation of population growth — one that facilitated intervention into the phenomenon it explained, as will be discussed in greater detail in the following section. Whereas the logistic law was fully determined by past population dynamics and offered only one vision of the future, the cohort component model was not at all determined by past population dynamics, only by the baseline population structure and by the expected future vital rates. Moreover, by specifying independent effects for each of the components of population growth, it suggested that adjustments to those components (for example a reduction in fertility through the spread of birth control, a reduction in mortality through public health initiatives, or a reduction in migration through restrictive legislation) could alter the future it described. By contrast, the explanation of population growth embodied in the logistic law was both semantic — in that it explained population growth and its cessation in terms external to population, the availability of subsistence resources — and syntactic in that it described that growth in the elegant language of mathematics. It was explicitly not pragmatic, as the ability to intervene in population growth would have undermined the argument that growth occurs according to an unchanging mathematical formula. The cohort component model was neither syntactic nor semantic: future population was the result of a set of additions and subtractions to current population rather than the result of a mathematical formula, and the model attributed such growth only to elements of the system itself — birth, death, and migration — rather than biological, social, economic, or political forces. These differences are vital to the history of demography and population control.

---

because they meant that, in contrast to Pearl’s description of population growth occurring according to an inalterable law of nature, in Whelpton’s model, population growth was the contingent product of policy and individual choices, mainly about fertility, which — as he noted — was “coming under human control faster than life extension.”

2 A More Useful Model

As existing histories of population projection have demonstrated, by the mid-1930s, demographers and their patrons and clients had generally accepted the cohort component method as the preferred mode of estimating future population. The U.S. Bureau of the Census adopted the cohort component model as its official method, as did the U.K. Royal Commission on Population. Even Pearl, before his death in 1940, disavowed the logistic method as a natural law of population growth for reasons that I will describe in greater detail at the end of this section. However, I argue that this consensus was reached not because the cohort component model was more scientific or gave better results than the logistic model, nor because the social sciences “won” the boundary war over human population. As we have seen, the two models embodied different modes of scientific explanation. Furthermore, when the results of the 1930 U.S. Census were released, they revealed that Pearl’s projection of 122,397,000 was closer to the observed population of 122,775,000 than was Whelpton’s projection of 123,600,000. Rather, I contend that the cohort component projection gained popularity and institutional support because it was more useful than the logistic method.

What makes a model useful is its ability to accomplish the task at hand. But what was the task of population projections between the world wars? I argue that the task was not simply to predict future population size and composition, but also to facilitate intervention into future population size and composition, and that this additional task was what made the cohort component method more useful than the logistic method. Understanding the task of population projection between the world wars requires a brief excursion into the politics

31 Whelpton, see n. 24 257.
of population in the nineteenth and early twentieth centuries, and an introduction to the population analysts themselves and their patrons.

2.1 The Politics of Population Before World War II

Prior to the 1798 publication of Malthus’s *Essay on the Principle of Population*, European rulers and intellectuals had generally viewed population and its growth as almost unqualified goods. Populations — defined administratively and territorially — belonged to sovereigns, and were resources that sovereigns could extract in the form of labor and military service or extract from in the form of taxation. Mercantilism, the leading political-economic theory of the early modern period, sought to increase state wealth as the basis of national security and international power. Mercantilists viewed large populations as both sign and source of strong and wealthy states, and population growth as a fuel for economic growth and dynamism. Political theorists interpreted population growth as a sign of effective government.

Malthus’s *Essay* introduced ambivalence into scientific, economic, and political understandings of population growth. Writing in opposition to the optimism and idealism of intellectual supporters of the French Revolution, Malthus inverted the valence of population growth, casting it as the fundamental source of poverty and misery at both individual and societal levels. He attributed all individual and social ills to a natural tension between two fundamental facts: “First, that food is necessary to the existence of man. Secondly, that the passion between the sexes is necessary and will remain nearly in its present state.” From these basic principles, Malthus deduced that individuals who could not control their sexuality, and societies whose members could not control their sexuality, would suffer the consequences of population pressing against the limits of food supply. This was so because, Malthus contended, “the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geomet-

---


33Malthus, *An Essay on the Principle of Population, as it Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers*, see n. 4.
rical ratio. Subsistence increases only in an arithmetical ratio."\textsuperscript{34} That is, Malthus stated that population increases geometrically — by a constant proportion — while subsistence increases arithmetically — by a constant increment.

Present-day scholars who cite Malthus often describe him as the first prophet of overpopulation and inaccurately interpret his law of population as a prediction “that uncontrolled population growth would lead to war, starvation, and disease.”\textsuperscript{35} This interpretation, however, is incorrect. Malthus was not concerned with the future, but rather with explaining — and thereby legitimizing — everyday misery. In fact, Malthus never predicted overpopulation, and contended that population simply could not grow beyond the limits of subsistence.\textsuperscript{36} However, he argued that, always and everywhere, human population strained the capacity of the food supply, and that the balance between population and food supply was maintained by two types of checks on population. First was what he called “the preventive check” — sexual restraint, or delaying marriage until the resulting offspring could be supported.\textsuperscript{37} Second were “positive checks,” a category that included “every cause, whether arising from vice or misery, which in any degree contributes to shorten the natural duration of human life.” He listed as examples of these causes “all unwholesome occupations, severe labour and exposure to the diseases and epidemics, wars, plague, and famine.”\textsuperscript{38}

Because he attributed all forms of misery and all causes of mortality (other than old age) to population pressure, he interpreted all woes and calamities as evidence of population pressure. Similarly, he attributed to every social institution — such as political organizations, labor practices, and marriage customs — the motive of managing the balance between population and resources. Malthus viewed the existence of these institutions as both responses to population pressure and evidence of it. The constant pressure of population on resources

\textsuperscript{34}Malthus, \textit{An Essay on the Principle of Population, as it Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers}, see n. 5, 4.


\textsuperscript{37}Malthus, \textit{An Essay on the Principle of Population, as it Affects the Future Improvement of Society with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers}, see n. 5, I.II.9.
was neither a result of Malthus’s analysis nor a prediction. Rather, it was his foundational assumption.

Although Malthus is widely regarded as a scholar of population, the main purpose of his work was not to understand, predict, or control population growth, but rather to justify the existing social order by naturalizing poverty. For Malthus, poverty was the result of unrestrained sexuality. The only preventive check he offered was the delay of marriage, and he interpreted non-procreative sexuality — including the use of contraception within marriage — as a form of “vice” caused by the pressure of population on resources. Malthus thereby attributed all forms of human suffering to excessive sexuality, naturalizing poverty and misery and blaming the poor for their own plight. By the sixth edition of his *Essay*, published in 1826, Malthus had developed a strong argument against poor relief, contending that assistance to the poor would lead only to an increase in their numbers, and would spread their misery further across the social spectrum by redistributing resources from those he deemed worthy to those he deemed unworthy. Malthus’s argument carried substantial weight in England. His law of population became the intellectual basis for the New Poor Law of 1834, which eliminated all outdoor relief, forcing the poor to either accept low-paying factory work or enter workhouses. By helping to create the labor force necessary for the Industrial Revolution, the New Poor Law participated in the formation of what Marx has termed “a disposable industrial reserve army, that belongs to capital quite as absolutely as if the latter had bred it at its own cost.”

Present-day scholars also mistakenly assume that Malthus’s premise regarding the disparity between population growth and food production — and, by extension, the danger of population growth — was accurate and widely accepted. Political economists Karl Marx


40Karl Marx, “Capital, Volume One,” in *The Marx-Engels Reader*, ed. Robert C. Tucker, Second edition (New York: Norton, 1978), 423. Demographers readily acknowledge that the Industrial Revolution led to a large increase in England’s population as a result of rising living standards and a concomitant fall in mortality. It is, however, less commonly acknowledged that the population thought of Malthus helped to provide the Industrial Revolution’s workforce by justifying the elimination of poor relief.

41See, for example: Robertson, see n. 35; Derek Hoff, *The State and the Stork: The Population Debate*
and Friedrich Engels rejected Malthus’s explanation of excessive reproduction as the ultimate cause of individual poverty. They attributed poverty and hunger not to an inevitable imbalance between population and food supply, but to the capitalist mode of production, in which “the laboring population therefore produces, along with the accumulation of capital produced by it, the means by which itself is made relatively superfluous, is turned into a relative surplus population.”[42] Malthus’s contemporary Adam Smith correctly identified the population increase that accompanies economic growth not as a function of irresponsible sexuality, but as a function of mortality reductions among workers’ children that follow from higher wages.[43]

Even economists and policy makers in Western Europe and North America who accepted Malthus’s attribution of poverty to lack of sexual self control — for example, supporters of the New Poor Law — continued to view aggregate population growth as a sign of strength, wealth, and power at the national level. The government of the United States, for example, promoted white population growth throughout the nineteenth century, largely through unrestricted immigration and land grants, as a means of expanding its political power westward across the continent.[44] French thinkers attributed their country’s defeat in the Franco-Prussian War to falling birthrates, and this disaster touched off a series of debates about nationalism and women’s roles in and reproductive duties to family, economy, and nation.[45] Similar concerns surfaced in Great Britain surrounding the South African (Boer) War at the turn of the twentieth century, with falling birthrates among the middle classes and growing evidence of ill health among the working classes sparking fears that the British population might be losing the size and strength it needed to maintain its empire.[46]

[44] Hoff, see n. 41.
Toward the end of the nineteenth century, social reformers on both sides of the Atlantic—aligned with the Progressive movement that introduced systems of insurance and public support to address the ills of unfettered capitalism—began to promote two projects that focused explicitly on the management of reproduction as a means of alleviating poverty and promoting national strength: neo-Malthusianism and eugenics. Neo-Malthusianism began from the Malthusian premise that large families impoverished workers. However, what made their program “neo” was that, rather than simply arguing for an end to poor relief, as Malthus had done, neo-Malthusians advocated for the legalization of birth control so that workers could restrict their families to a size they could support. This logic continued to blame the poor for their own plight, and was no doubt motivated by the desire of its supporters—largely middle-class professionals—to legalize the birth control they were already using illicitly. Neo-Malthusianism originated in Europe, where “Malthusian Leagues” at the national level were linked together through international publications and conferences. As it spread to the United States, neo-Malthusians there began also to discuss the dangers of overall population growth relative to food supply, promoting immigration restriction along with birth control legalization as a means of averting this potential disaster.

