Journal of Hellenic Studies 123 (2003) 120-40

THE GREEK DEMOGRAPHIC EXPANSION: MODELS AND COMPARISONS*

Abstract: For much of the first millennium BC, the number of Greeks increased considerably, both in the Aegean core and in the expanding periphery of the Mediterranean and Black Sea regions. This paper is the first attempt to establish a coherent quantitative framework for the study of this process. In the first section, I argue that despite the lack of statistical data, it is possible to identify a plausible range of estimates of average long-term demographic growth rates in mainland Greece from the Early Iron Age to the Classical period. Elaborating on this finding, the second section offers a comprehensive rebuttal of the notion of explosive population growth in parts of the eighth and seventh centuries BC. In the third section, I seek to determine the probable scale and demographic consequences of Greek settlement overseas. A brief preliminary look at the relationship between population growth and the quality of life concludes my survey. The resultant series of interlocking parametric models is meant to contextualize the demographic development of ancient Greece within the wider ambit of pre-modern demography, and to provide a conceptual template for future research in this area.

1. CONTEXTS, TRENDS, AND ORDERS OF MAGNITUDE

THE socio-cultural evolution and geographical expansion of Greek civilization went hand in hand with population growth and demographic change. From the vantage point of historical demography, these processes must be viewed in context, as part of developments that spanned a whole millennium from the late Bronze Age to the Hellenistic period. Upon attaining a new level of population density, economic output and social complexity by the thirteenth century BC, Greece subsequently appears to have experienced a substantial demographic contraction with concurrent losses in production and complexity, conventionally known as the Dark Age. Following a nadir in the tenth century BC, recovery was underway in the ninth century before accelerating in the eighth. Raising population numbers and production significantly beyond Mycenaean levels, demographic and economic growth continued into the late Classical period before beginning to peter out in the fourth or third centuries BC.[1]

In this respect, Greece conformed to the typical cyclical pattern of pre-modern growth and development: a growth phase would often begin by regaining ground lost in a preceding slump before it produced net growth and eventually stalled in stagnation or depression, followed by a similar cycle taking off from a higher base than the preceding one and eventually scaling a higher peak.[2] Secular growth cycles of this kind are well attested for more than two millennia of European and Chinese history. In Europe, the growth phase of the Roman period ended in stagnation and decline (*c.* AD 200-700) followed by slow (*c.* 700-1000) and then much more rapid growth (*c.* 1000-1300), stagnation (*c.* 1300-1340s), sharp contraction (*c.* 1340s-1450), recovery and limited net growth (*c.* 1450-1600), renewed stagnation (seventeenth century), and further growth. It was only in the eighteenth century that incipient Modern Economic Growth began to break the traditional cyclical sequence. Similar sequences are attested for China from the Han period onwards.[3]

* I am greatly indebted to Jonathan Hall, Ian Morris, Robin Osborne and an anonymous reader for detailed comments on an earlier version of this paper.

[1] For a new summary, see Morris (forthcoming b). Highland populations developed at a different pace, expanding later and peaking in the Hellenistic and Roman periods: see Bintliff (1997b, 1998).

[2] Judging from the archaeological evidence, the Dark Age slump appears to have been more pronounced than many other cyclical depressions. I should note in passing that development in Crete followed a different chronological pattern.

[3] For general surveys of European development, see McEvedy and Jones (1978); Grigg (1980); Livi-Bacci (1992). For China, see Chao and Hsieh (1988).

Demographic growth has moved at different speeds and repeatedly in different directions in the short, medium and long terms. Interannual fluctuations have been driven by short-lived climatic, epidemic or political events such as poor weather conditions, flare-ups of infectious disease and war. While significant in terms of the relative scale of variability from one year to the next, these ups and downs tend to be drowned out in broader averages.[4] At the opposite end of the spectrum, in the long run as measured in millennia, population and production have grown steadily with increasing aggregate knowledge. Although this underlying trendline rate of growth accelerated incrementally over time as a function of the positive correlation between population size or density and technological progress, it remained extremely low up to the Industrial Revolution.[5]

For the historian, it is movements of the medium term, unfolding over a few centuries or within conventionally defined historical 'periods', that hold the most interest. Undulating patterns of growth are the result of a combination of exogenous and endogenous determinants of expansion and depression. Population equilibrates with resources at a level mediated by technology and conventional living standards. While technology – very broadly defined as a system of production comprised of productive techniques and institutional arrangements – limits economic output and therefore population, population number and density *per se* tend to spur technological change in response to declining marginal productivity. In consequence, productive capacity is progressively enhanced by improvements in the stock of knowledge, enabling further population growth.[6] Prior to the nineteenth century, economic progress was not in the long term dissociated from demographic growth beyond marginal improvements in conventional living standards (which are to some extent a by-product of more elaborate productive technologies).[7] Thus, population would normally tend to approach the saturation point – i.e. its largest feasible size – circumscribed by the prevailing system of production and living standards.[8]

Whether historical populations ever came close to full saturation level remains doubtful. The balance of the evidence suggests that technological progress and institutional change kept raising the ceiling for demographic growth by incrementally expanding productive capacity. Thus, 'overpopulation' relative to a *fixed* resource base is unlikely ever to have been a genuine historical phenomenon since even in 'natural fertility' regimes, social conventions will tend to regulate and curb population growth in response to economic opportunities.[9] In reality, contractions of the resource base, not uncontrolled reproduction, were the principal cause of 'overpopulation'. At most, latent 'overpopulation' might arguably be diagnosed in cases in which population densities close to current saturation levels rendered a community perilously exposed even to minor and temporary resource deficits.[10]

Major demographic contractions are commonly induced by partly or fully exogenous forces such as communicable disease and climatic change. Warfare and other forms of violent unrest and disruptions of institutional frameworks may contribute significantly beyond the local level only if they occur with unusual intensity; the Mongol expansion is a popular example. By contrast, economic conditions have little direct impact on mortality. Recent studies of early modern Europe have shown that although (or in fact because) real wages and population size are inversely

[4] Galloway (1988) is the most comprehensive survey.

[5] For the link between population and progress, see Kremer (1993); Simon (1986) 61-79; (2000).

[6] Boserup (1965) and (1981) are the classic statements on the relationship between population pressure and development. On the ubiquity of declining marginal productivity in this context, see Wood (1998) 105-6.

[7] For secular changes in living standards with advances in technology, *cf.* Lee (1986b) 98-100.

[8] See Wood (1998) 109-10 for a formal demonstration that stable equilibria are only possible at saturation point; *cf.* also Lee (1986a).

[9] E.g. Mason (1997) 447-8; Lee and Wang (1999). *Cf.* also Schofield (1989) for the nexus between marriage rates and real incomes.

[10] To be of any use at all, this diagnosis must be very restrictively applied: otherwise, since substantial segments of all agrarian societies were vulnerable to intermittent harvest failures, every pre-modern society would have to be defined as 'overpopulated'.

correlated, it was exogenous mortality change rather than a fall in real incomes that caused population loss.[11] Thus, it appears that phases of stagnation or recession may largely be attributed to forces that are not entirely exogenous merely in so far as they are boosted by factors such as high population density (which expedites epidemics) or low elasticity in responding to resource scarcity (which exacerbates climatic deterioration), even though war can be a less clear-cut case. This is not the place to enter the discussion about the causes of the Greek Dark Age depression. Suffice it to say that while epidemics were accountable for the most dramatic demographic contractions or collapses (such as the plague pandemics of the sixth/seventh and fourteenth/fifteenth centuries AD, not to mention smallpox and measles in the post-Columbian Americas), climatic change and political turmoil can likewise be linked to substantial population losses.[12] What matters here is that in the Dark Age, population density must have dropped below sustainable levels as determined by existing productive technology. On theoretical grounds, one would expect a system of production to regress (in terms of total output) together with falling population density: the extent to which this happened in Greece (involving shifts between cerealiculture and pastoralism) is still debated.[13] In any case, recovery from a recession would be easier to achieve than net growth. The loss of existing practical knowledge need not have been total (unlike in the case of recondite skills such as scribal literacy), and thanks to Greek contacts with more developed regions in this period could easily have been mitigated even if it indeed occurred.[14] As a result, the low level of Dark Age development must have been unstable and population was destined to rebound.[15] From a demographic perspective, the fact of recovery once the factors that were responsible for the contraction had waned is neither surprising nor in need of explanation. Rather, it is the scale and the duration of the ensuing expansion that merits attention.

