Two Concepts of Population:
The Long View

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Abstract:

Historical research in the last three decades has altered profoundly our understanding of the contexts in which demography emerged, from the 17th to the 20th century. An established literature now covers: the impetus of humanism in early modern population arithmetic; the 'probabilistic revolution'; the rise of statistics; the public health movement; population genetics and evolutionary theory; and the troubled story of eugenics. In consequence, a new narrative line of the long-term development of population theory is now possible. Its central problematic is that population dynamics require human groups to be conceived *both* as limited but unbounded networks and as formally closed aggregates. The most distinguished modern formulations are, respectively, those of Darwin and Lotka. This paper tracks briefly the narrative line that combines these two approaches and the framework they together open up for population theory, pinpointing main implications as demography faces the problems of late and post-transitional societies.

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When Notestein (1945) refurbished Thompson's (1929) model of modern demographic change, calling it 'the demographic transition', he retained its primary focus on recent and projected trends in the 20th century. The "long view" in his subtitle was chiefly a nod to Carr-Saunders' (1936) estimates for 1650 –1900, which appear in some of the graphs. Their (very effective) role in his article was to give emphasis to the accelerating pattern of world population growth in the era up to 1945. Even so, the world population projected for 2000 now seems stunningly modest: 3.3 billion. Notestein viewed such increase with foreboding. The transition coincided with an era of undoubted achievements in Western Europe and America: tremendous industrial growth, improved living standards, widespread literacy, and a considerable extension of popular sovereignty. For Notestein, fertility control flowed directly from "growing individualism and rising levels of popular aspiration developed in urban industrial living" (1945:40). Yet two world wars and the rise of communism had shown that sustaining peace and development in the modern world remained fraught with difficulty. In the early post-war era, governments of new or soon-to-be-created 'undeveloped' countries – i.e. lacking cultures and economies rooted in appropriate individualistic values -- could only be expected to fall short both of resources and experience. If open societies enjoying popular sovereignty and progressive economies had proven fragile even in the West, surely rapid population growth in places without these advantages would prove to be a major destabilising force in the world for the foreseeable future.

More than half a century later, the prognostication of rapid growth, poverty, and conflict is broadly confirmed for many places. Much more happened, however, that was not anticipated. Actual world population growth turned out to be double the estimate Notestein employed, while much of Europe sustained reproductive declines to levels far lower than anticipated. Fertility and mortality transitions are now advanced in economies that do not rely chiefly on industry, and in cultures strongly opposed to Western individualism. More generally, the timing, duration and trend of fertility and mortality declines are much more diverse than anticipated -- and this has also proven to be the case for Europe's past. As the rapidity of growth varies, diffing patterns of age-structural transition have emerged. Different cultures, also having different paths of institutional development, vary in their capacity to absorb growth and age-structural change. Most recently, the ideal of Western society and economy rooted in individualism to which Notestein appealed has been assaulted from within. A series of financial crises has made it clear that open societies are endemically vulnerable to individual choice that is given unfettered access to credit. As with the issue of sustained low-low fertility, no reliable policy that will alter this pattern is to hand. The irony is that countries that Notestein and his contemporaries considered most imperilled by massive population growth -- India and China -- have in the same period acquired a radically different status: they are now seen as key engines in the world economy, on which the West increasingly depends. Their economic strength reflects the productivity of immense workforces, even as the advantages of possessing potentially vast internal markets have scarcely been tapped. Whether as a model of

government, of the parameters of individual choice, or of the long term implications of population trends, Western precedent is no longer simply accepted as laying down the pattern for the whole world to follow.

Instead of the regular three-stage transition that Notestein's 'long view' seemed to suggest, demographers have begun gradually to accustom themselves to multiple trajectories, with precise causalities remaining an open question. The preoccupation of the post-war era with rapid population growth has given way to multiple demographic agendas, pursued for the most part as a set of separate issues: sub-replacement level fertility, transmigration, diffusion, ageing, AIDS, and the diversification of marital and family forms. Likewise, the individualism and aspirations that Notestein believed to power a single pathway of modern population history are recognised to be much more complex. Far from simplifying population diversity, individual decision-making is often a process in which continuing uncertainties are negotiated and renegotiated. The several issues just noted have become familiar examples: the life course factors that lead young women to postpone reproduction; individuals' difficulties in assessing sexual risks of HIV; the vulnerability of individual migrants to exploitation; increasing longevity in a context of absent or non-supportive children; the difficulty of attaining real reductions in individuals' energy and other consumption; and the seeming impossibility of large scale reform of pensions and health systems in political systems that reward short-term individual interest. Transition theory was never intended as an explanatory model for all this. There is a real need for demography to comprehend these issues not as so many topics, but as pieces of a single puzzle.

The diversity of transitions and of pre- and post-transitional populations, established by demographers since 1945, remains without doubt a major achievement. Histories of changing mentalities and economies that accompanied this diversity also now exist, as remarkable studies of particular cases testify.[i] The several issues noted above, however, reveal that the role of the individual and the nature of demographic agency in transitional and post-transitional societies remain ambiguous. Just as the heterogeneity of transitions has undermined the simplicity of Notestein's account of long term trends, so a realistic long view requires rethinking the configuration of ideas that allowed demographers to prioritise reproductive control as the only form of individual demographic choice that really matters. This priority was, of course, a position that Malthus had previously determined. The idea that a strategic relationship exists between individual behaviour, populations, and government did not, however, begin with Malthus. By the time of the first *Essay*, this configuration already had a substantial history in Western thought, in which the importance of population differences as arbiters of stability and change was not narrowed to matters of reproductive choice.