Eugenicists also blamed the poor for their own plight, but attributed poverty to their supposed genetic “inferiority” rather than their sheer numbers. Eugenic thinking was widespread on both sides of the Atlantic by the turn of the twentieth century, and in the next few decades would also gain support in Asia and Latin America. Like neo-Malthusianism,
the eugenics movement was an international network of national-level organizations. Unlike neo-Malthusians, early eugenicists generally opposed the legalization of birth control. While they did support “negative” eugenics programs — the limitation or prevention of births among they genetically “inferior” — they also supported so-called “positive” eugenics programs — the promotion of births among the genetically “superior” — in order to shift the overall composition of the population and thereby strengthen it. Eugenicists welcomed large populations, as long as they were genetically “fit.” Both eugenicists and neo-Malthusians, however, sought to ameliorate poverty by reducing the number of people born into it, thereby avoiding redistributive measures.

By the early 1930s, the eugenics and neo-Malthusian movements had moved considerably closer together. Growing apprehension in the U.S. and the U.K. about sterilization policies in Nazi Germany (some of which were based on California policies) inspired the rise of what Daniel Kevles has termed a “reform” eugenics program. Led by Frederick Osborn in the U.S. and Carlos Blacker in the U.K., “reform” eugenicists advocated for a program based on the universal availability of contraception combined with subtle forms of social control to ensure that the “wrong” people used birth control and the “right” people did not.\footnote{Daniel J. Kevles, \textit{In the Name of Eugenics: Genetics and the Uses of Human Heredity} (New York: Knopf, 1985).}

Meanwhile, acknowledgment that fertility rates were rapidly falling in North America and Western Europe — and had been doing so for several decades — quieted neo-Malthusian claims that impending overpopulation necessitated immigration restriction and birth control legalization. As eugenicists and neo-Malthusians came together, they railed against what they called “differential fertility”: that is, higher fertility among less-favored groups relative to more-favored groups. In the U.S., for example, differential fertility could refer either to the higher fertility of the foreign born relative to the native born or to the higher fertility of the working class relative to the middle class, while in Western Europe it usually referred to the latter. While eugenics was based on anxiety about intra-national fertility differentials...
— between groups defined on the basis of race, nationality, or class — neo-Malthusianism began to shift from concern about global population growth to concern about international fertility differentials — between the countries of North America and Western Europe on the one side, and those of Eastern and Southern Europe and East Asia on the other.

2.2 Population Analysts and their Patrons and Clients

Scientists were active participants in the political debates of the interwar period surrounding the population-related issues of birth control legalization, immigration restriction, and eugenics. For example, Alfred Lotka co-authored an article with his MetLife colleague Louis Dublin that pointed to the stable population model as an argument against immigration restriction. Robert Kuczynski compared net reproduction rates across Europe to sound the alarm about an impending eastward shift in the geopolitical balance of power. The work of interwar scientists was also sponsored and utilized by individuals and organizations who had skin in the game. Here I refer to those who directly funded scientific inquiry as “patrons” and those who utilized its results as “clients.” These categories are not mutually exclusive, and they also overlapped with the category of scientist, for example when scientists served on the boards of funding agencies or engaged in activism.


It is important to recognize that overpopulation was the starting point of Pearl’s analysis, not its outcome. Drawing on Malthusian theory, he assumed that any slowing of popula-

---

54 There was, as yet, no concern about population growth in Latin America or Africa, where population densities remained low and where high mortality prevented rapid growth in high-fertility societies.
tion growth was evidence of population pressing on the limits of subsistence — impending overpopulation. However, the slowing of growth is a fundamental property of logistic curves. Because Pearl’s logistic projection method extrapolated every pattern of population growth into a logistic curve, it imposed slowing population growth in the future even if it had not yet been observed. The logistic projection method therefore assumed in advance that every population would eventually become stationary as it reached its saturation point, rather than continuing to grow or leveling off for reasons unrelated to subsistence limits. Although he described the saturation point as the largest population that could be supported on a given territory, Pearl presented saturation as overpopulation, marked by scarcity and suboptimal living conditions, though he never defined saturation in terms of population density or the ratio of people to agricultural production. As noted above, that saturation point was fully determined by the curve-fitting process, not by the size of the territory or its productive capacity.

Every logistic projection was therefore an a priori prediction of overpopulation, and even Pearl’s own math did not necessarily support his prediction of food shortage when the U.S. reached its supposed saturation population of 197 million shortly after the year 2100, or his claim that “our children’s children will have to face a standard of living much below that which we enjoy.” He admitted that the 197 million he predicted for the U.S. seemed “absurdly small,” as it was only twice the 1920 population. At the projected saturation point, the U.S. would have a density of 66 persons per square mile, which Pearl acknowledged was much lower than the density of many European countries that had standards of living at least as high as those in the U.S., potentially belying his prediction of scarcity. Unwilling to give up his Malthusian premise, however, he reasoned that, at this density, U.S. agriculture would not be able to meet the nation’s food needs, and other countries would stop exporting.

---


56 Pearl, “Forecasting the Growth of Nations,” see n. 8, 708; The U.S. population reached 197 million around the year 1967. Carter et al., see n. 9, Table Aa7.
food because their populations would be nearing saturation as well, according to Malthusian theory.

Pearl’s logistic projections not only indicated the size of future populations, but also warned that overpopulation was looming. That is, they had two uses: they could be used to plan for impending population growth, but they could also be used to advocate for measures to forestall impending growth — birth control legalization and immigration restriction. Indeed, Margaret Sanger was a major client of Pearl’s in the 1920s, and in 1921 Pearl joined the board of Sanger’s American Birth Control League (ABCL). However, Pearl’s logistic projections did not exactly work for Sanger’s political purposes. In contrast to plant geneticist Edward East, also an ABCL board member, who advocated birth control legalization and immigration restriction as policy measures that could, in fact, slow population growth and prevent overpopulation, Pearl’s logistic law was premised on the inevitability of overpopulation. As described above, Pearl held that logistic growth according to a predetermined trajectory was unchangeable. Birth control legalization and immigration restriction would therefore be compensated for by involuntary reductions in mortality to maintain the projected growth trajectory.

Pearl nonetheless sought to redeem the logistic law as a political tool for the birth control cause through eugenics. Born in New England in 1879, Pearl graduated from Dartmouth College in 1899 and completed a Ph.D. in zoology at the University of Michigan in 1902. In 1905, he went to London to study biometrics — the statistical analysis of human heredity — with Karl Pearson at the Francis Galton Eugenics Laboratory. In London, Pearl developed considerable rapport with Pearson, who described his protégé as “the most original and powerful of the younger Americans who have taken up biometric work,”57 and appointed him to the editorial board of the journal Biometrika. When Pearl returned to the United States, he put his eugenic training to use at the Maine Agricultural Experiment Station, attempting to breed hens that would lay more eggs. Following the principle of ancestral inheritance

embedded in the British biometric version of eugenics, Pearl selectively bred good layers — with the expectation that their offspring would also be good layers — but soon concluded that this approach was ineffective. Rather, he found that increasing egg production required that he selectively breed the parents of good layers, a result that offered support for Mendelian genetics rather than ancestral inheritance as the mechanism of heredity. Pearl himself was surprised at his finding. As he admitted, he had “approached the subject with a bias in the other direction so far as there was any bias at all.”

In 1910, when Pearl informed Pearson of his findings, and of the challenge that they presented to the principle of ancestral inheritance, Pearson dropped Pearl from Biometrika’s editorial board.

Pearl remained an advocate of eugenics into the 1920s, and used a eugenic argument to bridge the gap between the logistic projection method and advocacy for birth control. Although he continued to claim that the overpopulation predicted by his model was inevitable, he promoted birth control to improve the “quality” of the saturation population. As it was, he argued that

in mankind that part of the population which, if not the most stupid, at any rate takes least thought of the future, has the highest birth rate. Hence the lower classes tend to replace the upper classes. The poor man, facing poverty, and least able to rear children with the advantages necessary to make them good citizens, is likely to have the largest family.

But, he continued, with “birth control, directed along eugenic lines,” it was now possible “to determine what kind of people will make up the earth’s population when saturation is a fact.” He contended that, although saturation could not be avoided, it increased the urgency of a eugenically-oriented birth control program.