Owing to the lack of quantifiable data from earlier periods, growth rates can only be derived from final population size. Recent estimates for the total population of mainland Greece south of Thessaly and Epirus including the Sporades and Cyclades in the Classical period converge on approximately 2 million.[16] Given that slaves are included in this tally, not all of these individuals would descend from early Iron Age Greeks, and 2 million can be no more than a convenient (and somewhat generous) target figure for computational purposes. In any case, it should be noted that a reasonably higher or lower figure would have little impact on the calculation of long-term growth rates.

Although the scale of long-term growth in mainland Greece cannot be determined with precision, it is easy to show that any even remotely credible estimate inevitably falls within a relatively narrow band of probability. If the population grew at an average annual rate of 0.2% for 600 years from the tenth to the fourth centuries BC and reached 2 million at the end of that period, it would have numbered some 600,000 at the beginning. (Here and in the following, different numbers could be substituted at the same ratio.) At 0.3% per year, the initial population

[11] Lee (1986b). For further findings, see Tsouhoulas (1992); Reher and Osona (2000). A comparable linkage of exogenous mortality shock, demographic contraction and rising real wages can already be discerned in Roman Egypt from the 160s to the 260s AD: Scheidel (2002).

[12] E.g. McNeill (1977) (epidemics); Galloway (1986) (climate); Chu and Lee (1994) (dynastic crises in China). See Walloe (1999) for the theory that bubonic plague may have been responsible for the post-Mycenaean contraction.

[13] See Tandy (1997) 38-42 for a recent survey, arguing for significant regression; but note the scepticism in Cherry (1988) 26-30. For the general principle, see Boserup (1965) 62-3.

[14] *Cf.* Osborne (1996a) 24-8.

[15] On stable and unstable equilibria, see Wood (1998) 110, 113; *cf.* also Lee (1986a).

[16] Corvisier and Suder (2000) 32-4. Thessaly, Epirus and Macedonia are thought to have been inhabited by another 1 to 1.5 million (34). While these figures may seem modest by modern standards, it should be borne in mind that at that time, Egypt, endowed with vastly superior natural resources, probably supported not more than 4 or 5 million people, and that the population of the Achaemenid empire may have peaked at around 25 million (for bounding estimates, see McEvedy and Jones (1978) 125 (low) and Aperghis (2001) 73-7 (high)). The size of the population of Ionia is obscure: see Cook (1982) 218 for some estimates.

stands at 330,000, and at 0.4%, it is as low as 180,000, requiring it to increase elevenfold between the tenth and the fourth centuries BC. At 0.5%, it shrinks to a mere 100,000, very roughly at Neolithic levels, and higher growth rates would leave Dark Age Greece virtually uninhabited. Therefore, it is unlikely that the mean long-term growth rate deviated significantly from a range of between perhaps 0.25 and 0.45% per year.[17]

There are two ways of putting this estimate into perspective. First, we must allow for the fact that not all of this increase represented net growth, since part of it merely helped regain late Bronze Age levels. Assuming that Mycenaean Greece did not support more than 0.5-0.7 million inhabitants, an increase to 2 million between the thirteenth and the fourth centuries BC translates to an average long-term growth rate of somewhere around 0.15±0.02% per year.[18] Again, wildly different assumptions are hardly feasible, and the proposed value is compatible with later estimates. Between AD 200 and 1800, annual long-term growth in Europe and China amounted to 0.1%, a rate which in both cases accommodated multiple demographic contractions.[19]

Comparison with growth rates in other pre-modern populations recovering from demographic depressions provides additional context. From AD 1000 to 1340, the European population increased by about 0.25-0.3% per year, and at 0.3% from AD 1500 to 1600 following the Black Death. Smaller regions could diverge from the overall trend: England and France may have grown by 0.4-0.5% a year between AD 1100 and 1340.[20] These data tally well with the estimate for ancient Greece, although it deserves notice that in the latter case, expansion appears to have been a more prolonged process covering up to six centuries, and may well have outpaced European demographic growth from, say, AD 700 to 1300. All in all, both a trendline growth rate between the late Bronze Age and the late Classical period of around 0.15% and a recovery and expansion rate of between 0.3 and 0.45% from the tenth to the fourth centuries BC seem credible in the light of comparative evidence. Although these figures are only approximations, I must emphasize that due to their logical implications for overall growth, substantially divergent rates (of, say, 0.05 or 0.25% from the thirteenth to the fourth centuries BC, or of 0.1 or 0.6% from the tenth to the fourth) are simply not possible.

The results of what may be the most detailed attempt to reconstruct population growth in one region of ancient Greece are broadly consistent with these estimates. In the southern Argolid, population is assumed to have increased tenfold from the eighth to the fourth centuries BC, at a mean annual rate of about 0.45-0.5%. As immigration is thought to have contributed to this development, the natural growth rate would have been somewhat lower and within the bounds of my general estimate. Overall increase from the Mycenaean to the Classical periods is put at 0.2% per year, slightly higher than predicted. Needless to say, the margin of error in these calculations is considerable, especially for the more distant periods, and some degree of regional variation must have occurred.[21]

More importantly, average growth rates would vary over time. In principle, we might expect them to have been lower close to the beginning and the end of the growth phase than in the middle.[22] Yet it is equally possible that this phase was broken up into secondary growth cycles (*cf.* below, FIG. 2). For example, at an overall growth average of 0.4% per year from 1000 to

[17] McEvedy and Jones (1978) 110 reckon with 1 million people within the modern borders of Greece *c.* 1250 BC, which can only be a guess. If this figure is anywhere near correct, a Dark Age population of 600,000 might be too close to Mycenaean levels to justify a long-term growth rate of as low as 0.2%. Note, however, that survey data may conceivably exaggerate the scale of Dark Age depopulation: *cf.* Bintliff, Howard and Snodgrass (1999) 159.

[18] See above, n.17. For what they are worth, the calculations undertaken by Bintliff (1985) suggest that the population of Boeotia in the Classical period was 4.5 times as large as in the Bronze Age. The implied mean long-term growth rate is 0.18% per year.

[19] Scheidel (forthcoming).

[20] Livi-Bacci (1992) 31 (Europe); Grigg (1980) 53 (England, France).

[21] Jameson, Runnels and van Andel (1994) 562-3.

[22] *Cf.* Sallares (1991) 91, and below, Fig. 3.

400 BC, the Greek population could have increased by 0.3% per year from 1000 to 800 and from 700 to 500, and by 0.6% from 800 to 700 and from 500 to 400, and achieved the same final size as if it had grown at a steady rate of 0.4% throughout that period.[23] Again, the flexibility of growth patterns may have been considerable but must not be overrated: annual rates of 1%, if they were realistic at all, could not have been attained for more than a few generations during the period in question. Thus, if we were to substitute a rate of 1% for the 0.6% rate posited in the above scheme, overall growth between 1000 and 400 BC would more than double, implying a Dark Age population of 85,000. Alleged annual growth rates of 2, 3 or 4% that have repeatedly been mooted in the literature (see below, section 2) entail even more serious implications and would compel us to adopt a bizarre saltationist model of punctuated equilibria with short growth spurts and no growth for most of the time: at 3% per year, all growth that could possibly have occurred between the tenth and the fourth centuries BC could be compressed into a single century, and the same may even be possible for a 2% increase.[24] I am not aware of any comparative evidence for whole countries that would exhibit such a slanted growth distribution.