The era of demographic transition is evidently a great exception to most of population history, and we should not expect a general model of population to be grounded in the exceptional. This paper will offer a new narrative line of population thought in the long term. The structure and change of populations which early modern writers (i.e. from the 16th to the 18th centuries) conceived as normal and natural relied on a very different framework than the one that has prevailed since Malthus and the rise of statistics. Network population thinking, as we might now characterise this framework, provided a tolerant and topical medium in which the tools of population arithmetic – demography's elementary measures and models in process of formation – were conceived and gradually developed. Beneath early modern thinking are sources in classical antiquity. Filling in this long view is not just background. The successful rise of statistics and demography in the 19th and 20th centuries opened up a second major framework for inquiry, yet closed

off analytical developments of the concept of population that prevailed before 1800. Population phenomena that gave rise to the earlier developments have in recent years returned to haunt demography, as they remain components necessary to explaining the heterogeneity of trends. A larger domain of population thinking in the 20th-century -- evolutionary biology – is notable for never having excluded them.

An overview will be presented first, in which the successive conceptualisations of population are described, and the long view is divided into two, or perhaps three, main periods. The narrative line is illustrated with reference to some key episodes. There have, of course, been many variant forms of the two main concepts, but there is not space here to detail them. The conclusion makes brief observations on the implications of the long view for demography's current agendas. In a short conference submission it is impossible to do justice to the substantial body of historical research that makes a new long view possible. I can only acknowledge my debt to some of this work here.[ii]

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Population arithmetic, from Graunt to the late 18th century, pioneered uncharted territory. Its fundamental problem was how to apply number as an investigative tool fairly and realistically to society. What counts as fairness and realism depends on the idea or model of society employed, as well as on whether or not the results of quantitative description and analysis are useful or appear sufficiently accurate. In the early modern era, under the powerful influence of humanism, the models on which Graunt and his followers relied owed to classical sources. Political theory, at least since Aristotle, recognised population size, composition, and relations between constituent sub-populations as key factors determining the constitution, development, and stability of states. The main types of polity (monarchy, aristocracy, democracy), the characteristic problems of each, and the explanation of how and why these forms of government change, were all defined in terms of these factors. Put very simply: monarchies are able to amass much greater population size, with potential economic and military advantages, but tend inevitably to tyranny because of the imbalanced distribution of power amongst constituent groups. Democracies are likely to work only in small states where rich or aristocratic elements can be incorporated in balance with significant numbers of middle strata (usually small landholders) active in government. Even so, small states are vulnerable to the military capacities of larger ones, and also to internal factionalism that can push them into tyranny. The prevailing humanist framework, in which individuals were linked in a system of balances to family and successively wider groups in the state, and states in turn compared for proportionate capacities dependent on these systems, was entirely suited to the emergence of population arithmetic. The idea of balances began in natural history and political and religious symmetries of the macro- and micro-cosmos. With this model well-established as the basis of polity, society, and economy, what Graunt proposed could be more direct: to take this model literally and empirically by counting and comparing the many quantitative balances and proportions making up the state. His method, as he remarked, was designed to enable a prince, or any man, to assess the current condition of a state and the quality of its policies.

The parameters of political discourse from Machiavelli to Rousseau remained rooted in classical sources, and the works of major authors like Aristotle became widely available in translation as the early modern era continued. Not only theory, but popular arguments of partisans, from the English to the French and American Revolutions, were

steeped in classical influences. Thus, we do not need to know for sure whether Graunt and other writers on population were actually versed in their Aristotle. (Although Graunt himself went to considerable lengths to become competent in Latin, in which most Greek as well as Roman writers were accessible.) Classical models of the state and its relations to its parts remained the common idiom of the period. Later in the 18th century, principal theorists of the state, like Rousseau, Hume, and Madison, were still trained in the classics, and continued to frame their discussions of forms of government in terms of the three classical types of polity, and distinguished them using criteria that began in relative population size and composition.[iii]

At first glance, this general humanist way of thinking about individuals, states, and populations may appear unexceptionable. Its historical development as a practical commonsense of population and society in the early modern era, however, led this logic to a powerfully different conception of population than the 19th and 20th-century demography to which we are now accustomed. Indeed, demography and statistics first emerged largely in reaction against classical models. A bit more detail on four features of the earlier conceptual framework help to bring out the differences:

1. Incommensurability. States are composed of a number of different groups or sub-populations. Major differences among groups commonly reflect contrasts of power and wealth, and usually lead to endemic factionalism. Differences in the size and composition of sub-populations may sustain unequal relationships, and become self-perpetuating. Or, conflicts and shifting alliances may alter memberships and lead to changes of state. Either way, a central problem in any state is to arrive at proportional balances between unequal groups that allow them to co-exist; otherwise differences will act as a major check on the development of a state and a key source of instability, possibly leading to disintegration. A strong element of realpolitic thus characterises early modern attitudes to population: even if all citizens are supposed to possess naturally equal rights and opportunities, societies do not actually function equitably. Not all people in a state are citizens, and not all citizens are equally enfranchised. It is therefore misleading to count individuals and aggregate units of sub-population making up a state as if all people are fundamentally the same. A general quantitative method, such as statistics made customary after 1800, was not inconceivable to early modern writers on population: it was of no real interest because it failed to countenance the most important problems that shaped the size and composition of states.