By 1927, however, although Pearl continued to support eugenics as a political program, he had fully abandoned his scientific support for it. He began to argue that socioeconomic

---

58 Raymond Pearl to Karl Pearson, Jan. 27, 1909, “Karl Pearson UCL Copies #3,” box 22.
59 Raymond Pearl to Karl Pearson, 1910, “Karl Pearson UCL Copies #3,” box 22.
60 Pearl, “Forecasting the Growth of Nations,” see n. 8, 713.
61 Pearl, “World Overcrowding: Saturation Point for Earth’s Population Soon Will be in Sight, with the Safety Limit for United States Estimated at 200,000,000 People—How the Nations Grow,” see n. 55.
fertility differentials were not really a problem, but rather “a very subtle but far-reaching and extremely significant mechanism of self-regulation in the social super-organism,” compensating for the fact that people in more menial occupations had higher mortality rates. Also in 1927, Pearl published an article in *The American Mercury* attacking the assumed scientific basis of eugenic programs that sought to encourage the reproduction of successful individuals and limit the reproduction of unsuccessful individuals. The article described a study he had carried out of the fates of the fathers and sons of famous poets and philosophers to refute the idea that great men are either born of great men or sire great men. By demonstrating that famous poets and philosophers are no more likely to have accomplished fathers or sons than anyone else, he suggested the futility of encouraging large families among “superior” couples and small families among “inferior” couples. This statement reflected growing scientific consensus about Mendelian genetics, but was a sharp reversal of Pearl’s earlier belief that, “for the welfare of the state or nation those stocks which are on the whole endowed with the best traits should contribute more, many more, individuals to the next generation than should those stocks whose characteristics are on the whole bad.” Although Garland Allen has argued that this article signals Pearl’s abandonment of the political project of eugenics, Pearl himself claimed otherwise. He was not withdrawing his support from eugenics, he explained in a letter to a colleague, but rather was trying “to make a more or less subtle distinction between eugenics with a good genetics foundation and eugenics with a bad genetics foundation.”

---

63This was purely a scientific critique, as Pearl continued to advocate for eugenics as a political program. He certainly shared the racism, classism, and anti-Semitism of his time, and these personal politics did not soften over the course of his life. In 1925 he described Gregory Pincus, who would later play a key role in the development of the birth control pill, as a “lazy Jew,” and in the same year suggested to a colleague that the National Academy of Sciences should take no further nominations from the mathematics section “until such time as they have somebody to offer who is neither a Jew nor an ass.” Raymond Pearl to Edward M. East, May 7, 1925, “E.M. East #5,” box 7; Raymond Pearl to Edwin B. Wilson, Mar. 7, 1925, “Edwin B. Wilson #2,” box 29.
64Pearl, 1908. Quoted in Robertson, see n. 35, 17.
Neo-Malthusian arguments about impending overpopulation were readily believable for some interwar U.S. observers. As a result of large-scale immigration, increasingly from Southern and Eastern Europe, the population of the country had grown dramatically from just under 76 million in 1900 to over 105 million in 1920. The 1920 census classified more than half of the U.S. population as urban for the first time, and problems of poverty and overcrowding were evident in the country’s larger cities. Because birth control was more readily available to wealthier couples with access to private doctors, and because larger families required more resources, poorer families tended to be larger and larger families poorer. All of these factors made it easy to attribute poverty and its sequelae to overpopulation, rather than to inadequate wages or the absence of social insurance. The businessmen whose philanthropic ventures funded both social science and poor relief were also heavily invested in Malthusian explanations, which exonerated their business practices and the capitalist status quo. Pearl’s logistic law of population growth and his logistic method of population projection were based on the Malthusian theory that population growth was entirely governed by subsistence availability, Pearl’s own claim of human population growth as a subject for the field of biology, and Pearl’s political support for birth control legalization and immigration restriction as part of the eugenic project of improving the quality of the U.S. population by reducing the proportion that was poor or foreign born.

Through 1975, Whelpton’s projection produced numbers slightly higher than Pearl’s. However, in contrast to Pearl, he did not interpret his numbers as an indication of impending overpopulation, scarcity, or a reduced standard of living. Rather, to Whelpton, the numbers indicated a slowing of growth in the United States that had the potential to limit

---

67 Carter et al., see n. 9 Table Aa2.
economic growth and weaken the country politically and economically. Quite the opposite of Pearl and his fellow neo-Malthusians, who predicted looming food shortages, Whelpton warned that U.S. farmers would need to halt their efforts toward ever-higher production levels in order to avoid oversupply and a consequent fall in prices. Whereas Pearl had argued that any slowdown or cessation of growth was evidence of a dangerous level of population pressure on resources that would be paralleled by overpopulation worldwide, for Whelpton, population growth was itself a source of political and economic strength, and slowing growth in the United States had the potential to weaken the country’s geopolitical and geoeconomic position.

Whelpton’s patron, newspaper magnate Edward Scripps, had established the Scripps Foundation for Research in Population Problems in 1922 to address exactly this concern. Scripps specifically feared that the conjunction of population growth in East Asia and population decline in North America would weaken the U.S. in relation to its neighbors across the Pacific. This fear had been popularized in the U.S. by historian Lothrup Stoddard, who published *The Rising Tide of Color Against White World-Supremacy* in 1920, and eugenicist lawyer Madison Grant, who published *The Passing of the Great Race* in 1916 and wrote the introduction to Stoddard’s book. When Scripps established his research center, it was not immediately clear what type of experts he should hire. Nobody yet called himself a population scientist or demographer. Pearl had claimed the study of human population for biology, but scholars in other disciplines were also analyzing population data. Scripps ultimately chose sociologist Warren Thompson, whose work Scripps admired. Thompson had completed his dissertation, titled “Population: A Study in Malthusianism,” in 1915 under the direction of Columbia University sociologist Franklin Giddings, who pioneered the use of quantitative methods in the social sciences. Giddings had encouraged Thompson to work with population data for the United States because those data were readily available and had not yet been extensively analyzed outside of government statistical offices.\textsuperscript{71} In so doing,

\textsuperscript{71}Warren S. Thompson, *Population: A Study in Malthusianism* (New York: Columbia University Press, 1915); For more on Giddings and quantitative sociology, see Robert C. Bannister, *Sociology and Scientism:
Giddings claimed population as a topic of inquiry for the social sciences.

In 1922, Thompson accompanied Scripps on a yacht tour of East Asia, where Scripps was most concerned about population growth. On their return, Scripps appointed Thompson director of the brand-new Scripps Foundation for Research in Population Problems, housed at Miami University in Scripps’s native Butler County, Ohio. Scripps envisioned his Foundation as a haven where talented scientists could pursue independent research into questions of population, free from the burden of teaching. He planned to hire a new young scientist every few years.\(^{72}\) Scripps’s death in 1926 derailed this plan, but before his death, Scripps hired Whelpton as the second member of his population research team. Whelpton had no prior experience with population research, but such experience was rare, and the other candidate for the job — Pearl’s biology colleague Lowell Reed — was two years beyond Scripps’s arbitrary but strictly enforced age limit for recruits of 35.\(^{73}\) Thompson and Whelpton’s work at the Scripps Foundation focused on both international fertility differentials — particularly those between the U.S. and Japan — and intranational fertility differentials, as defined by race, nativity, and urban/rural status.

### 2.3 Recent Social Trends: The Cohort Component Model and Population Engineering

In 1930, sociologist William Ogburn, director of research for President Hoover’s Recent Social Trends project, enlisted Thompson and Whelpton to project the future population of the U.S. and write a monograph about the causes and consequences of past and future population dynamics. Demographers and historians have identified Ogburn’s choice of Thompson and


Whelpton — rather than Pearl and Reed — to project the U.S. population as signaling the ascendance of the cohort component projection method over the logistic method, and initiating its institutionalization as the preferred method by academic demographers and their governmental clients alike.\(^74\) I do not wish to challenge this characterization, but rather to argue further that the cohort component method gained ascendancy because it was more useful for the task at hand — population engineering. Here I contend that, while the logistic projection method was useful for estimating future population quantity and therefore useful in planning for population — planning to accommodate future population growth or decline — the cohort component method was useful not only for these activities, but also for estimating future population composition — known as quality in the eugenically-informed lexicon of the time — and for what I call the planning of population — altering expected future population size and composition, or quantity and quality.

An engineer who saw in social science the potential to solve the mounting social problems associated with the speculative capitalism of the 1920s, President Hoover launched the Recent Social Trends project in December of 1929. This project was a follow-up to the just-completed Recent Economic Changes project, which had surveyed economic activities in the U.S. during the 1920s, a period that would later be recognized as one characterized by the unsustainable growth that culminated in the 1929 stock market crash and the ensuing Great Depression. Following the publication of the final report of the Recent Economic Changes project, Hoover appointed a committee, chaired by economist Wesley C. Mitchell, to commission scholarship in various areas of the social sciences, which would together paint a composite portrait of U.S. society, illustrating its problems and pointing to policy solutions. The project was funded by the Rockefeller Foundation, and University of Chicago sociologist William Ogburn served as research director.\(^75\) Ogburn, a former student of Franklin Giddings who would become one of the first vice-presidents of the Population Association of


America, included the study of population in the Recent Social Trends project. He engaged Thompson and Whelpton to write a chapter for the volume *Recent Social Trends*, published in 1934, and a monograph for the Recent Social Trends series, published in 1933. By including population in the project, Ogburn claimed its study for the social sciences; by selecting Thompson and Whelpton to carry out the research, he helped to standardize their cohort component projection method and their understanding of population as a social aggregate of individuals.\(^76\)

There are many reasons why Ogburn may have chosen Thompson and Whelpton over Pearl and Reed to project the future U.S. population and write the population components of the Recent Social Trends works.\(^77\) First, the project was explicitly a social scientific one and, until the mid-1930s Pearl continued to give priority to biological rather than social determinants of population dynamics (Pearl’s shift in emphasis will be described below). Ogburn’s selection of Thompson and Whelpton was, as Edmund Ramsden has argued, certainly a move to claim population analysis for the social sciences.\(^78\)

Second, the cohort component method provided substantially more detail about future population composition. Such distinctions were irrelevant to Pearl’s model, which emphasized the growth of the population as a whole rather than subgroups within it. Initially, the logistic projection method provided estimates only of future total population size. In 1931 Lotka, who had worked in Pearl’s lab at Johns Hopkins before joining MetLife, contributed to the model a method for inferring the age and sex structure of a population growing along a logistic trajectory.\(^79\) With future population size and structure, the logistic method should

\(^{76}\)Demographer Harold Dorn acknowledged the importance of the Recent Social Trends project for establishing the authority of social scientists to analyze population in a paper presented at a 1949 joint meeting of the Population Association of America and the American Statistical Association. This paper was published as Dorn, see n. 74.