Archaeological remains are a poor substitute for statistical material but the only evidence that may allow us to trace demographic trends. Temporal variation in the frequency of countable artifacts, such as the number of sites or the intensity of surface scatter, are often interpreted as reflecting changes not only in settlement patterns but also in absolute population size. Beyond the most general probabilistic assumptions, it remains difficult to decide to what extent more or fewer sites or scatter mean more or fewer people. Shifts in settlement practices and exploitation structures may account for a good deal of observed variation.[25] Yet even in the absence of a stable ratio of settlement growth or dispersal on the one hand and population expansion on the other, it is worth noting that the use of archaeological data as a broad index of population trends has now in one case been validated by a reasonably close match between the demographic implications of a field survey and the evidence of original census records.[26]

As is well known, a general shortage of sites in the Dark Age was followed by a gradual increase from the tenth century BC onwards.[27] In central Greece, expansion into the countryside picks up around the mid eighth century BC, although regional differences are visible.[28] Given signs of high levels of cultic activity, the scarcity of certain types of finds from the seventh century BC (especially in Attica and Euboea) cannot readily be explained in terms of a demographic slump, and continued growth remains plausible.[29] Snodgrass distinguished between two ideal types of rural settlement dispersion, which often occurred either in the form of gradual expansion from the Late Geometric and Archaic periods onwards (termed Model A) or more abruptly in the fifth and fourth centuries BC (Model B). Political factors may have been instrumental in creating these differences which may in any case conceal underlying similarities in demographic development: Model A expansions continued in the Classical period, while Model B dispersals must have been preceded by a build-up of power (accounting for nucleated settlement patterns) as well as population.[30] Across the Greek lowlands, settlement density peaked in the fifth

[23] According to the reconstruction by Jameson, Runnels and van Andel (1994) 563, the population of the southern Argolid grew by 0.6-0.7% a year between the Late Geometric and the (presumably late) Archaic periods, scarcely expanded in the fifth century BC, but surged again in the fourth century BC (at *c.* 0.5% a year).

[24] At 3% per year, a population would grow 20 times within 100 years (e.g. from 100,000 to 2 million); at 2%, eight times (e.g. from 250,000 to 2 million).

[25] E.g. Alcock (1993) 33-92; for a general survey, see now Sbonias (1999a). *Cf.* also Pettegrew (2001).

[26] Sbonias (1999b) 235 figs 16.6-7, on Ottoman Boeotia.

[27] For a recent survey of some of the Dark Age evidence, see Eder (1998). The findings for subsequent centuries have been gathered by Morris (1998a). Site counts in Attica, the Argive plain and the Corinthia suggest growth from the tenth century BC onwards: Morris (1987) 157 fig. 54. See also the survey data summarized by Bintliff (1997b) 2-17.

[28] Morris (1998a) 16. For regional variation, *cf.* Bintliff and Snodgrass (1997) 177 (Boeotia).

[29] Osborne (1989) discusses the evidence for seventh-century BC Attica. See also Morris (1987) 158-67; (1998a) 19, 77; Sbonias (1999b) 222 fig. 16.4.

[30] Snodgrass (1987-89) esp. 56, 62-3.

and especially the fourth centuries BC.[31] The Classical shift to dispersed settlements may have been associated with changes in agrarian practices that produced higher yields but also required higher labour inputs and increased risk.[32] This development, together with more specific signs of intensification such as limited terrace-building, is strongly suggestive of rising population pressure: probably responding to Archaic demographic growth, these changes may initially have created new surpluses but also facilitated further population increase, thereby curbing intensive growth and pushing settlement density closer to saturation levels. In the most general terms, the violent upheavals of the late fifth and fourth centuries BC are consistent with significant population pressure, in much the same way as in later episodes of Eurasian history.[33]

The nature of the archaeological evidence makes it hard to decide which of two idealized models of demographic growth is closer to reality. In the simplest scenario, the growth rate gradually rises and declines over the course of six centuries (FIG. 1). Sustained growth over such an extended period seems unusual, and it is perfectly possible that the Greek demographic expansion was articulated into two distinct growth cycles linked by an intermittent slowdown (FIG. 2). Somewhat counterintuitively, however, an early growth spurt in the eighth century BC can be shown to generate a *smaller* Archaic population than the unimodal model (FIG. 3).

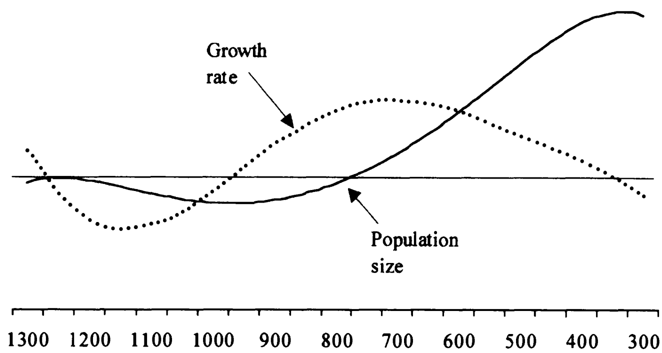


FIG. 1.
Demographic trends in Greece,
1300-300 BC:
unimodal growth cycle.*

*Here and in the following two figures, the middle line represents zero population growth and the population size of the thirteenth century BC

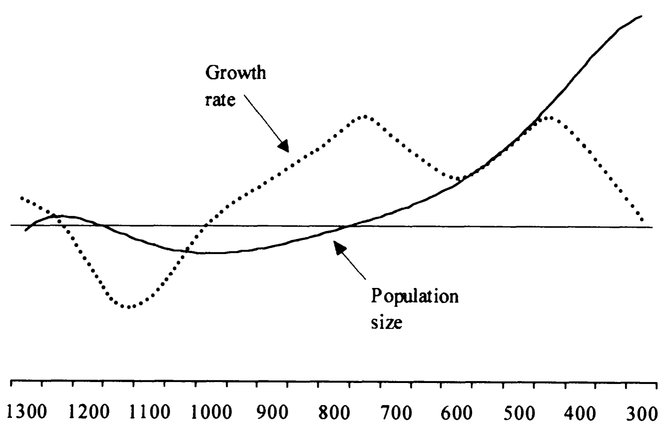


FIG. 2.
Demographic trends in Greece,
1300-300 BC:
bimodal growth cycle.

[31] For fourth-century peaks, see, e.g., Jameson, Runnels and van Andel (1994) 383-94, 563 (Attica, Argolid); Bintliff and Snodgrass (1997) 177-8 (Boeotia).

[32] See Morris (1994) 363-4 for a concise summary; also (1998a) 77-8. It is unclear whether a similar process simultaneously unfolded in Sicily: *cf.* briefly de Angelis (2000) 140-1.

[33] *Cf.* Goldstone (1991).

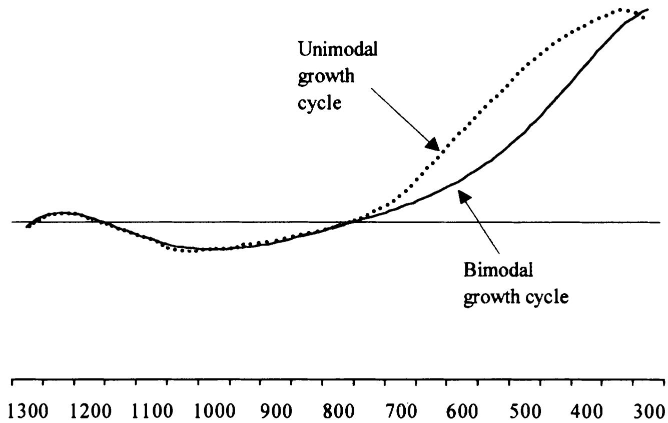


FIG. 3.
Changes in population size according to different growth cycles.