   Working out effective relative population balances and imbalances involves countenancing different *kinds* of population, according to the properties that make them incommensurable. This principle lies at the core of good government and potential individual development. Two groups (rich and poor, for example) may at a given point in time be identical in size, age structure and so forth – yet their possibilities for development are markedly different, and numerical comparison of their demography in itself is likely to be misleading. Incommensurability may be due in part to innate differences, but arises chiefly from distinctive differences in the quality and strength of relationships or solidarities that create particular groups and bind them together. Incommensurability typically characterises groups of citizens (generally identified with property) as opposed to the great multitude of poorer people (generally without property, or very little) and others (e.g. resident aliens, slaves, ethnic or religious groups with designated statuses). Within the citizenry there are normally estates (which have varying rights and powers,

as well as property differences), occupational groups, ethnicities, and so forth; these sub-populations are not incommensurable.

2. Networks. Since numerical differences are insufficient to characterise the dynamics of balances and imbalances in a state, it is necessary to consider the relationships between members of groups, and between memberships, as it is these relationships that function as primary mechanisms of population change. In short, a population is not simply an aggregate defined by attributes of enumerated members; rather, it is a set of networks, i.e. aggregates that are being composed, built up, or broken down according to the nature and history of network relationships. The several incommensurate groups just cited were defined by differences of status produced by particular types of relationship (e.g. authority, appointment to office, contract, property, marriage, kinship) that together shape their potential growth or decline as populations. In the early modern era, as in classical Greece, alliances via marriage and family ties were bound up with systems of patronage, giving rise to competing groups in society. Allied to these groups were varying forms of clientage that brought poorer strata and aliens into the contest as soldiers, servants, and so forth. While it might be in the interest of the highest strata in society not to grow too large (leading to practices of delayed marriage, birth control and celibacy), management of client groups was a different matter. Where an ongoing demand for labour or troops was great, client fertility was an asset; where demand varied, client groups could be redeployed via migration (moving them where they were needed), assimilation (via marriage or reclassification of status), or, in the case of slaves, simply by buying and selling.

   Machiavelli's *Prince* articulated this realpolitic at its most elemental: it is not sheer numerical size or characteristics of a population that is important, whether the contest is an internal struggle between factions, or a war between states; the crucial issue, rather, is whether the relationships that bind together groups are effective. Patronage and alliances between groups with genuine common interests that ensure the loyalty of all concerned are likely to be the best way of amassing the size and composition necessary, but trickery that will gain the support of people when it is not in their interest will suffice. Merchant writers of the 17th century made the same point in a different way: the economy on which a state relies may be strengthened by population growth, but only if workers are well distributed as to skills and places where they are needed. The root argument here goes back to sources like Aristotle, who used historical evidence to show that small states with well-integrated and loyal populations could easily out-fight bigger states lacking these characteristics. Aristotle also took these arguments to their logical conclusion where population growth and decline of a state are concerned: where one group or state comes to dominate another, the whole fabric of relationships that existed in the defeated population are altered: citizens become exiles, labourers, or slaves; the relationships that constituted their family and patronage groups are broken down, and existing groups often disappear; even where they survive, their fertility and mortality are likely to be subject to major changes as the basis of their livelihood and position in society have been removed by those groups now in control.

3. Openness. Network population thinking, as the above illustrates, is a complex and powerful logic in which what determines the size, composition, growth and decline of groups, and thence of whole states, is not primarily fertility and mortality. Rather, levels and trends in births and deaths tend to follow the relative effectiveness of the networks that individuals forge or in which they are incorporated, and which regulate polity, economy, and

morality. Networks are open population phenomena: they expand and contract according to the functions and situations they serve. This is another reason why, from an early modern point of view, enumerating a population, and analysing it as a self-contained or effectively closed unit, was taken as likely to be misleading. Networks and factions are open-ended, multiple, and overlapping. They have to be tracked, as they are not conveniently located in units defined by physical residence (e.g. households, registration districts). And, particularly as factions, they are highly unlikely to be open to public view. Not surprisingly, proposals by advocates of census taking who were well-placed at the time, like Petty and Vauban, made little progress. The authoritarian states in the 18th century that did develop population counts (Prussia, Sweden) guarded them, lest they prove useful to opposing elements within and without the realm. They were conceived not as instruments of a general science of population, but instruments that produced approximate information that could give an advantage to elites currently in power. Demographers and statisticians writing the history of their subjects have accordingly berated the era for its failure to appreciate the analytical and empirical importance of comprehensive and closed data sets.[iv]