\(^{77}\)An additional reason may have been that Thompson and Ogburn had both been students of Franklin Giddings at Columbia University around the same time and therefore may have known each other in graduate school.

\(^{78}\)Ramsden, see n. 1.

have been an adequate tool with which to plan for population, particularly in terms of military mobilization, educational provision, old age pensions, and industrial development. However, the cohort component method provided even more detail. Because it was an additive model — viewing total population as the sum of its subgroups — it allowed analysts to produce separate projections for subsets of the population defined along axes that could be measured in the census. In his 1928 projection, Whelpton had estimated future population separately by race, national origin, and urban/rural status. Therefore, his projections indicated not just future size and age-sex structure, but also future racial, national, and regional composition. Whelpton justified these separate projections by pointing out that fertility and mortality rates varied by race, nativity, and urban/rural status.

Third, cohort component projections provided a conceptual and pragmatic basis for population intervention or engineering — planning of population — that logistic projections did not. Conceptually, the cohort component model both reflected and fostered a sense indeterminacy regarding future population that sharply contrasted with the determinism of Pearl’s logistic law. According to the logistic law, the trajectory of population growth was fully determined by the carrying capacity of the population’s territory. Because the logistic law left no room for alternative patterns or speeds of population growth, the logistic projection method produced only one future scenario, which — Pearl argued — could not be altered by policy or even by disaster, such as war or epidemic. It could predict future population explicitly because it excluded the possibility of controlling future population. In contrast, the cohort component method modeled population growth as the sum of the independent effects of each component — fertility, mortality, and migration. Although each component was bounded by biological possibility — for example, by the fact that people can’t live forever and by the fact that women usually can’t bear more than one child in any given year — they were otherwise open to possibility and manipulation, and alterations in any of them would alter the growth of population in the aggregate. The cohort component model therefore allowed for the mathematical assessment of the effects of various types of
policy interventions into fertility, mortality, and migration rates on overall population size. Its ability to project subpopulations independently of one another also suggested its utility for designing interventions aimed at manipulating population composition. This possibility made it particularly attractive to eugenicists, immigration restrictionists, and those who feared the differential growth of the world’s population.

Reflecting the openness of the cohort component projection method to a range of future courses of population growth, Thompson and Whelpton’s projections of U.S. population for the Recent Social Trends project included five possible future fertility trajectories, three possible mortality trajectories, and six possible immigration rates, with ten different scenarios combining these possibilities in various ways. All variants, however, included falling mortality and fertility and positive net international migration (more immigrants than emigrants). These scenarios emphasized the dependence of overall population size and structure on the components of growth, and the accompanying text emphasized the dependence of the components of growth — particularly fertility and migration — on government policy. According to the cohort component model, fertility, mortality, and migration were the product of social, economic, and political circumstances — operating within biological limits — rather than predetermined forces of nature. In contrast to Pearl, Thompson and Whelpton acknowledged the unknowability of events that have not yet happened. In so doing, they offered up the possibility that future population, *because* it could not be known in advance with certainty, could be controlled, and because it could be controlled, could not be known in advance with certainty.

Indeed, the cohort component model might be more accurately described as a method to *simulate* the effects of various fertility, mortality, and migration rates on future population size and structure than as a method to *predict* population growth. Typically, demographers using the cohort component projection method accompany their projections with a disclaimer, noting that the projections do not constitute predictions. As Whelpton stated

---

in his 1928 article, cohort component projections “represent simply what will happen under certain conditions of immigration, birth-rates, and death rates,” and are therefore simply the arithmetical outcomes of a set of assumptions.\(^{81}\) Although Whelpton’s 1928 article included only one future course of population growth, cohort component projections produced since then, by Whelpton and by others, have typically included multiple variants, emphasizing both the non-predictive nature of the projections and the dependence of future population size on future vital rates.

Nonetheless, consumers of population projections — including governments, inter- and non-governmental agencies, businesses, and scientists — often demand a definitive statement about future population for use in other scientific models or as a basis for planning. To serve this purpose, Thompson and Whelpton offered a “medium” variant, which they designated as the most likely scenario, absent any major social, economic, or political upheavals (such as world war). As the use of cohort component projections spread, the production of a set of scenarios — including a medium or most likely variant — became standard practice.

As a result, cohort component population projections are one of a class of objects that Star and Griesemer call “boundary objects”: “scientific objects which both inhabit several intersecting social worlds... and satisfy the informational requirements of each of them.”\(^{82}\) Boundary objects are those that may be recognized as the same thing by two different groups of users, but have different identities among those groups. Boundary objects serve as interfaces between different groups of actors, allowing them to work together despite — or, as Star and Griesemer might argue, because of — the fact that the common object has a different meaning for members of each group. Population projections are recognized as projections by both their producers and their users. However, their producers tend to view them as simulations — how a particular course of fertility, mortality, and migration would influence population size and structure — while their users tend to view them as the best

---

\(^{81}\) Whelpton, see n. 24, 267.

available prediction of future population.

As boundary objects, population projections speak differently to different audiences. Their producers recognize that they are always statements about the effects of past, present, and assumed future dynamics on population. For consumers, however, population projections are simply statements about the future; consumers are often less interested in population for its own sake than in the population that will serve as the denominator for some other indicator or as an input to some other model. This distinction between producers and consumers is an observation about the division of labor; it is not meant to distinguish demographers from other scientists or from non-scientists. Indeed, demographers — particularly those working in government — can be both producers and consumers of population projections. Demographers recognized the boundary quality of cohort component projections as early as 1948, when an unsigned article in *Population Index* argued that projections served the needs of both academic demographers — who could use them to “survey the range of possibilities that lie ahead and contemplate philosophically the gyrations of the late ’forties” — and “the demographer in government work,” who “faces incessant demands from operating agencies for estimates of the population today, tomorrow, and next year.” Demographers working in government, the article continued, had to cope with “the burden of giving categorical answers to queries as to which one of the Thompson-Whelpton estimates is ‘best’” because “the manufacturer, the business man, and the government official making per capita estimates require a specific population divisor.”83

Logistic projections, because they specified an absolutely certain population at any future date, could serve as an excellent tool in planning for population. The medium variant in a set of cohort component projections also serves this purpose. But cohort component projections, because of the range of possibilities they permit for future population size and structure, can also be used in the planning of population. Two aspects of the cohort component model make it a particularly useful tool for this purpose. First, the model isolates the effects

of each component of change, illustrating how each one affects overall population growth and allowing for calculations of the effects of an adjustment in any of them on the aggregate outcome. Second, the model can be run in reverse, allowing the user to specify a future “level regarded as desirable, and then determine what would have to happen to fertility, mortality, and migration, if the assumed goal were to be achieved.”

That is, it can demonstrate the interventions necessary to produce an ideal population size and/or structure.

While the medium variant in a set of cohort component projections may employ the future rates their creator believes most likely to occur in the absence of policy intervention or drastic social, political, or economic change, cohort component projections that are explicitly intended as the basis for the planning of population are more likely to employ future rates that are avowedly hypothetical: either rates that must be achieved in order to produce the desired population size or composition or rates that must be avoided so as to avert an undesirable future population size or composition.

Perhaps the earliest example of this use of the cohort component model is Dublin’s presentation at the 1931 meeting of the IUSIPP in London. Concerned about declining fertility in the United States, which he described as “a possible threat to national survival” with “disturbing implications in the international distribution of the various races,” [85] Dublin used the cohort component projection method not to calculate the future population size and structure he expected would actually materialize, but rather to illustrate his concern, working up two scenarios based on different hypothetical assumptions about the future course of fertility in order to demonstrate the effect that individual childbearing decisions had on population size and structure. In both scenarios, Dublin had the mortality rate fall to what he thought was its biological minimum by 1970, bottoming out at a life expectancy of 70 years. In the first scenario, he specified fertility rates declining only until 1970, an outcome he personally thought too optimistic; in the second scenario, fertility continued to

---

decline through the year 2100. The second scenario resulted ultimately in a smaller and older population, which Dublin cited to warn of the potential dangers of falling fertility. He argued that similar changes will undoubtedly occur in most other countries; but if certain of them, for example, Russia, and especially China and India, continue to increase their populations, or even maintain their present numbers, the question forces itself upon us what the international relations in the future will be like. In the last analysis, numbers must count, and in the future more than ever, when different political and economic ideals will strive for supremacy. The changes that are coming through the differential decline in the birth-rate will make a totally different kind of a world for our grand-children and our great-grand-children to live in. Those groups that will maintain higher rates will dominate the scene. There are signs that the era of ruling and of subject peoples is rapidly coming to an end.\footnote{Dublin, see n. 85, 123-124.}

Dublin’s projections demonstrate that the population stationarity he feared were not the necessary outcome of natural laws — as Pearl had argued — but rather were under human control through the control of fertility and immigration, and potentially under governmental control through the implementation of policies to increase fertility and immigration. Dublin’s projections illustrate both the political anxieties underlying demographic research between the wars, and the utility of cohort component projections to argue for policies to influence future population change.