The conspicuous dispersal of rural settlement in the Classical period may seem to lend support to the second variant. However, we must allow for substantial population growth even as its *rate* declined: a given annual amount of population increase can be maintained at progressively lower relative rates of growth. If the agrarian intensification of the fifth and fourth centuries BC was induced by population pressure, the scale of the Classical dispersal may well be a poor guide to the actual extent of further demographic growth. As Sbonias points out, 'a picture of a dense settlement pattern overestimates growth rates, as the large number of small sites is disproportionate to the population size associated with them'.[34] In theory, Classical dispersal may merely have been the last leg of a continuous post-Dark Age expansion that need not have left room for a dramatic population increase between the late sixth and the fourth centuries BC.[35] Since regardless of its scale, the demographic contribution of the Archaic period is necessarily overshadowed by the more visible dispersal process of the fifth and fourth centuries BC, it is not inconceivable that much of the build-up supporting Classical population numbers took place in the seventh and sixth centuries BC. Unfortunately, this contribution is not susceptible to either absolute or relative quantification. Even though average growth rates may have varied considerably from one century to the next, perhaps by as much as 100 or even 200%, we must be aware of the logical corollaries of more adventurous assumptions (*cf.* above). The more extreme a claim is, the better the evidence to support it needs to be. As I will show in the next section, there is no good reason to believe that such evidence exists.

2. ATHENIAN POPULATION GROWTH IN THE EIGHTH CENTURY BC: EXPANSION OR EXPLOSION?

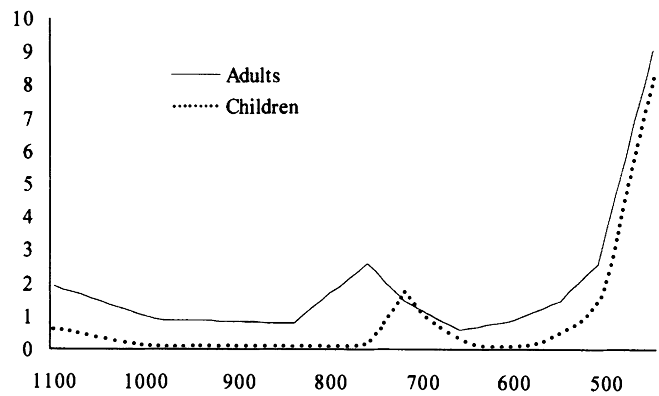
Over the past quarter-century, the character of demographic development in eighth-century BC Attica has been much debated. This is of relevance in so far as any assessment of Archaic population growth critically depends on our understanding of what had happened in the preceding century: thus, evidence for truly explosive population growth in the eighth century BC would leave less room for substantial increases in the seventh and sixth centuries BC (*cf.* above). Moreover, a putative sharp demographic upsurge in the eighth century BC has repeatedly been considered a driving force behind various social, economic and political transformations of that

[34] Sbonias (1999b) 227, who adds that 'in the Southern Argolid small Classical farmsteads found by the survey could represent 5% of the total population estimated, rising to 16% if four times as many sites remained to be found' (after Jameson, Runnels and van Andel (1994) 55), and that 'in Boiotia the figure is 20%' (after Bintliff (1997a)). See also Osborne (2001). The controversial question of whether small rural sites were residential farms introduces further uncertainty (e.g. Osborne (1987)): the spread of seasonal dwellings could not be taken to indicate any net increase in population numbers.

[35] Because of its imperial endeavours, fifth-century BC Athens may well have been a special case with regard to its very substantial demographic expansion.

period.[36] In 1977 and 1980, Anthony Snodgrass observed that the number of burials in Attica (and somewhat less so in Argos) rose precipitously between 780 and 720 BC. Reading the grave count as an index of actual mortality, he calculated that the Athenian population increased by 3-4% per year during the 60 or so years in question.[37] This straightforward extrapolation was rejected by Ian Morris, who demonstrated that a temporary surge in sub-adult burials in the late eighth century BC exaggerates the scale of the observed increase (FIG. 4), and sought to explain both the temporarily enhanced mortuary visibility of children and the peak in the number of adult burials in terms of short-lived changes in socio-political structure and commemorative practices. In his view, variation in the recovery rate of graves undermines any reconstruction of demographic change derived from the observable incidence of burials.[38] A few years later, Robert Sallares took issue with Morris' aside remark that annual growth rates as high as those suggested by Snodgrass were 'rather improbable', maintained that rapid growth spurts were demographically feasible, and proceeded to develop a complex argument in support of a demographic explosion in the eighth century BC triggered by economic opportunity and the collapse of an age-class system that had thus far constrained fertility.[39] Most recently, David Tandy tried to steer a middle course by restricting his demographic interpretations of the funerary record to adult burial counts in order to control for fluctuations in the representation of children, arriving at an estimate of 1.9% annual population growth from 780 to 718 BC.[40] At the same time, Robin Osborne expressed doubts about the existence of any sharp population increase in the eighth century BC.[41]

FIG. 4.
Annual numbers of adult and child burials at Athens, 1100-450 BC
(Source: Morris (1987) 73 fig. 22)



I will argue that these burial counts are unlikely to mirror demographic events and in any case cannot be used as a basis for quantitative estimates of population change. Two separate issues are at stake: (1) whether judging by comparative evidence, short-term growth rates of 2-4% per year are possible in principle, and (2) whether the mortuary record may be taken to reflect any such increases.

In support of their view that rapid growth phases are not unknown and may therefore also have occurred in ancient Greece, Sallares and Tandy mix comparative data drawn from colonial settings and recent developing countries without appreciating that material from these two very different sources cannot be treated as equivalent and interchangeable, and that only findings from the former context might possibly be of any relevance to the issue in question.[42] While it

[36] E.g. Snodgrass (1980); Tandy (1997).

[37] Snodgrass (1977) 10-16; (1980) 22-4, 43.

[38] Morris (1987) 57-109. See esp. 100-1 for evidence suggestive of significant changes in recovery rates between *c.* 700 and 510 BC. Despite some criticism, subsequent research has largely sided with Morris' reading: see Morris (2000) 208 for references, and *cf.* Morris (1992) 78-80, and (1998b), responding to critics.

[39] Sallares (1991) 50-192, esp. 86-90 and 122-9 against Morris (1987) 72.

[40] Tandy (1997) 23-4, 46-58.

[41] Osborne (1996a) 74-81.