Yet the whole tenor of systems of thought over the early modern era mitigated against treating populations as closed. When Graunt first applied number to the bills of mortality, the method he developed used bookkeeping techniques in which population totals were analogous to provisional sums and proportions in ongoing merchant exchanges – the population of London was like an accompt in which the books were still open. The writings of his merchant contemporaries developed an economic version of the classical model of balance in the body politic in which states could grow endlessly richer by maintaining a balance of trade in which the nation's wealth included floating capital far beyond its boundaries, while its population was equally far flung, and sustained also by encouraging immigration. Economic writings, from Cantillon and Quesnay to Turgot and Smith, while recognising the tendency of population to rise to the level of subsistence, only led in 1798 to Malthus's principle of population; more generally, the division of labour, the development of technology, education, migration, and selective state interventions all indicated ways in which populations would be able to go on expanding, or make other adjustments to subsistence levels. For many writers, corrupt privileged interests, often allied o profits from excessive taxation, were the major problem because they kept subsistence and population far below natural capacity. Of course, politics and war also made the idea that populations exist within fixed limits look wildly abstract: not only were the boundaries of states and empires within Europe notoriously fluid, the colonisation of Africa and Asia, and the American frontier, beckoned. Only within the confines of the mathematics of probability were closed models, i.e. life tables, of interest; and where they were applied to actual populations, by Hudde, de Moivre, Deparcieux, and Price, it was to populations (annuitants, friendly societies) constructed for the purpose.

4. Historical Stasis. The world view in which populations are observed in nature, politics, and economic relationships to be open phenomena ceased to prevail in the early 19th century with the rise of the modern nation-state, especially the promulgation of central statistical offices and related public inquires. A new commonsense prevailed in which nations were believed to be bounded populations of shared language, morality, and history, living in material conditions that would naturally accompany such association from the earliest times, such as residence in a common territory. A national population was, so to speak, a people that grew up together. Fertility, marriage, and descent in this view became primary forces shaping population composition. In this context a population statistics and demography based on the census appeared obvious, since it treated the nation in its

territory as an effectively closed population. Emigration, the existence of religious and ethnic minorities, issues of internal population movement of course existed – but they were secondary both quantitatively and in principle to the nation-state as a whole. The debate over Malthus's 'principle', which likewise addressed natural, moral, and economic limits on population, steadily moved the interpretation of population data and history away from open population thinking. The motives behind these developments were not driven by the idea of creating demography as a formal mathematics of population, although this soon emerged as stationary models developed for closed institutional populations came to be applied directly to census data. Rather, the rise of what we now think of as demography was integral to a new political dispensation, which was consequent on perceived limitations, including open attitudes to population, of the *ancien régime.* The new population statistics appeared to speak directly to these limitations, and to solve them, opening up a new era of progressive reform.

As political historians have remarked, the classical model contained a historical trap, which early modern writings on the state in the end could not escape. Whatever the type of polity, it would sooner or later be overcome by the forces of factionalism, tyranny, or liabilities of scale. At most, versions of the classical model put forward by writers like Polybius and Machiavelli saw states passing through a cycle of republican, oligarchic, and tyrannical forms of government, in varying permutations – but there was no escape. Republican forms, in which the freedom and responsibility of individual citizens was greatest, seemed most vulnerable. The few republics of the early modern era that managed to endure, Venice and Geneva, although widely admired, appeared to most authors to be more oligarchic than republican. The English variant, or mixed constitution, which, from 1688, became the primary source of attempts to rethink classical models, was acutely criticised by the commonwealth tradition: parliament was not representative because it remained susceptible to adroit royal and oligarchic networking.[v] Put bluntly, members of parliament could be bought, and the balance of political representation was further skewed by manipulation of franchise and the survival of 'rotten boroughs' (i.e. parliamentary seats without populations). As doctrines of natural law and the rights of man gained ground, from the later 17th century, the need to resolve the seemingly inescapable fatality of republican polity came to be identified with the difficulty of designing truly representative government.

Population arithmetic from the beginning straddled these debates. It could be deployed either to support the status quo, or as part of republican and other critiques of the *ancien regime.* Graunt's *Observations*[vi] faced in two directions, republican and monarchical. It's overt stance, reflecting its appearance immediately following the Restoration, adopted the traditional image of the body politic in which the king and his ministers are the head, brains, eyes, and spirit of the state. Graunt began his text with a dedication to the Lord Privy Seal, and ended it with the remark that his population arithmetic, as it dealt intimately with the strength of states, should perhaps best be confined to ministers' eyes only. A second dedication, however, was to the Royal Society, which Graunt likened to a 'parliament of nature', i.e., representatives of science who are thereby actually qualified to interpret the data and assess whether the King's policies actually are in accord with natural and divine order. Graunt even remarked that his method may be applied to the problem of factions, although he stopped short of doing so. Population arithmetic, as first formulated, thus contains an unmistakable element of subversion, reflecting Graunt's own commitment to independent scientific judgement, his active involvement in the civil war on the republican side, and his reported Socinianism. A major strand of 18th-century population thinking, including

works of major figures like Davenant, Swift, Montesquieu, Price, Franklin, Turgot, and Condorcet, continued to regard evidence of population change chiefly as a basis for criticising royal and aristocratic policy. As the 18th century proceeded, this tradition pointed increasingly (if not entirely correctly) to declining population growth in France and England as evidence of specific defects in state policy.