In their chapter for \textit{Recent Social Trends} (1934) and in their monograph for the series, \textit{Population Trends in the United States} (1933), Thompson and Whelpton presented all of their projections in neutral terms, and did not explicitly designate any as a scenario to be aimed for or avoided. Nonetheless, the accompanying text both described and encouraged the possibility of government intervention to shape the future population of the United States. Thompson and Whelpton legitimized explicit government planning of population by arguing that government policy had always influenced population growth, stating that “though perhaps it is not generally realized, it is nevertheless a fact that the United States has had a definite and effective policy regarding the increase of population practically from
the commencement of white settlement.\textsuperscript{87} The goal of that policy, they contended, was to increase and whiten the population of the U.S. through the encouragement of immigration from Northern and Western Europe, limitation of immigration from other regions, and prevention of the spread of contraceptive knowledge through such laws as the Comstock Act, which made it illegal to send contraceptive information or materials through the mail. Thompson and Whelpton offered policy solutions to the problems posed by the slowing growth they projected, but also suggested specific policies to alter the size and composition of the future population they forecast. As an example of the former — policies to plan for population — they pointed out that rural areas would age more dramatically than would urban areas (as a result of the rural-to-urban migration of the young accompanied by declining fertility), and suggested that government should equalize the cost of old-age dependency across communities. As an example of the latter — planning of population — they suggested that if it is believed that the present population is not too large, or that still further increase is needed, then the financial burden of raising the next generation, which is very unevenly distributed at the present time, should be redistributed so that those who raise the children will not be compelled to forego their reasonable share of the material enjoyments of life. If children, in reasonable numbers, are a national asset, the cost of rearing them should not be loaded so heavily on the rural population as is now being done.\textsuperscript{88}

In contrast to Pearl and Reed, who posited that the size and growth rate of any population were fully determined by the carrying capacity of its territory (as expressed through past growth), Thompson and Whelpton contended that the size and growth rate of populations was also determined by individual reproductive and migratory choices, and by public policy that influenced such choices.

\textsuperscript{87}Thompson and Whelpton, see n. \textsuperscript{80} 126.
\textsuperscript{88}Ibid. 171.
2.4 The Efficacy of Birth Control

By the mid-1930s, Pearl himself had abandoned the theory that human population growth was a completely biological phenomenon and conceded that it was influenced by private contraceptive practice and public policy. To today’s reader, this seems obvious. However, among interwar scientists, it was anything but. Census data indicated that fertility had declined over the last several decades in the U.S., the U.K., and France, but scientists disagreed over what had caused the fertility decline.

Any theory that claimed to explain fertility decline also had to explain the differential decline of fertility by country and by socioeconomic status within countries. For example, Italian statistician Corrado Gini developed a theory of the “cyclical rise and fall of racial reproductive vigour,” which argued that populations go through youth, maturity, and old age. It explained the declining fertility of Western Europe relative to Eastern Europe with Western Europe’s supposedly more advanced position along the civilizational trajectory, drawing from the stadial theories of human development that Arland Thornton describes as “reading history sideways.”

Gini also argued that fertility was lower among those with higher socioeconomic status because they are farther along the evolutionary trajectory than were those with lower socioeconomic status, and thus less capable of reproducing. Gini’s theory echoed Pearl’s organic understanding of population, and Pearl himself often conflated population aging — the weighting of a population toward older members as a result of fertility decline — with civilizational advance.

U.S. sociologist Frank Hankins proffered a physiological theory. He argued that, because humans gain energy through food and expend it through such activities as work and reproduction, increase in expenditure in one area must

---


be accompanied by decrease in another area, so those who were more successful professionally had fewer metabolic resources available for reproduction. As he put it, “when the individual is put under ever-increasing pressure to advance or maintain his social position, his sex activity and fertility will begin to decline after a certain equilibrium point is passed.” Pearl also made a similar claim when he argued that those in lower status occupations had more children because they had fewer non-sexual activities with which to dissipate “nervous energy.” This theory also resembles the 1890 social capillarity theory of Arsène Dumont, which held that social strivers reduced their fertility in order to advance themselves socioeconomically, though in Dumont’s concept of social capillarity, reduced fertility was a conscious choice, while in Hankins’s physiological theory it was not. Even those who did attribute fertility declines to the increasing use of contraception, such as Dublin, did not completely eschew the idea that “some loss of natural capacity to bear children” had affected North American and Western European women in general and women of the middle and upper classes in particular.

In 1931, the Milbank Memorial Fund, a public-health oriented philanthropy that was one of the largest funders of demography between the world wars, issued a press release stating that “in the country as in the city, the higher the economic and social status of the parents, the fewer are the children born.” It explained further that “whether this limitation of babies is accomplished entirely by birth control or is partly the result of diminished fecundity, it is impossible to say.” However, it was important to the Fund’s trustees that an answer be found. A few years earlier, trustee Thomas Cochran had proposed that the

91 Hankins, see n. 89, 183.
94 Dublin, see n. 85, 117.
95 “Press Release,” May 13, 1931. Milbank Memorial Fund Records, Yale University Library, New Haven, CT, folder 175, box 22. The Milbank Memorial Fund sponsored the establishment of the International Union for the Scientific Investigation of Population Problems in 1928, the Population Association of America in 1931, and the Office of Population Research at Princeton University in 1936. Its journal, *The Milbank Memorial Fund Quarterly*, was also a major outlet for demographic research during this period. Between 1928 and 1942, 20% of its 299 articles were on topics that today would be classified as demography, including studies of fertility, contraception, mortality, and general population trends and policies.
Fund distribute birth control among the people it served, with the idea that its use would ultimately reduce the size of the populations in need of public health services. At the time, however, contraception was still highly controversial, and was even illegal in many states. Few doctors or scientists had studied it, and studies that did exist focused on its individual clinical efficacy rather than its effects on aggregate population.

Pearl argued that such studies had no bearing on the effect of contraceptive use on aggregate population size or structure. He maintained that it is dubious logic to reason from the fact that a highly intelligent woman, thoroughly trained in biology in a university, and obsessed with an overwhelming fear of unwanted pregnancy is able to use a particular contraceptive device with unfailing success, to the conclusion that this contraceptive device is, or will be, equally effective as actually used by all women who resort to it in the general population. Nor can it be safely inferred from the same premise that birth control is a major factor in causing the decline in the birth rate.\textsuperscript{96}

In the early 1930s, the Milbank Memorial Fund made a grant to Pearl to test just this proposition. Pearl interviewed a sample of 2,000 women who had just given birth in the maternity ward “of some hospital located in or near a large city east of the Mississippi River,” asking them whether they had “ever used any method for prevention of conception” or “ever had self-induced abortion” or “abortion induced by someone else.”\textsuperscript{97} Contrary to his expectation, Pearl found that differences in contraceptive prevalence fully explained both observed fertility declines in the aggregate and socioeconomic differentials in fertility. His research indicated that, in the aggregate, women who used birth control experienced lower fertility rates during periods of use than they did during periods of non-use.\textsuperscript{98} Moreover, among “the

\textsuperscript{96}Raymond Pearl, “Contraception and Fertility in 2,000 Women,” \textit{Human Biology} 4, no. 3 (1932): 367.
\textsuperscript{97}Ibid., 369-371.
\textsuperscript{98}Around the same time, demographer Frank Notestein would also undertake a study of the aggregate effects of individual contraceptive use. He found that women knew independently how to prevent conception: prior to their first visit to a birth control clinic, 95% of the women he studied had already been undertaking measures to avoid pregnancy (including withdrawal, douching, condoms, vaginal suppositories, rhythm, pessaries, cervical caps, and sponges) with a 75% success rate. These findings supported Pearl’s conclusions, and also suggested that couples could control their fertility even in the absence of organized family-planning programs. Regine K. Stix and Frank W. Notestein, “Effectiveness of Birth Control: A Study of Contraceptive Practice in a Selected Group of New York Women,” \textit{Milbank Memorial Fund Quarterly} 12, no. 1 (1934): 57–68.

44
lower social and economic classes in large urban centers,” who were disproportionately represented in his dataset, “the practice of contraception is far less prevalent than it has been assumed to be by some of those who have discussed the problem of declining birth rates, and is much less frequent than in the classes on higher social and economic levels.”\textsuperscript{99} Pearl announced that “this evidence destroys the basis of most of my life’s work.”\textsuperscript{100} Acknowledging that human population growth was governed by social as well as biological processes, Pearl renounced his logistic law of population growth. Moreover, although he had long advocated the legalization of birth control as a eugenic measure, he began to promote it as a means of poor relief, arguing that “poverty and unemployment are being encouraged by the national policy of prohibiting the free dissemination of scientific birth control information.”\textsuperscript{101}

Pearl’s research indicated that individual family planning decisions — and public policy enabling and encouraging or disabling and discouraging contraceptive use — could have a measurable effect on aggregate population size and composition, suggesting that population engineering — planning of population — was a viable undertaking. The cohort component model provided a straightforward tool for estimating the effects of future mortality, fertility, and migration rates on population quantity and “quality,” and allowed analysts and policy makers to gauge the effects of a variety of potential policies. But for straightforward population projection — estimating the size and structure of future population in the absence of policy intervention — it was lacking a theory of how populations grow. The cohort component model allowed its users to specify any future vital rates, but did not include any criteria for selecting those rates. Indeed, the flexibility and openness that made it ideal for population engineering left analysts with a range of futures and no theory on which to base a selection among them. In the following section, I argue that interwar demographers imported elements of the logistic law of population growth into the cohort component model, making it more useful as a method of population projection.