[42] Sallares (1991) 86, 90; Tandy (1997) 55-8.

is true that in recent decades, some developing countries attained annual growth rates of the order of 3%, this phenomenon is typical of the early stages of the Demographic Transition. In traditional populations with high mortality and fertility, exogenous input of medical knowledge may cause death rates to plummet quite suddenly, whereas reproductive behaviour adjusts more slowly to these changing circumstances. At that transitional stage, birth rates may temporarily be twice as high as death rates, resulting in rapid population growth until subsequent fertility decline gradually reduces the imbalance of births and deaths. Since no comparable process could have taken place in antiquity, examples of rapid growth in Third World countries are irrelevant to our understanding of Greek population history.[43]

Evidence of demographic expansion in newly settled territories may be more pertinent here. In North America in the eighteenth and nineteenth centuries AD in particular, an abundance of natural resources is known to have translated to precipitous growth of immigrant populations. Annual rates of natural growth of 2-3% were not uncommon for a number of generations.[44] It is worth pointing out that these developments were not associated with dramatic changes in life expectancy or marital fertility. Moderate adjustments in the average length of married life of women appear to have been sufficient to generate substantial net growth. For much of the eighteenth century, the number of French settlers in Canada increased naturally by over 2% per year while the population of France stagnated. The greatest difference concerns the rate of female remarriage: in Quebec, 70.4% of all women had remarried by age 50, compared to 48.8% in France. Colonial women married slightly earlier than in Europe, at a mean age of 20.9 instead of 23 years; probably thanks to lower levels population density, their mean life expectancy at age 20 exceeded the European French rate by 4.6 years.[45] By contrast, Sallares feels compelled to explain the supposed population explosion in eighth-century BC Attica with reference to a breakdown of an otherwise unattested traditional age-class system that had regulated marriage and hence fertility.[46] This thesis has attracted little support, although not necessarily for the right reason[47] – after all, we could not reasonably expect pre-eighth-century conventions to be reliably documented even if they had in fact existed. In my view, his thesis is not necessarily incorrect but merely unnecessary. The American data show that relatively minor modifications of social conventions and mortality patterns may result in large changes in the rate of population growth.

But were economic and demographic conditions in eighth-century BC Attica similar to those in colonial North America? Is this a plausible analogy? The Athenians did not expand across virgin soil. Even so, given that Dark Age Attica was probably only sparsely populated, significant improvements in the resource base and productive technology (brought about by a more benign climate, new crops, enhanced security, better equipment, etc.) would almost inevitably trigger demographic growth commensurate with the gains in economic potential. Historical populations recovering from prolonged depressions have certainly exhibited substantial growth rates. However, the pace of these expansions must not be exaggerated. As noted in section 1, continental rates of 0.3% per year and national rates of 0.4-0.5% are known from mediaeval and early modern Europe, almost an entire order of magnitude lower than the rates envisioned by Snodgrass, Sallares and Tandy. Yet it is possible that smaller geographical units may deviate from these broad averages: after all, Attica covers only a thousand square miles.

In this connection, census data from early modern Greece may be of particular interest. Following the Black Death of the fourteenth and fifteenth centuries AD and warfare between

[43] Sallares' reference to Madagascar in 1966, with Crude Death and Birth Rates of 25 and 46 per 1,000, respectively ((1991) 90), is a case in point. Tandy (1997) 56-7 lists several meaningless parallels.

[44] E.g. McEvedy and Jones (1978) 286; Sallares (1991) 86; Tandy (1997) 56.

[45] Livi-Bacci (1992) 56-61.

[46] Sallares (1991) 160-92.

[47] For bibliographical references to critical reactions, see Scheidel (1996) 210 n.17, to which I need to add Osborne (1996a) 77-8.

Byzantines, Franks and Turks, the population of central Greece increased considerably in the late fifteenth century and for much of the sixteenth century AD, at the same time as Europe as a whole experienced a demographic upturn. Machiel Kiel finds that according to Ottoman records, the number of households in Athens rose at an average annual rate of 1.1% between AD 1506 and 1570. The mean rate was the same for a sample of six villages in Attica and as high as 1.45% from AD 1528 and 1570. In a group of 16 villages in Boeotia during the same period, the number of households grew by 1% per year, compared to 0.45% in four other villages, and 0.25% in a town and three villages in the same region. The corresponding rate in East Locris was 0.4%.[48] Tax reports that can be linked to some of these household tallies show that per capita output fell as population increased.[49] After AD 1570, the number of households declined sharply, although changes in registration style may contribute to this picture.[50] Moreover, the possibility that coverage improved during the sixteenth century AD as the Ottoman administration matured and that new households – set up by newly independent couples – may have been smaller than average should caution us against taking the extrapolated population growth rates at face value. Nevertheless, these records suggest that short-term demographic surges of up to 1% per year may have been feasible in a pre-modern Greek ecosphere. The degree of regional difference is even more instructive: although all samples converge in indicating significant growth, it would be impossible to compute an overall growth rate for Greece from these data.

No comparable statistics survive from ancient Greece. Is it sensible to expect burial counts to be as dependable a source of genuine demographic information as original census records? Two types of archaeological material have been taken to shed light on demographic change, *viz.*, graves and settlement sites. In the eighth century BC, both increased in number in Attica and elsewhere, and although Morris observes that this match may in part be a function of the fact that many sites are known only because of the chance finds of graves, it is generally agreed that this period experienced *some* demographic growth.[51] Most recently, Donald Jones developed a model designed to infer population growth from the rate of increase in the number of rural settlements. This (highly schematic) approach points to mean annual demographic growth of about 0.8-0.9% in eighth-century Attica.[52] Nevertheless, as indicated in section 1, it remains doubtful to what extent the *scale* of demographic change can be extrapolated from trends in the density of settlements. This leaves burial sites. Two readings are possible: either the visibility (i.e. the modern recovery rate) of burials changed over time, or the distribution of graves faithfully tracks demographic developments. In the first scenario, which Morris has been demonstrated to be true at least for some periods, burial counts cannot support quantitative demographic estimates. What remains to be shown is that the second approach is unacceptable because if applied in a consistent manner, it yields results that are both *eo ipso* implausible and at variance with other contemporaneous evidence.

Tandy seeks to salvage grave counts as demographic proxy data by following Morris in dismissing the representative character of sub-adult burial frequencies whilst assuming that the rate of formal commemoration of adults remained stable over time. By confining his analysis to adult burials, he is able to reduce the implied rate of population growth to 1.9% per year, down from 3.1% if child burials are included.[53] This lower figure may seem less implausible but is by no means more compelling. If burial statistics for children cannot be used as an index of demographic developments, how can one assume that adult visibility ratios did not vary as well? Tandy appears to see no reason to justify this arbitrary distinction. Yet there is no logical reason

[48] Kiel (1987) 128-31 (Attica); (1997) 338, 348-9 (Boeotia); (1999) 205 (East Locris).

[49] E.g. Kiel (1999) 198-9; *cf.* (1987) 137 for a shift in the balance of barley and wheat in favour of the former.

[50] *Cf.* Kiel (1999) 195.

[51] For the increase in sites in Attica and elsewhere, see Osborne (1996a) 70-4, 81; Tandy (1997) 27-30. *Cf.* Morris (1987) 156 (sites/graves), 23 (growth).

[52] Jones (1999) 37-41.

[53] Tandy (1997) 23-4, 51-3.

to privilege one sub-sample over the other unless data are deemed reliable merely because they corroborate preconceived notions about explosive population growth – a classic case of circular reasoning.

The fallacious nature of demographic extrapolations from burial counts can best be demonstrated by taking the latter as a mirror of demographic realities. Sallares points out that the sudden increase in sub-adult burials in the second half of the eighth century BC (see above, FIG. 4) is compatible with rapid natural growth: when a population increases at several per cent a year, its average age drops, children account for a larger share of the total population, and the relative incidence of child deaths rises accordingly.[54] As a consequence, in demographically representative burials, children would come to dominate the record. This is both correct and irrelevant. For that observation to be of any help, the surge in child burials would have had to occur *prior* to the spike in adult burials, and not afterwards.[55] In order to make sense of the attested pattern while assuming that the sub-adult burial counts somehow do reflect demographic events, we would have to believe that population growth caused relative child mortality to surge in the late ninth century BC without leaving a trace in the material record, followed by a palpable increase in the overall number of adult deaths caused by progressive expansion, and that it was only in the late eighth century that the final phase of the rise in sub-adult mortality became archaeologically visible. And even this intricate and arbitrary construct critically depends on Morris' model of unstable grave recovery rates. However, once one chooses to apply this line of reasoning selectively, there is no obvious reason not to go all the way and accept the possibility that *all* segments of the data may to some extent be artifacts of malleable cultural conventions. In that case, both the need and the justification for a demographic 'explanation' of the observed pattern vanishes.