In contrast, the line of population arithmetic that followed Petty's solidly monarchical attitude – including writers like Vauban, Arbuthnot, Derham, Süssmilch, and Moheau – asserted that population sizes and balances shown by their arithmetic indicated a symmetry – even a divine order -- underlying contemporary political and economic policies. Historians of population statistics, like Glass, Westergaard, and the Dupâquiers, frequently remarked the relative analytical poverty of this tradition, which has been confirmed by more recent historical research.[vii] It is, indeed, hard to read this literature and feel that the symmetries demonstrated are real, or that the arguments underlying them are scientifically motivated. Scepticism was expressed at the time by political economists, and more brilliantly by essayists like Swift. And, as historical demography and economic history have now documented pre-transitional levels of mortality and poverty – high levels that were supposed nonetheless to be concordant with divine order -- the complacency of what might be called the congratulatory school population arithmetic remains arguably its outstanding characteristic. Writ large, the results of population arithmetic showed that forces in nature, like endemic and epidemic disease, or levels of births, might vary widely within the remit of supposedly divine right rulers; yet comparison of vital records also showed that different polities could have differing success in ameliorating them. The stage was set for events of the later 18th century, and for 19th-century reforms, that brought an end to the *ancien régime*.

The historical trap that characterised the classical model had two important features bearing on the development of quantitative methods. First, because key sub-populations making up a state are incommensurable, numerical methods were not applied to the endemic problem of factionalism. Network population thinking was defined in a way that precluded some key issues from quantitative development. Second, acceptance of the classical view that republican forms of government could only work in small polities meant that the countries in which debates over population and government were pursued most intensively – Britain and France – would inevitably require a powerful monarchy. The congratulatory school thrived because alternative forms of polity by definition could never solve the problem. The increasing focus on the inadequacy of political representation in the later 18th and early 19th century, however, meant that questions of numerical balance and proportion gradually became bound up with thinking about reform. Political arithmeticians like Franklin, Price and Condorcet were part to these discussions. The injustice of existing arrangements was evident: different parts of a country, with differing levels of mortality and economic disadvantage, could be seen also to suffer differing influence amongst the elite. As developments in the American colonies became the testing ground of efforts to resolve the problem of representation in numerical terms, they will be used as an example here.

The idea of checks and balances, which eventually became a signal feature of the American constitution, proposed a way out incommensurability via institutional structure. Versions of the idea were put forward by Harrington in the 17th century, and by Montesquieu in the 18th; when the colonies began separately to create their own constitutions, a number of forms of balance were attempted.[viii] The legislative arrangements that were part of this

included unicameral (e.g. Pennsylvania) and bicameral (e.g. Massachusetts) experiments, with varying criteria of representation. Discussion of the future national government followed the latter, with much controversy. A central proposition in constitutional debates was that purely numerical criteria should determine representation in Congress, whilst quantitative criteria of substantial wealth should distinguish the Senate. As in classical models, citizens were taken to be (male) property owners, small and large. The colonies, however, lacked an aristocracy, and there was little historical depth to other cultural differences that were sometimes put forward as grounds for distinction (e.g. privileging founding groups, e.g. Quakers in Pennsylvania, proved unsuccessful). Occupational differences (e.g. servants, apprentices) might be separated from property owners, as in some classical models, on the grounds that they were not their own masters. Differences of material wealth were, however, rarely radical, and clear boundaries proved impossible to draw. Serious conflicts inevitably arose between landowning and merchant interests, e.g. on the relative advantages of particular forms of taxation. Ultimately there was no evident, single principle for isolating a property qualification as a basis of representation, and the national constitutional convention eventually discarded the idea. Instead, political franchise was grounded on numerical arrangements in which census counts were used to define equal representation of individuals (in representation districts making up Congress, and in voting the executive), and of states (in the Senate). This mechanism effectively abandoned incommensurability in favour of universal suffrage for adult, white males. Ironically, although the evils of factionalism remained a paramount issue in constitutional argument[ix], the compromise led directly to the rise of party politics. Bringing population arithmetic into the core of the state thus had the effect of giving a programmatic form to factionalism, rather than solving it. As is well known, the new doctrine of popular sovereignty founded on censuses was immediately compromised: first, by the arrangement that allowed southern states to count each slave as three-fifths of a person for representation purposes, despite their complete lack of rights; and second by the institution of 'gerrymandering', in which parties found means to control the distribution of representatives by rigging the boundaries of voting districts. Madison nonetheless argued in the *Federalist* that the bicameral system effectively solved the 'small states' dilemma of the classical model: the American republic would be a democracy in which the equality of states in the Senate, together with further checks via the executive and judiciary, would guarantee equality of rights, enabling the United States to expand, new state by new state, into the western frontier.

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The move to quantifying populations as a function of government was not just an American experiment with representative democracy. In Europe, the rise of the modern state, and ideas of national culture that accompanied it, integrated the several measures and models of the old population arithmetic, and put them on a different footing. France pioneered community statistics immediately following the Revolution, and a *statistique générale de la France* emerged under Napoléon. Between 1805 and 1872 national statistical offices were founded in most European states, charged with the collection and compilation of census data. Although there were many variations, particularly in multi-national empires, like Austria-Hungary, and in consequence of repeated impacts of war on national boundaries and constituency, 'population' nonetheless came to be identified principally with the ideal of the nation-state, in which the dominant national group asserted its priority in territorial, linguistic, and moral terms. Not only censuses, but registration systems, local government statistics, public health inquiries, and professional actuarial and statistical

bodies proliferated as population data became a basis of policy and contests over it. The major role of these inquiries in promoting health reforms that helped to drive mortality transition from the middle decades of the 19th century, and in exciting concern about fertility declines towards its end, is widely acknowledged. Demography thus emerged as an apparatus of centralised government and a potential science in the era of demographic transition, understood primarily as a national phenomenon. The term 'demography' was first used by Guillard to emphasize the subject's basis in public quantification.[x]