\textsuperscript{99}Pearl, “Contraception and Fertility in 2,000 Women,” see n. \textsuperscript{96}, 397.
\textsuperscript{101}“Birth Control Ban Opposed (news clipping),” Mar. 14, 1934, folder 185, box 22.
3 Demographic Transition Theory: A “Logistic Law” for Cohort Component Projection

Let’s return to the striking similarity between Whelpton’s 1928 projection of the U.S. population and Pearl’s 1920 projection. Even Pearl’s critics had commented on the accuracy with which his logistic curve tracked the growth of the U.S. population to that point. The logistic law of population growth held that populations could only grow along an S-shaped trajectory. In contrast, the cohort component method does not specify any particular trajectory of population growth. Depending on the analyst’s assumptions about future fertility, mortality, and migration, a population can either increase or decrease over the period of projection, at any rate, and along any path. Nonetheless, in his 1928 projection, Whelpton specified future vital rates that reproduced a logistic growth trajectory. In the following year, his colleague Warren Thompson would present what is now considered one of the first articulations of demographic transition theory. In this section, I argue that demographic transition theory provided the cohort component projection method with its own logistic law of population growth, this time based on social and economic modernization rather than biological constraints on subsistence.

Whelpton did not present a coherent theory of population growth in his 1928 article, but he did assume that both mortality and fertility would continue their secular decline, but that these declines would level off, ultimately producing population stationarity, or non-growth. In his 1928 projection, he assumed that white U.S. mortality rates were heading asymptotically toward the then-current mortality level of New Zealand, which at that time had the world’s highest known expectation of life at birth.\footnote{Expectation of life at birth is a life-table index \( e_0 \) defined as the average number of years lived by all persons born in a given year. Samuel H. Preston, Patrick Heuveline, and Michel Guillot, \textit{Demography: Measuring and Modeling Population Processes} (Oxford: Blackwell, 2001).} This choice suggests a belief that mortality was declining toward a biologically-determined minimum, beyond which it could not continue to decline. Whelpton similarly derived future fertility rates from the
observed downward trend in age-specific birth rates, which he also assumed to be asymptotic — suggesting that he did not expect people to stop having children altogether — though he did not use data from other countries to establish the lower limit.

Although Whelpton’s 1928 projections were based on changes in vital rates and did not impose a pre-determined trajectory of population growth the way Pearl’s did, it did suggest a universal trajectory of mortality and fertility rates — declining steadily over time but at a slowing rate, forming inverse logistic curves — and produced a logistic trajectory of population growth that looked much like Pearl’s projections. It is important to note, however, that the cohort component is explicitly non-Malthusian and includes no concept of an upper limit on population growth. Therefore, nothing in it requires that the growth curve take a logistic shape. Had Whelpton assumed lower fertility and higher mortality in the future, his projection would have curved downward, and had he assumed higher fertility and lower mortality in the future, it would have continued to climb. Whelpton’s projected population curve took its logistic shape because he designed it to do so. In the United States, fertility and mortality had declined steadily over the period for which data were available. Nonetheless, Whelpton assumed that these rates would level off — with life expectancy never exceeding 70 years — and that they would do so gradually, producing the same gradual slowing of population growth predicted by Pearl’s logistic law. As Jan Van Bavel has pointed out, however, there was at that time no theory of population growth that would have suggested the decline in fertility would ever end. It is possible, therefore, that with little information about trends in or the biology of vital rates and no theory about population dynamics, Whelpton may have selected the future rates he did because they produced results that were similar to Pearl’s but slightly higher, as Pearl’s had been critiqued for being too low. Whelpton may also have based his projections on the theory now known as demographic transition, which his colleague Thompson described in an article.

---

103 Whelpton, see n. 24.
published the following year.

3.1 A Social Theory of Population Change

Demographic transition theory is usually attributed to mid-century demographers Frank Notestein and Kingsley Davis, both of whom made well-known statements of it in the 1940s, or to Adolphe Landry, who described something similar in his 1934 *La Revolution Demographique*. However, it was Warren Thompson who first laid out the stages of demographic transition in a 1929 article in the *American Journal of Sociology*, though he did not name it. Demographic transition is both a historical description and a theory. As historical description, it refers to the nineteenth-century English experience of declining mortality, which initiated rapid population growth, followed by declining fertility, which slowed — and was expected ultimately to end — population growth. Demographic transition theory is the universalization of this experience: the prediction that all societies will follow the same demographic trajectory (reduction in mortality followed by reduction in fertility with population growth in between) as part of the supposedly-universal process of modernization — either cause, consequence, or both.

Figure 6 is a recent textbook illustration of demographic transition theory, with downward-sloping lines representing mortality and fertility and an upward-sloping line representing population growth. The diagram is divided into four sections, with the first three indicating the experience of three groups of countries described by Thompson in his 1929 article as representing sequential phases in a universal progression from high fertility and mortality to low fertility and mortality:

---

105 Dudley Kirk, “Demographic Transition Theory,” *Population Studies* 50 (1996): 361–387; Although most commentators describe Landry’s demographic revolution as simply an early version of demographic transition, Jan Van Bavel has argued that it was fundamentally different in that it had no end point. Whereas demographic transition is a shift from a high-pressure equilibrium to a low-pressure equilibrium, demographic revolution involved an infinite decline in fertility to the point of extinction. Van Bavel, see n. 104.

106 Demographic scholarship has indicated that, although demographic transition is often described as the general experience of Western Europe, only England experienced the textbook case.

**Group A.** Low mortality and fertility, with little overall population growth: Northern and Western Europe, and the English-speaking non-European world.

**Group B.** Declining mortality and still-high fertility, with rapid population growth: Southern and Eastern Europe.

**Group C.** High fertility and mortality, with little overall population growth: The rest of the world

Group A had progressed the farthest in the supposedly-universal demographic transition, and Thompson described Group B as being about 50 years behind group A, but experiencing a much more rapid mortality decline. Thompson attributed the mortality decline of both groups to industrialization, and predicted that population could also grow in the Group C countries if they were to begin to industrialize, pointing to Japan as an example.

Although Thompson may have been the first to formally state this theory, it crystallized the geopolitical concerns of his patron Edward Scripps, as well as those of Lothrop Stoddard, Madison Grant, and other population observers. At the 1927 World Population Conference, which Thompson had attended, British economic historian Mabel Buer, who had recently published a monograph describing the population consequences of the Industrial Revolution

---


[109] Ibid.
in Great Britain\(^{110}\) cautioned her fellow population scientists that, although population
growth in Asia and Africa appeared to be slow or nonexistent,

> it is important to note that the slowness of their increase is due to the same cause
> as was the slow increase of pre-18th century Europe, that is, to a high death rate
> and in particular to a high infantile mortality, due to lack of elementary hygiene.
> There is every sign that in a few years this will be remedied, and the change has
> already begun in India. It seems probable that we shall then have a period in
> the East corresponding to the first half of the 19th century in Europe, a period
> of a lower death and infant mortality rate (which, however, is still high according
> to our notions) and of a birth rate little, if at all, diminished. The result will
> be a rapid increase in population which may well be fraught with world-shaking
> consequences.\(^{111}\)

Demographic transition theory is clearly a variant of the modernization theory that was
beginning to emerge in the social sciences, and part of a much longer tradition of conjectural
history and social evolutionary thought that Arland Thornton describes as “reading history
sideways” and Anne McClintock has describes as “anachronistic space” and “panoptic time”
— viewing different parts of the world as representing distinct stages in a universal trajectory
of human and social development.\(^{112}\) Demographic transition theory associates high mortal-
ity and fertility rates with so-called pre-modern or traditional societies and low mortality
and fertility rates with so-called modern societies, positing that the transition to modernity
in Western Europe and North America both caused and was facilitated by declining mortal-
ity and fertility rates. It assumes that the demographic history of these places represents a
universal trajectory, such that the demographic condition of the rest of the world reflects Eu-
rope’s past and the demographic condition of Europe predicts the rest of the world’s future.

As is also true of modernization theory, demographic transition theory elides the role played


by the non-European world in Europe’s economic development and demographic transition, supplying raw materials for the industry that supported Europe’s population boom and providing an outlet for Europe’s excess population. The concept of demographic transition as a supposedly-universal experience attendant on the also supposedly-universal societal shift from tradition to modernity was an attractive concept for early twentieth-century social scientists, who sought to identify the laws that universally governed modern societies. The emerging science of demography would benefit considerably from the integration of population dynamics into modernization theory after World War II, as modernization theory held social, economic, and political change to be mutually causative, and demographic transition theory placed reductions in mortality and fertility at the center of that nexus.