The only way to interpret the record without invoking any kind of change in funerary practice is by assuming that around 780 BC, Attica was struck by a major epidemic such as bubonic plague or smallpox that was capable of raising adult mortality rates several times, thereby creating the spike in adult burials.[56] Once the crisis subsided, the survivors proceeded to have larger numbers of children to repopulate the territory, causing the subsequent spread of child graves. In this case, no net growth need have occurred at all. This theory is perfectly consistent with the fact that child burials start to go up precisely when adult graves are becoming less common: at that point, the contraction would end and recovery commence. This hypothetical interpretation was in fact foreshadowed by John Camp's thesis that the surge in eighth-century BC burial counts reflected a mortality crisis brought about by a prolonged drought, a theory that does not account for the then unappreciated asynchronicity of the adult and sub-adult spikes and has widely and no doubt correctly been rejected.[57] But even with an epidemic rather than a drought, would any of this be credible at least in theory? Although nothing along these lines is attested, arguments from silence count for little. More importantly, the observed expansion in the total number of settled sites in the eighth century BC (see above) may reasonably be taken to indicate that a certain amount of net growth did take place. This alone would tell against the assumption that following a mortality crisis and a rapid recovery in the eighth century BC, Athenian population remained at Dark Age levels until the end of the sixth century BC, as suggested by a literal reading of the burial counts in FIG. 4. I am devoting so much space to a far-fetched counterfactual to make one crucial point: any interpretation of the burial data as an index of demographic realities that does not allow for substantial cultural refractions yields untenable results.

This leaves us with what might be called the 'weak' positivistic position: the contention that *some* of the grave counts reflect demographic change while others do not. Tandy adopts this approach without making it explicit. While he correctly states that the incidence of adult burials

[54] Sallares (1991) 124-6.

[55] See above, FIG. 4. Morris (1992) 80 and Osborne (1996a) 80 make the same point.

[56] This effect has been modelled by Paine (2000).

[57] Camp (1979); for criticism, see Snodgrass (1983) 169-71; Morris (1987) 160-2; Tandy (1997) 24-6.

in the eighth century BC, which on average increased by 1.9% per year from 780 to 718 BC, 'must be coordinated with the number of burials *after* this period, here the seventh century', the drop in attested grave sites after the eighth century remains unexplained.[58] At any rate, he does not seem to reckon with a significantly smaller Greek population in the seventh century BC. None of this is strictly speaking impossible. Let us be charitable and accept the possibility, for the sake of argument, that a literal reading of the eighth-century burial data does not require us to take the seventh- and sixth-century material at face value as well, and even that the annual growth rate of more than 2% from the late sixth to the mid fifth centuries indicated by the grave statistics is somehow not entirely impossible, thanks perhaps to a massive influx of slaves and metics. However, the fundamental flaw of this approach is immediately obvious: while cultural explanations for some of the observed trends might enable us to declare others to correspond to genuine demographic events, the admission that shifts in representation and recovery rates *must* account for *some* of the characteristics of the record makes it impossible to be sure that *any* of them can be used to glimpse the mortality history of ancient Attica. Neither Sallares' nor Tandy's readings differ structurally from Morris' approach except in trying to have it both ways by acknowledging change in burial conventions *and* exploiting the same corpus of evidence for demographic purposes in order to salvage some empirical basis for a supposed population explosion. Reduced to essentials, their argument is that because explosive expansion occurred, it must be discernible in the sources. The issue in need of substantiation is taken as a given.

This is not to say that it is impossible that some of the data reflect demographic reality (better) than others. What is, however, impossible is to decide which parts of the record are reliable and which are not. Moreover, even if we were to concede that some of the burial counts make sense in that they coincide with other – albeit not entirely independent – evidence, such as the spread of settlement sites,[59] there is absolutely no way to determine *to what extent* they reflect demographic events or are governed by cultural conventions. To put it crudely, if half of the observed eighth-century BC increase in adult burials had been due to an actual increase in the annual number of deaths and the other half to improved visibility, the estimated population growth would have to be halved. But what if the respective shares were $^1/_4$ and $^3/_4$, or vice versa? It is surely impossible to put figures on these trends. Attempts to derive demographic growth *rates* from burial data are irremediably flawed and must be abandoned.

3. THE DEMOGRAPHIC DIMENSION OF OVERSEAS SETTLEMENT

Much of the Greek expansion took place outside the Aegean. Between the early eighth century BC and the Classical period, the Greek overseas population grew from almost nil to hundreds of thousands. Two questions merit investigation: what was the numerical size of the aggregate founding population, and how did emigration affect demographic growth in the source regions? I shall avoid the more traditional concern with the causes of this migration movement.[60] Suffice it to say that overpopulation, once a common explanation, is hard to document and perhaps implausible to begin with: one would expect population pressure to rise near the end of a demographic expansion, not during its early stages (from, say, the ninth to seventh centuries BC).[61] A

[58] Tandy (1997) 24.

[59] *Cf.*, e.g., Carter (1990b) 19-24, for matching trends in the number of graves and farm sites in the territory of Metapontum.

[60] See most recently Osborne (1998).

[61] See above, section 1. For doubts about overpopulation, see Osborne (1996a) 119, 125-6, (1998) 268. Cawkwell (1992) rejects 'plain over-population' and opts instead for 'climatic disaster', seemingly unaware of the fact that overpopulation is a relative concept that varies with the resource base: thus, food shortage caused by drought *is* overpopulation. Horden and Purcell (2000) 267 point out that 'in Mediterranean history food crisis has not been caused by demographic growth's outstripping carrying capacity ... In the Mediterranean environment *any* population exceeds carrying capacity in a bad year.' *Cf.* their argument that demographic explanations of Greek emigration are simply unnecessary (286).

simplified distribution chart of the geographical provenance of colonists enables us to track broad changes in the extent to which different regions contributed to the founding of new settlements (FIG. 5).[62] Mainland Greece took an early lead, gradually replaced by Ionia and established overseas settlements. Notwithstanding the dubious nature of some of the evidence linking 'colonies' to 'mother cities',[63] this chart suggests that these attributions are not entirely spurious. Otherwise, we would encounter a more random distribution since there is no obvious reason why settlements founded in the eighth century BC should be more inclined to claim descent from mainland communities than those dating from the following century.

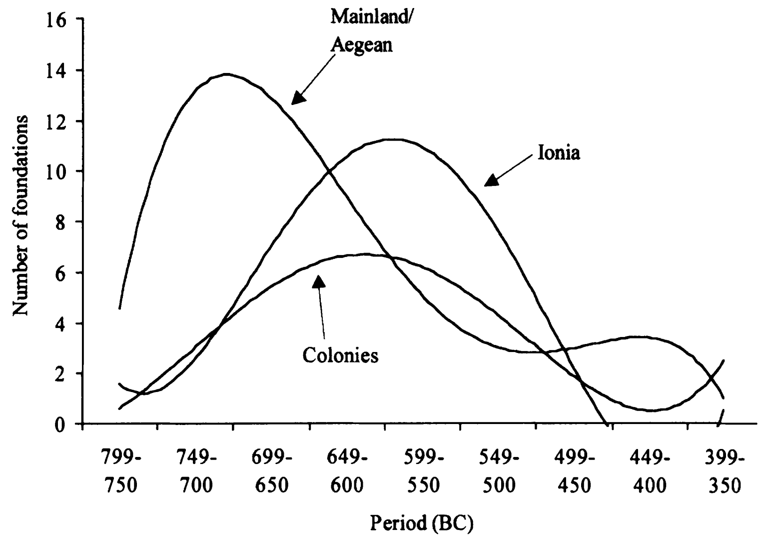


FIG. 5.
Overseas foundations by region of provenance
(polynomial trend lines)
Source: Osborne (1996) 121-5