This conception of population was opposed, at every point, to the old piecemeal approach of independent political arithmeticians before 1800. Statistics, as the new methods of state came rapidly to be known, were supposed to be uniform and unbiased, because carried out by trained professionals using standard classifications, comprehensive enumerations, and formal data collection protocols. Statistics was promoted as a universal method, treating all individuals in the same way -- in striking contrast to the particularistic world of privilege and factional interests that typified the *ancien régime.* The individual would be cut away from the old networks, and viewed quantitatively on his own; populations defined in terms of individuals, and compounded of individuals, would be free of bias. No longer would the state and its individual members be trapped by the historical stasis of factions and alternating forms of polity. The rise of the modern nation-state would usher in a world order defined objectively y methods that facilitated popular sovereignty and material progress. The ideal of the rational behaviour of individuals as a norm in applying economic theory, was, of course, also bound up in these developments.

An essential methodological step underlying all of these changes deserves special note: the assumption that a state's population is closed for descriptive and policy purposes. Closure of course stood in radical contrast to the open methods of classical models. Closure was, moreover, multiple. First, a state was taken to be composed of a stable unity, a nation of related people residing within effectively permanent boundaries. Second, national censuses were accepted as an effectively exhaustive accounting of that population. Third, sub-populations constituted by the census were not defined in most cases by traditional lines of power, which shifted to include larger or smaller constituencies according to circumstance. They were, rather discrete classes of individuals defined by objective attributes such as age groups, occupations, and households. Fourth, closed analytical models (life tables, and later stable populations) became applicable to national data. The irreversible and unrepeatable nature of individual births and deaths provided the model for events suited to this closed methodology –- a model into which reversible and repeatable events characteristic of network populations, like migration and changing group membership, fit with great difficulty.[xi] This powerful logic of population closure was also, of course, apt to Malthus's principle of population. The identification of principle historical units of population with the boundaries of nation-states meant that the population on which each state depends for its development must, so to speak, be primarily home-produced. Hence the primacy that fertility steadily acquired in national policy as the modern era progressed: there could be too many people, as well as too few.

There was, however, a major exception to the profound shift from open to closed population thinking that characterised the 19th century. Darwinian natural selection incorporated Malthus's positive check as a mechanism that helps to ensure the fitness of populations by eliminating weaker members of the population. For natural selection to occur, however, populations could not be closed to mating with other groups, and there must also be genetic sources of variation in inheritable traits within a population, otherwise the remarkable variation observed in sub-populations of a

species would not be possible. Darwinian population thinking remains fundamentally open, since the mating networks that define sub-populations (i.e. Mendelian populations) expand and contract in changing environments. Laboratory conditions, crucial to the subsequent development of evolutionary theory, while enabling closed population modelling to be applied to Mendelian groups, did not extend to ongoing environmental changes. Nonetheless, the analysis of closed population data on population genetics, from Mendel to Fisher, was shown to be compatible in principle with Darwin's concept of selection in natural populations in the 1930s and 1940s, opening the way to research on DNA and the human genome later in the 20th century. Evolutionary theory and population biology remain of considerable theoretical interest to demography, as they provide the one area of science in which open and closed population thinking are both requisite.[xii]

Demography in the 20th century has likewise come up against the problem of integrating closed population models with data on the heterogeneity of populations in actual historical environments. Lotka, as is well known, provided the formal mathematics of renewal in closed populations, which he intended as a general theory encompassing human and other species. Although written expressly as a contribution to evolutionary theory, Lotka's analysis took no account of the problem of renewal of population heterogeneity, which was so central to Darwin's thinking. The programmatic post-war restatement of Lotka's approach by Ryder, Hauser and Duncan, in which formal analysis was proposed as the 'core' of a social science of population, also ignored this issue, and pushed evolutionary theory and population biology to the margins of demography.[xiii] The prevailing paradigm, meanwhile, became Notestein's 'demographic transition', which updated 19th-century ideas of progressive history by identifying modern population change as a function of economic development and modernization; the overriding focus on nation-states as primary aggregate units of change also followed 19th-century precedent, as did the utilitarian focus on individual rational choice. Issues fundamental to open population thinking, like migration and the changing identity and relationships of sub-populations, likewise remained a secondary interest, at best.

Our narrative at this point returns us to the multiple agendas outlined at the beginning of this paper. As the post-war paradigm provided by transition theory revealed a much more diverse picture of trends and mechanisms of modern population change, so the role of the individual in this process has increasingly begun to be reconsidered in relation to the contextual relationships that shape his or her action. Beneath the closed units and methodologies of national censuses and surveys, a range of population processes characteristic of network populations – like diffusion, epidemiology, family networks, migration – have again become visible and primary. The long view sketched in preceding sections, however, means that we now possess a different perspective in which to view these current issues and problems of explanation.