Demographic transition theory recuperated Pearl’s logistic trajectory of population growth and reinterpreted it in terms of the social, economic, and political process of modernization. The growth pattern described by demographic transition theory has a similar S shape to that of Pearl’s logistic, as shown in Figure 6. According to its premises, prior to modernization, population is at a high pressure equilibrium, with high rates of mortality and fertility that balance one another to prevent overall growth; the first consequence of industrialization or economic development is more secure access to food and higher living standards, which reduce mortality, particularly among the young, causing population to increase ever more rapidly as mortality falls further; finally, the social and economic changes attendant on modernization produce smaller families, and this decline in fertility slows population growth until fertility rates match mortality rates and a low-fertility, low-mortality equilibrium is reached. According to demographic transition theory, population growth takes a logistic shape because mortality and fertility decline along reverse-logistic paths from steady high rates to steady low rates. The theory thus retained Pearl’s logistic pattern of population growth, but explained it in terms of changing birth and death rates. It therefore had a flexibility that the logistic law lacked: Pearl’s theory required a Malthusian limit to population

---

growth and defined the slowing of growth as the nearing of that limit; demographic transition theory did not preclude Malthusian limits or the possibility of that limit exerting a dampening effect on population growth, but also explained the slowing of population growth independently of Malthusian limits. While Pearl’s logistic law explained population change entirely in biological terms — growth resulted from subsistence availability; limits to that availability slowed growth — demographic transition theory explained population change in socioeconomic terms — growth resulted from improvements in food security and sanitation; urbanization, education, and industrialization slowed growth by incentivizing smaller families.

Demographic transition provided demographers with a theory that allowed them to draw assumptions about the future course of fertility and mortality without relying on a biological law of population growth. Demographic transition was a social theory of population growth that attributed the logistic shape of growth to the effects of modernization: in its early stages, modernization reduced mortality rates by providing more reliable access to food, clean water, and sanitation; in its later stages, modernization reduced fertility as industrialization and urbanization were incompatible with large families. The pattern of mortality decline followed by fertility decline produced rapid population increase that gradually leveled off, the same trajectory posited by Pearl’s logistic law of population growth. Indeed, although demographers using the cohort component method to project population did not extrapolate overall population growth along a logistic curve, they did extrapolate future fertility and mortality rates along reverse logistic curves, and then used those rates to drive the additive cohort component model.

Through the remainder of the twentieth century, the cohort component method — driven by demographic transition theory — was the gold standard for population projection, though it was not always the method used, as will be discussed before. However, although the downward logistic curves of mortality and fertility in demographic transition theory are ostensibly driven by modernization, the demographers who used demographic transition
theory and the cohort component method to project future population never formalized the relationship between economic development, social change, and mortality or fertility rates. Attempts at such formalization — notably the Princeton European Fertility Project of the 1960s and 1970s — failed to identify consistent relationships between fertility, mortality, and socioeconomic indicators. Instead, population analysts have used the reverse-logistic curve itself to predict future fertility and mortality rates, much as Pearl used the logistic curve to predict future aggregate population growth. However, whereas Pearl’s logistic law implied that each population grew along its own unique logistic trajectory, identified by fitting a logistic curve to historical data for that population, demographers using the cohort component method and demographic transition theory have at times attempted to identify universal reverse-logistic trajectories of fertility and mortality.

One of the earliest such examples is found in *The Future Population of Europe and the Soviet Union, 1940-1970*, published in 1944 by Frank Notestein and his colleagues at Princeton’s Office of Population Research. In these projections, Notestein’s group divided population growth into two components: a “natural” component — fertility and mortality without the effects of war — and a “social” component — all immigration and the excess mortality and reduced fertility produced by war. The group then explicitly ignored the second component, projecting only the changes in Europe’s population that would have been expected in the absence of immigration and war, contending that the results “reflect the natural sources of future population growth” and reveal “the populations that might have been expected in the absence of immigration and war, contending that the results “reflect the natural sources of future population growth” and reveal “the populations that might have been expected in the nations of Europe from an uninterrupted development of the trends of the interwar period.”

By labeling war and migration as “social” and excluding them from projections of “natural” population change, Notestein’s team elided the socioeconomic factors contributing to changes in mortality and fertility rates – the determinants of so-

---

called “natural” population change — even though demographic transition theory explicitly attributed declines in those rates to the social change resulting from modernization and its sequelae. In so doing, Notestein’s team naturalized modernization theory — particularly its assumption that “modernization” advances over time — and implicitly embedded it in the demographic transition theory that drove their population projections.

By referring to the declines in fertility and mortality as “natural,” Notestein’s group and later users of demographic transition theory and the cohort component projection method could excise any reference to the social and economic correlates of fertility or mortality decline, and simply represent vital rates as a function of time. Notestein’s group did this by constructing synthetic trajectories of fertility and mortality declines on the basis of available data from European countries that were thought to represent different stages of demographic transition. That is, Notestein and his colleagues arrayed the then-current mortality and fertility rates of the countries of Europe along a continuum from high to low, and then assumed that this continuum traced a universal trajectory of demographic transition, with those at the higher end occupying an “earlier” stage of transition and those at the lower end occupying a “later” stage. Interpreting geographic difference through a chronological framework based on an assumed universal trajectory “progress” or “development,” was precisely the basis of modernization theory, but also echoed Pearl and Gini’s theories of a population “maturing” as it neared the saturation point. By constructing these supposedly-universal trajectories, Notestein’s team treated Europe as “anachronistic space” — with different places representing different stages in universal development — and the variation it represented as “panoptical time” — a view of the entirety of human history in a single glance.115

Once they had constructed these synthetic trajectories, Notestein’s team could predict future mortality and fertility for any country by locating it on the constructed trajectories and reading forward.

Naturalizing trajectories of falling mortality and fertility associated with demographic

115These terms are borrowed from McClintock, see n. 112.
transition theory allowed demographers to predict demographic change without making explicit reference to social or economic change. In keeping with modernization theory, which viewed “modernization” in either the social, economic, or political domain as a driver of “modernization” in the other domains[116] demographers resented declines in fertility and mortality as a function of time, leaving its causal relationship with social, economic, and political changes undefined. Similarly, Pearl had quite literally represented population growth as a function of time, leaving the carrying capacity that was supposedly the only driver of population growth undefined. Just as Pearl’s logistic projection method had been a closed system, using only past population data from the country in question and no information about the potential of a given territory to support population growth, the cohort component method was also a closed system, as it used only current population data from the country in question and past population data from other countries, with no information about socioeconomic conditions in the country whose population was being projected, despite the fact that demographic transition theory identified those conditions as the drivers of population change.

Evidence of the general acceptance of the logistic as a trajectory of population growth is that, even as the cohort component method was being institutionalized as the only legitimate approach, projections made using it began to take on and rely on some elements of the logistic law of population growth, specifically the idea that population is a natural entity with emergent properties that everywhere and always follows the same pattern of growth. Even though the cohort component model formally allows populations to grow at any rate and in any direction, in the absence of detailed data on which to base individualized projections for specific countries, demographers using this method naturalized population growth in order to make it predictable: if population growth exhibited the same uniformitarian principles as other natural phenomena, then it could be predicted without reference to any particularities of the population in question.

[116] See Latham, see n. 112
3.2 Reviving the Logistic

These similarities between the logistic projection method and the cohort component projection method in conjunction with demographic transition theory come into sharper relief when we move into the decade following World War II. Existing accounts of the development of the cohort component projection method and its competition with the logistic law of population growth typically end before World War II. Indeed, by that point, Pearl had renounced the logistic as a “natural law” of population growth and the government agencies responsible for projecting population in the United States and several European countries had adopted the cohort component method.117 But that is not, in fact, the end of the story. After World War II, demographers briefly revived the logistic projection method (now separated from Pearl’s logistic law of population growth) for use in countries that lacked the detailed data required for the cohort component method. Examining this final episode in the early history of population projection further supports the contention that the cohort component projection method became a more “useful” model by adopting elements of the logistic method.

One of demography’s most important new clients after World War II was the United Nations, established in 1945 as a successor to the League of Nations by the United States, the United Kingdom, the Soviet Union, and China. Its fundamental mandates were to maintain world peace and improve the human condition, and early delegates believed that population played an important role in both projects. For that reason, they understood planning for and of population as critical to the U.N.’s mission. Delegates viewed knowledge of past, current, and future population dynamics as critical to the planning for population that would help to raise global standards of living. They also viewed the planning of population as a critical activity, seeing population itself as an independent variable in the world peace equation and as an object to be monitored and managed.118 The United Nations encouraged member

117 de Gans, Population Forecasting 1895-1945: Transition to Modernity, see n. 1
states to count, project, plan, and plan for their populations, stating that

in modern times,...government has become more and more entrusted with the planning of economic and social programmes; this requires a fairly accurate knowledge of the size of the country’s population, its rate of growth, its distribution among the various towns and provinces, its composition by sex, age, ethnic and educational groups, and the extent to which it is engaged in, or depends on, various branches of economic activity.\[119\]

However, to the extent that the U.N. aspired to global governance, it also sought to count, project, plan, and plan for a new statistical object: global population.