The scale of this process is much more difficult to estimate. The total number of overseas settlements is still unknown. FIG. 5 is based on about 120 settlements whose foundation can be dated within reasonable margins of error. The actual total must have been larger: suggested numbers reach as high as 500.[64] And not every attempt to establish a settlement need have succeeded. Is it possible to relate the total number of emigrants to the total number of overseas Greeks in the Classical period when neither figure can be determined with precision? The first variable is only weakly constrained by probabilistic assumptions: a Greek overseas settlement could not have been started by a dozen people and did not normally entail the simultaneous migration of many thousands of settlers, along the lines of the largest Roman *coloniae*. By contrast, final population size is somewhat less uncertain. Beloch's discussion of the population history of Sicily and Greater Greece, while more than a century old, has yet to be superseded and need not be wide of the mark.[65] His breakdown for Sicily in 415 BC suggests the presence of around 300,000 Greeks at that time and of perhaps up to one-and-a-half times as many in the fourth century BC. He also reckoned with about 320,000 Greeks in southern Italy *c.* 400 BC.[66] Pounds, by com-

[62] Based on Osborne (1996a) 121-5.

[63] E.g. Osborne (1996a) 8-17, 127-9.

[64] The website of the Copenhagen Polis Centre (www.igl.ku.dk/polis/about.html) mentions 500 colonies, though the actual tally remains uncertain: about 1,000 poleis could thus far be identified in the Greek world as a whole (M.H. Hansen, pers. comm., 6 September 2001).

[65] Beloch (1886) 261-305. More recent estimates for individual communities are of little help in this context: e.g. Carter (1990a).

[66] See Beloch (1886) 298, for 130,000 Greeks outside Syracuse and Acragas, perhaps 80,000 in Acragas (*pace* 282 n.3), and maybe another 80-100,000 in Syracuse (*cf.* 276). On Italy, see 305. According to de Angelis (2000) 138-9, the Greek sector of Sicily may have been able to support 1.2 to 1.6 million people at bare subsistence if agricultural exploitation was maximized, whereas the actual population may have numbered about 600,000 (139). It is unclear how many of them would have descended from Greek immigrants: a 75% share would be compatible with Beloch's maximum total of Sicilian Greeks.

parison, assigned 350,000 Greeks to Sicily and 150,000 to Italy.[67] Their estimates point to an overall range of between 450,000 and 770,000 Greeks in that region. Taking 400 BC as our target point, we may therefore work with an approximate figure of 450,000 to 600,000. The total number of Greeks in other settlements, especially in the Black Sea region, is even more obscure but must have been smaller than in the West.[68] For computational purposes, I will adopt a range of from 600,000 to 900,000 in 400 BC for all settlements combined. (This figure excludes slaves and resident aliens.)

How many migrants did it take to build up these numbers? For what it is worth, the foundation tale of Cyrene as related by Herodotus (4.153) seems to suggest a contingent of some 200 settlers. The cemeteries of Pithekoussai have been taken to point to a population of between 5,000 and 10,000 in the second half of the eighth century BC, a surprisingly large number fraught with interpretive difficulties.[69] Isolated and questionable bits of data such as these are a poor foundation for global estimates. Further uncertainty arises from our inability to assess the extent of intermarriage and acculturation of native populations. Even if we reject the possibility of substantial enfranchisement of non-Greeks, the problem of the provenance of the settlers' wives defies generalization.[70] Although the genetic landscape of modern Sicily and South Italy may hint at an overwhelming ancient ethnic Greek dominance in the settled areas, the precise meaning of the pertinent data is still being debated.[71]

Under these circumstances, parametric modelling is the only available option. I will proceed on the simplifying assumption that all emigrants were 20-year-old men, each of whom was the survivor of two male newborns (e_0~30), and that the departure of every such man deprived his native community of one young adult woman either because she accompanied him or stayed but remained unmarried (or had been disposed of after birth in anticipation of a low adult sex ratio caused by male emigration). Hence, the migration of each male settler is regarded as equivalent to the transfer of four live births. While none of this can strictly have been true, these assumptions are necessary to relate the scale of emigration to its demographic impact on the source population.[72] In the most extreme alternative scenario, only men would have left Greece while all remaining women reproduced in the same way as they would have done in the absence of any migration. In that case, there would not have been any consequences for overall fertility and population growth. As so often, the truth must lie somewhere in the middle: whereas mixed or even all-male emigration would have had some impact on demographic development, it was probably smaller than implied by my schematic model. It is important to bear in mind that the following calculations are therefore likely to overstate the extent to which emigration curbed fertility in the Aegean.

[67] Pounds (1973) 54.

[68] For a recent survey of research on Greek settlements in the Black Sea region, see Tsetskhladze (1998) (esp. 37 n.93, criticizing dubious estimates of population numbers and agricultural output).

[69] Ridgway (1992) 101-3; but *cf.* Morris (1996) 57 n.1, who opts for 4-5,000. It is unclear how many of them would have been ethnic Greeks.

[70] Very little is known about this issue. For attempts to grapple with this problem, see Rougé (1970); Graham (1980); various papers in *Modes de contacts* (1982), esp. Gallo (1982) and van Compernolle (1982); and subsequently Goegebeur (1987); Shepherd (1999) (*contra* Coldstream (1993)). Some stories suggest violent wife-seizing from locals: Archil. *fr.* 97 West (Thasos); Hdt. 1.146 and Paus. 7.2.6 (Miletus). For peaceful intermarriage, see *SEG* 9.3 (Cyrene, but much later).

[71] Cavalli-Sforza, Menozzi and Piazza (1994) 277 fig. 5.7.1; Rickards *et al.* (1992); for divergent results, see Rickards *et al.* (1998).

[72] The actual number of adult male emigrants may well have exceeded the range of figures suggested by the following estimates: after all, colonial populations are often characterized by high sex ratios and low mean reproductive success (e.g. Guttentag and Secord (1983) 113-50). In the present context, however, male migrants matter only in so far as they represent a real transfer in reproductive capacity from their homeland to new settlements, and excess males who failed to reproduce may be ignored. For likely levels of mean life expectancy, see Scheidel (forthcoming).

If the *c.* 50 dated settlements associated with mainland source populations (see FIG. 5) had been the only ones emanating from that region, and each had been set up by 100 men (equivalent to 400 live births), and 65% of all overseas Greeks in 400 BC had descended from that group (equivalent to the share of mainland-fed settlements in all sites in FIG. 5),[73] the original cohort would have had to grow by 1.1-1.3% per year between the median foundation date of *c.* 675 BC (for primary settlements linked to mainland Greece) and the target date of 400 BC. This scenario is unlikely to be correct: there must have been more than 50 settlements, and the crew of one pentekonter per foundation – though possible – may not be enough.[74] As a result, the actual long-term growth rate must have been lower. At the opposite end of the spectrum of probability, let us assume that 200 settlements were founded by 500 men each. In that case, the total number of emigrants (100,000 adult men or 400,000 live births) would have approached the size of the target population, suggesting virtually no growth. This reconstruction must also be discarded.