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Let us draw together briefly the several strands of the narrative line sketched in this paper. We began by noting that Notestein's 'long view' was not just about secular population trends and their socio-economic determinants. His long view also entailed assumptions about the nature of individual and collective action. Just as demographers have found Notestein's account of historical trends and their causes over-simplified, so a closer look at these assumptions is

warranted. The history of population and of thought about it is not just the history of demography. Population, from classical antiquity onward, is a fundamental conceptual component of theories of the state, civil society and their relation to individual agency. Once this wider framework is taken into account, the broad outlines of population thinking are reasonably clear. Up to the early 19th century, the continuity of classical models meant that populations were conceived as open both in nature and social practice; that is, the population of a given state or polity is composed of multiple, inter-related groups of different kinds, structured as limited but unbounded networks. From around the second quarter of the 19th century, a new prevailing approach, in opposition to earlier thinking, came to emphasize closed populations: nation-states as aggregates of individuals classified by discrete attributes and comprehensively or representatively compiled in censuses and surveys. Each concept has tended to privilege differing aspects of the nature and limits of individual agency, and possibilities linking individual and collective action.

Thus, in open population thinking the composition, structure and history of sub-populations in a state are primary. Individual members acting within these structures shape opportunities and constraints on action; relations within and between groups have the capacity to change the position and identity of individuals, sometimes radically altering the size and memberships of sub-populations, or of the state as a whole. Such patterns of association, in other words, define the kind of polity in which individuals live, and the character of its economy. Migration, marriage and status are population variables that tend to receive the most attention in open population thinking, as they provide readily manipulable options for individual and collective action. Often they give rise to factionalism, which acts as a powerful check on the stability and development of states and their constituent groups. Differing levels of fertility and mortality are not a primary focus of attention in open population thinking, as they are normally by-products of the logistics of networks. The dynamics of memberships, in other words, may be considered the social mechanics underlying changes in vital rates. Population arithmetic in the early modern era pioneered quantitative methods and models in the study of births and deaths within the framework of open population thinking, but was not applied to network memberships and their dynamics. It first became a major factor in the logistics of population, the individual, and the state not in respect of fertility and mortality, but in helping to solve problems of political representation.

Population arithmetic became a general function of the state in the 19th century, as a technique for structuring popular sovereignty, and an increasingly wide range of political, health and social issues. In its new guise, 'statistics', it was purported to provide an objective, universal method that swept away the inequalities preserved by networks and factionalism. As a new and *soi-disant* scientific methodology, statistics was very suited to ideas of progressive history that were at the same time replacing the stasis of alternating factional polities that characterised the classical model, and had been discredited by the policies of the *ancien régime.* Changing population, economic, and political changes could now be conceived as aggregate outcomes of so many independent individual agents. Or they could be stratified in terms of sub-populations no longer defined according to privileged interests, but as aggregates defined by standardised occupational, disease, or other categories. This paradigm, founded in reaction to the *ancien régime*, has flourished over a long period, from the early 19th to the late 20th century. The prevailing framework of the post-war era, the demographic transition, marked a stage that sought to extend the predominantly closed model of population systematically to data on all of population history, and throughout the contemporary world. Network dynamics as a fundamental component of population structure and change did not, however, cease with the end of the old political order. Its importance began once again to be recognised in the post war era as demographic transitions and pre-

transitional demographies revealed a profound heterogeneity that statistical methods, in the absence of observed network processes, are unable to explain. Attempts to revise the transition framework, beginning with the idea of diffusion, and subsequently including patterns of family and institutional support, migration, and constraints on life course opportunities – as well as new issues like AIDS and the relevance of genetic factors in ageing – have called renewed attention to the central importance of network mechanisms in population change. However separate these issues may appear substantively, they contain a common puzzle: the need to track population trends not only in terms of changing attributes of classes and individuals, but in terms of the way links between individuals and groups alter population composition, structure, and change.

With the benefit of hindsight, we can see that the two concepts or ways of thinking about population, while entailing important logical and methodological differences, are both necessary. The shorthand contrast adopted here – 'open' versus 'closed' population thinking – provides a starting point by showing that current demographic topics belong to a much older dialectic, and that explanation of population trends is in many cases likely to require both concepts. The need to integrate the two historical approaches to population is arguably the outstanding problem of population theory facing the 21st century. Hopefully we are now entering a third main era in the history of population thought, which will be characterised by concerted efforts to draw together the lessons of the previous two.

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[i] The classic statements on the transition noted above are: Thompson, W. S. 1929, 'Population', Am. Jrnl. Soc. 34,6,959-975; Notestein, F. W. 1945, 'Population – The Long View', In: T. Schultz, ed., Food for the World, Chicago: University of Chicago Press, pp. 36-57. Notestein's 'long' data are from Carr-Saunders, 1936. A. M. World Population, Oxford: Clarendon Press. The revision acknowledging the diversity of transitions begins with A.J. Coale 1969, 'The decline of fertility in Europe from the French Revolution to World War II', In: S. J. Behrmann, et al., eds. Fertility and Family Planning. Ann Arbor: Michigan University Press.etc. Recent examples of specific case studies include K. Fisher. 2008, Birth Control, Sex and Marriage in Britain 1918-60. Oxford: Oxford University Press; C. Bledsoe, 2002. Contingent Lives: Fertility, Time and Aging in West Africa. Chicago: Chicago University Press, and J. C. and P.T. Schneider, 1996. Festival of the Poor: Fertility Decline and the Ideology of Class in Sicily 1860-1980. Tucson: University of Arizona Press.