One of the first tasks facing the U.N. Population Division after its establishment in 1946 was to collect population data for all of its member states and their colonies and other territories. Between the wars, the Economic Intelligence Service of the League of Nations had published estimates of the total population of each country, but demographers did not consider these data reliable, and they did not include age-sex structure, which was critical to the cohort component projection method.\[120\] As censuses had never been taken in some parts of Africa and Asia, League of Nations figures were largely estimates or “reasoned guesses,” though demographers argued that they were “probably as near the truth as some of the so-called censuses” in other places. This statement impugned the quality of those censuses rather than praising the quality of the estimates.\[121\] Moreover, although the League of Nations estimates were updated annually, censuses were rarely conducted more frequently than every ten years; these estimates were therefore based on extrapolation of the growth rate calculated from the previous two censuses or on vital registration data — civil records of births, marriages, divorces, and deaths — which were also incomplete. Sometimes the same figure was used year after year.\[122\] Even in places with regular censuses, the war and the global depression that preceded it disrupted this time series.\[123\]
Where population data were available, they often lacked the detail required to project population into the future — vital rates and age and sex categories. In contrast to censuses in North America and Western Europe, which enumerated each citizen individually, colonial censuses often reported only the number of people estimated for each age-sex-race category that was relevant for colonial rule and for the extraction of wealth and labor. A useful comparison is with the slave schedules in U.S. censuses before the Civil War, which recorded only the names of slaves and of their owners, omitting information about family relationships, education, occupation, and other data that were collected for the free population of the United States beginning in 1850.\footnote{124} If age or sex were distinguished at all in colonial censuses, the population was often “subdivided merely into adult males, adult females, and children,”\footnote{125} which would give an estimate of the colony’s tax base and labor availability, indicating the imperial view of colonial population as a resource to be extracted or extracted from, rather than a citizenry to be governed. The lack of detailed census data for indigenous populations could also be read as a sign of the weakness of colonial states, or the resistance of colonial populations to enumeration, which is understandable when enumeration is the basis for taxation or extraction but not representation.\footnote{126}

The U.N. Population Division attempted to compensate for the paucity of League of Nations figures in 1946 when it requested population data from member states so as to estimate the world’s current population and project it into the future. The Division’s staff found that censuses had never been conducted in many countries, including Ethiopia, Liberia, Belgian Congo, Ruanda-Urundi, Eritrea, Ecuador, Afghanistan, Bhutan, Iraq, Kuwait, Nepal, Saudi Arabi, Yemen, Singapore, and New Guinea. In other countries, it had been more than a decade since the most recent census — most of the British colonies in Africa had not had a census since 1931, El Salvador had not had one since 1930, Costa Rica had not had one

\footnote{125}Kuczynski, see n. 120, viii.
\footnote{126}James C. Scott, *Weapons of the Weak: Everyday Forms of Peasant Resistance* (New Haven: Yale University Press, 1985); In the United States, censuses serve both purposes (taxation and representation), so there are incentives and disincentives for both underenumeration and overenumeration. Anderson, see n. 124

58
since 1927, and the most recent census in Haiti had been taken in 1918–1919. Official estimates for more recent periods were generally inferred from other types of administrative data, rather than complete enumerations. For example, population estimates for the British Cameroons were based on tax rolls, and therefore excluded “nomad herdsmen” who “do not reside in one place throughout the year and only pay tax on their cattle, so that their own numbers are irrelevant to taxation statistics.” Similarly, the Population Division found that “a complete census has never been carried out in Kenya and the statistics of the African population must be considered to have a fairly large margin of error” because “the population estimates at present available are estimates made by the Administrative Authorities based on the number of adult male taxpayers.” It determined that “calculation of [vital] rates [is] impossible at present.” Similarly, censuses in Northern Rhodesia (now Zambia) had carefully detailed the European and Asian populations, but the indigenous population was estimated on the basis of official employment, representing “only a fraction of the total African population.”

These data were not nearly sufficient for applying the cohort component method to project the world’s population into the future. Because the cohort component method projects populations by age-sex groups, it requires baseline data that can be broken down into such groups. Moreover, with an almost total lack of vital data — data on birth and death rates by age and sex — analysts could not locate these populations on the supposedly-universal trajectories of falling mortality and fertility rates. However, the logistic projection method required considerably less data — only total population at any three points in the past. In the years immediately following World War II, demographers affiliated with Princeton University’s Office of Population Research published population projections for

---

128 “Verification of Published Sources: Cameroons (British),” Aug. 1, 1950, folders 1-52, box 11, series 920.
129 “Verification of Published Sources: Kenya,” n.d., folders 1-52, box 11, series 920.
countries in Latin America, East Asia, South Asia, and the Middle East, often drawing on the logistic method when their data were insufficient for the cohort component method.

Demographers who used the logistic method in the 1940s, however, divorced it from Pearl’s logistic law of population growth. Rather than interpreting the logistic curve as a natural law of population growth, postwar demographers understood it as an approximation of projections that would have been made using the cohort component method and demographic transition theory, were the requisite data available. This worked because both the logistic law and demographic transition theory suggested that populations should grow along approximately logistic trajectories, with declining mortality followed by declining fertility producing an S-shaped growth curve. Therefore, even though they had discarded the logistic law, many demographers viewed the fitting of past population data to a logistic curve and its extrapolation into the future as a valid method of population projection, especially when the data necessary to extrapolate the mortality and fertility declines that produced the logistic trajectory were unavailable. Pearl’s former collaborator, Johns Hopkins University biologist Lowell Reed, drew on this logic when he argued in a roundtable at the 1947 meeting of the Population Association of America that “since population is a function of an almost infinite number of parameters over time, many of which are unknown, and since the analysis of the inter-relationship of these parameters is only beginning, the projection of some of the parameters of the series may frequently lead to results less valid than the mathematical expansion of the series.” In plain English, Reed contended that, although the cohort component method would produce more detailed projections if enough data were available, given the sparsity and unreliability of vital data, the aggregate projection produced by extrapolating the components of growth individually and summing them — as done by the cohort component method — would be less accurate than the extrapolation of the aggregate itself.

Perhaps the most well-known postwar use of the logistic projection method was Kingsley

---

132 Dorn, see n. 74.
Davis’s *Population of India and Pakistan*, published by Princeton University Press in 1951. Davis justified his choice of method by pointing out that the cohort component model “has the disadvantage that birth and death rates fluctuate more than the natural increase which is a function of the two, and our knowledge of components is often less than our knowledge of the population growth as a whole,”[134] an argument very similar to that made by Reed in 1947 (at a meeting Davis no doubt had attended). Davis conceded that “for short-run estimates the component method is preferable,” but maintained that “for long-run estimates the logistic is better.”[135] Conspicuously missing from his explanation is reference to data quality or availability. Rather, Davis argued that the logistic method produced better results over the long term *independent of data quality*, as overall growth rates were less volatile than mortality and fertility rates. This assessment may have been influenced by relatively recent epidemics in India, which had produced spikes in mortality, or by the North American and Western European baby boom, which had raised fertility and produced population growth well beyond that projected by Thompson and Whelpton between the wars. Indeed, the use of the logistic curve as a substitute for cohort component projections in the absence of sufficiently-detailed data suggests an acceptance of the idea that populations always grow according to an S-shaped curve. Such acceptance entailed a view that the curve itself could be used to project population, even if the curve was by then interpreted as a product of fertility and mortality declining along reverse logistic trajectories, as implied by demographic transition theory, rather than a product of population nearing its Malthusian limit, as implied by the logistic law.

Use of the logistic projection method, even when stripped of its association with Pearl’s logistic law of population growth, did not remain popular for very long, especially after the U.N. Population Commission rejected its use for official U.N. population projections. In 1954, the U.N. and the IUSSP co-sponsored the first of what would become a decadal series.

---


[135] Ibid., 89.
of world population conferences — meetings of demographers from throughout the world working in universities, government statistical bureaus, and inter- and non-governmental agencies. At the 1954 meeting, one U.N. demographer argued that “there is no reason that population should ever grow precisely in accordance with a mathematical formula,” while another criticized the logistic method for making population projection in general seem a much “more ‘scientific’ and respectable business than, say, predicting the date of outbreak of the next war or the name of the next President of the United States” as a result of its “use of numerical techniques of extrapolation which may suggest analogies with astronomers’ calculations of the future position of the stars.” Although it doesn’t specifically name Pearl or the logistic curve, this sentence directly references Pearl’s analogy of the logistic to the path of a comet, but suggests that his logistic law was actually much more akin to fortune-telling. In a 1956 manual on population projection, the U.N. Population Division rejected Davis’s concern about the volatility of fertility and mortality rates, and declared that “the ‘component’ method is superior to ‘mathematical’ methods [including the logistic] in that it involves a separate analysis of the changes affecting each component of the population,” although it also recognized that “unfortunately, statistical information is often not sufficiently detailed or accurate to permit the formulation of the specific assumptions needed in the projection of each component.”

One explanation for the U.N.’s rejection of the logistic method is that its results may have been less useful for some planning purposes than were the results of cohort component projections. As one U.N. demographer stated about logistic projections at the 1954 meeting, “since projections of this type are not analytic, they can give only very limited information, both as regards the causes of changes in population trends, and the detailed effects upon

population structure.” Also, since future population growth in the logistic model was fully
determined by past growth, “alternative courses of future population growth, under different
assumptions, can hardly be considered by this method.”139 These two statements point to
the two uses of projections: planning for population and planning of population. Planning
for population required information about future overall size, as well as age and sex struc-
ture; planning of population required information about the effects of the components of
growth on overall population. The third problem was political: in logistic projections, future
population growth is completely determined by past population growth, leaving no room for
manipulation via policy, or planning of population. In contrast to the cohort component
method, which explicitly simulated future population growth on the basis of assumed fu-
ture rates of mortality, fertility, and migration, and could therefore predict alternate futures
given different policy alternatives, the logistic method produced only one future. The co-
hort component projection method therefore offered greater leverage for efforts to plan and
manipulate future population growth.

139Grauman, see n. 136.