[ii] Historical research in the last three decades has altered profoundly our understanding of the contexts in which demography emerged, from the 17th to the 20th century. An established literature now covers: the history of population biology and its role in evolutionary theory (e.g. Mayr, E. 1982. The Growth of Biological Thought. Cambridge, Mass: Belknap Press; Lewontin, R. 2001. The Triple Helix Gene, Organism, and Environment. Cambridge, Mass: Harvard Univ. Press.); the 'probabilistic revolution' (e.g. Geigerenzer, G. et al. 1989. The Empire of Chance: How Probability changed Science and Everyday Life. Cambridge: Cambridge Univ. Press); the rise of statistics (e.g. Anderson, M. J. 1988 The American Census. New Haven: Yale University Press; Bourguet, Marie-Noelle. 1989. Déchiffrer la France. La statistique départmentale a l'époque napoléonienne. Paris: Editions des archives contemporaines. Porter, T. M. 1986. The Rise of Statistical Thinking, 1820-1900. Princeton: Princeton University Press; Desrosières, Alain. 1993. La politique des grands nombres. Histoire de la raison statistique. Paris: Éditions La Decouverte.); the public health movement (e.g. Szreter, S. ed. 1991. The General Register Office of Enalgnd and Wales and the Public Health Movement 1837-1914. Special Issue of Social History of Medicine 4,3:401-537) the impetus of humanism in early modern population arithmetic (e.g. Charbit, Y. The Classical Foundations of Population Thought from Plato to Quesnay; Kreager, P., 1991. "Early Modern Population Theory: A reassessment.", Population and Development Review 17(2): 207-227; 2003 'Population Thought, History of', Encyclopedia of Population, Vol. I, P. Demeny and G. McNicoll, eds., MacMillan: New York, Pp. 772-785; 2005, 'John Graunt', Encyclopaedia of Social Measurement, ed. K. Kempf-Leonard, San Diego: Elsevier, Vol. 2, Pp. 161-166.; 2008, 'Aristotle and Open Population Thinking' Population and Development Review 34,4, 599-630.

[iii] On classical influences on the republican tradition, see e.g. J. G. A. Pocock. 2003. The Machiavellian Moment: Florentine Political Thought and the Atlantic Republican Tradition. Princeton: Princeton University Press.

[iv] Westergaard, H. 1932. Contributions to the History of Statistics London; Glass, D. V. 1973. Numbering the People. Farnborough: Saxon.; Dupâquier, J. and M. 1985. Histoire de la Démographie. Paris: Libraire Académique Perrin.

[v] Robbins, C. 1959. The Eighteenth-Century Commonwealthmen. Cambridge: Harvard University Press; Bailyn, B. 1976. The Ideological Origins of the American Revolution. Cambridge: Belknap.

[vi] Graunt, John. 1662. Natural and Political Observations made upon the Bills of Mortality. London. (reprinted 1973 in The Earliest Classics: Pioneers of Demography. ed. P. Laslett. Farnborough, Hants: Gregg International.)

[vii] See not iv. More recently, A.Rusnock, 2002. Vital Accounts : Quantifying Health and Popultion in Eighteenth-Century England and France. Cambridge: Cambridge University Press. There were, however, exceptions like Leibniz, de Moivre, and Euler. See for example J-M. Rohrbasser and J. Véron, 2001. Leibniz et les Raisonnements sur la Vie Humaine. Paris: INED.

[viii] See for example J. R. Pole, 1969. Political Representation in England and the Origins of the American Republic. London: MacMillan.

[ix] [A. Hamilton, J. Madison, J. Jay] 2005. The Federalist, ed. J. R. Pole. Indianapolis: Hackett.

[x] Guillard, Achille. 1855. Éléments de statistique humaine ou démographie compareé. Paris: Guillaumin et Cie. ; More generally on the issues raised for population arithmetic by the rise of nation-states and nationalism, P. Kreager. 1992. "Quand une population est-elle une nation? Quand une nation est-elle un état? La démographie et l'émergence d'un dilemme moderne, 1770-1870." Population 47, 6, 1639-1656.

[xi] Coleman, D. A. 1994. 'Migration as a Primary Force in Human Population Processes', in M. Macura and D. A. Coleman, eds. International Migration. UN Economic Commission for Europe, Economic Studies No. 7. New York: United Nations. Nineteenth-Century attempts to fit ethnic and national identities into a *statistique ethnographique* are discussed in P_. Kreager 1997. 'Population and Identity', in D. Kertzer and T. Fricke, eds. Anthropological Demography. Chicago: Chicago University Press, pp. 139-174.

[xii] The development of Darwinian population thinking in the 20th century, and its relation to contemporaneous demographic developments, is discussed in a separate paper, 'Darwin and Lotka: Two Concepts of Population', currently submitted for publication.

[xiii] Hauser, P. and Duncan, O. D. 1959. The Study of Population. Chicago: Univ. Chicago Press.
Ryder, N. 1964. 'Notes on the Concept of a Population' Am. Jrnl.Soc. 69, 5, 447-463.