How do we narrow down this unhelpfully broad band of more than 5,000 and fewer than 100,000 adult men? I shall make one further assumption, namely that the average long-term natural growth rate in the settlements was not lower than in mainland Greece. This is impossible to prove but should seem plausible: if anything, one would expect higher growth overseas.[75] As I have argued in section 1, the lowest reasonable estimate for mainland growth between the tenth and the fourth centuries BC is approximately 0.25 or 0.3%. At 0.3%, between 46,000 and 68,000 adult men (and a matching number of spouses) were necessary to create a target population of between 390,000 and 585,000 Greek settlers in 400 BC (i.e. 65% of the total). At 0.5% annual growth, 26,000 to 39,000 men would have produced the same outcome, whereas at 0.7%, between 16,000 and 24,000 men would have sufficed. We can judge the plausibility of these hypothetical totals by relating them to the putative number of settlements (TABLE 1).

average no. adult male settlers*	number of settlements	men per settlement
20,000	80	250
20,000	160	125
20,000	240	83
20,000	320	63
33,000	80	413
33,000	160	206
33,000	240	138
33,000	320	103
57,000	80	713
57,000	160	356
57,000	240	238
57,000	320	178

TABLE 1.
Matrix of assumptions concerning the number of settlers and settlements. *rounded to '000

Though perhaps not impossible, the implications of the lowest estimate (of 20,000 initial settlers) are difficult to accept, and a total of between 30,000 and 60,000 adult male emigrants (alongside an indeterminate number of women and children) can be used as a working hypothesis. How do these figures compare to the size of the source population? 70% of the listed primary settlements were created between 750 and 600 BC. The required transfer of 84,000 to 168,000 live births over 150 years works out at *c.* 560 to *c.* 1,120 per year. Positing an average source population of one million, transfers on that scale could have absorbed annual natural growth of 0.06-0.11%, or around one-third to one-fifth of total mainland growth (*cf.* above, section 1). If mainland population growth in the Archaic period had exceeded the underlying

[73] I.e. settlements linked to mainland poleis as well as settlements founded by settlements linked to mainland poleis.

[74] de Angelis (1994) reckons with a few hundred settlers at Megara Hyblaea in the late eighth century BC, arguably a somewhat low estimate. Although only a fraction of these would have been adult men, initial sex ratios may have been unusually high (see n.73).

[75] In frontier regions of pre-transitional societies, fertility is often positively correlated with the availability of cultivable land: e.g. Easterlin (1976); Merrick (1978); Van Landingham and Hirschman (2001).

long-term rate, as seems plausible (see above, FIGS 1-2), the consequences would have been weaker still. More importantly, my estimate is predicated on the unrealistic assumption that no mainland Greeks moved to overseas settlements well after they had been established, and consequently overstates the number of migrants in the eighth and seventh centuries BC.[76] Thus, in the long term, and with regard to the whole of mainland Greece, emigration could have had only a comparatively moderate impact on population growth.

One major caveat is in order. This finding may have little meaning when applied to regional or local contexts. If different parts of Greece were unevenly involved in the creation of overseas settlements, the demographic drain of emigration would have been more strongly felt in some areas than in others. For instance, even if Chalkis and Eretria did not single-handedly populate all the settlements attributed to them, they must nevertheless have contributed more heavily than many other communities. For this reason, schematic calculations tell us little about regional features, and are of no obvious value for the study of individual poleis. They do, however, cast new light on the macro-demographic dimension of Greek migration.

4. WELL-BEING

This paper has focused on population size and growth. Although ancient historians have traditionally privileged these issues,[77] they are arguably of lesser significance than changes in mortality, fertility and household structure. Unfortunately, in the absence of tangible evidence, these crucial areas are largely impervious to quantitative investigation. In general, there can be little doubt that a certain amount of intensive (i.e., per capita) economic growth occurred between the Dark Age and the classical period.[78] In this respect, ancient Greece resembles other historical entities such as the early Roman empire or Song China.[79] Whether or to what extent economic progress translated to an amelioration of the demographic regime is an open question. It might be tempting to accept skeletal evidence suggestive of an increase in body height and life expectancy between 800 and 300 BC as proxy data for tangible improvements in physical well-being.[80] However, final body height is an unreliable indicator of life expectancy, trends in the Body Mass Index remain invisible, and osteological remains do not support statistically significant findings concerning differences in average life expectancy of up to five years.[81] The conventional notion that nutritional status improved after the Dark Age is doubtful for two reasons. First, a meat-rich Dark Age diet – if it was indeed common – may have been more beneficial than the later barley-based diet.[82] Second, and more importantly, food quantity or quality are not the principal determinants of well-being. Instead, the prevalence and incidence of infectious dis-

[76] For example, if only half of the transfers required to populate the settlements linked to mainland poleis that were founded between 750 and 600 BC occurred during that period, and the other half between 600 and 450 BC, the projected number of live-birth transfers from 750 to 600 BC drops from between 84,000 and 168,000 to between *c.* 40,000 and *c.* 100,000, while the aggregate total of migrants (now spread out from 750 to 450 BC) rises by 20 to 50%.

[77] *Cf.* Scheidel (2001a) 49-72.

[78] Morris (forthcoming a, in preparation).

[79] Saller (2002); Jones (1988).

[80] For these data, see, e.g., Grmek (1983) 103-4; Morris (1992) 76; and esp. Morris (in preparation).

[81] See Riley (1994) (height); Fogel (1993) (BMI); S.R. Johansson, pers. comm., 16 May 2001 (bones). According to the osteological data juxtaposed by Gallant (1991) 69, average Greek male body height did not vary between classical antiquity and the 1970s – despite dramatic changes in mean life expectancy. For the hazards of paleodemography in general, see Scheidel (2001b) and the references in Scheidel (2001a) 19 n.66. The observation that age-specific recovery rates of skeletons vary over time (see above, section 2) is incompatible with the notion that small shifts in mean life expectancy may be deduced from changes in the relative representation of different age groups in cemetery populations.

[82] For skeletal evidence indicative of higher meat consumption in the Dark Age, see Morris (1992) 98-9; but *cf.* Cherry (1988) 26-30, arguing against a wholesale shift to pastoralism after the Mycenaean period. The prevalence of barley in the Classical period may well have been a sign of population pressure: Sallares (1991) 313-16. In general, secular changes in dietary patterns in antiquity are hard to substantiate: *cf.* Garnsey (1999) 118-20.

ease appear to matter most.[83] The gradual rise in population density coupled with intensifying urbanisation and trade would have facilitated the spread of infections, thereby countervailing the potential benefits accruing from growing economic output. All in all, there is no compelling reason to suspect significant improvements in health or life expectancy during the Archaic period. Besides, even they had in fact occurred, rising population pressure in the Classical period (*cf.* above, section 1) might have absorbed any intermittent gains. In the absence of critical additions to the stock of medical and scientific knowledge, even egalitarian political systems could not indefinitely cushion their members against the consequences of declining marginal productivity. Until the eighteenth century AD in northwestern Europe and China, the growth of wealth and knowledge was not normally accompanied by palpable gains in life expectancy, not even among elites.[84] It is unlikely that ancient Greece was an exception.

5. CONCLUSIONS

In so far as it is at all perceptible, the demographic development of ancient Greece appears to have conformed to a conventional pattern: recovery from a depression turned into an expansion that raised population density to new heights before levelling off (section 1). Anomalous events, such as sudden population 'explosions', cannot be documented on the basis of the available evidence (section 2). Substantial changes in average mortality and morbidity are likewise unattested and generally implausible (section 4). Considerable levels of spatial mobility were not unique to ancient Greece but a characteristic feature of traditional Mediterranean populations in general.[85] In this regard, Greek 'colonization' was not particularly special (section 3), and it merits notice that the total volume of emigration from mainland Greece and the Aegean must subsequently have been exceeded by the aggregate influx of slaves in the late Archaic and Classical periods.[86] I am therefore inclined to conclude that in demographic terms, Greece was far less exceptional – and thus, perhaps, interesting – than in the political and intellectual sphere. In the long run, the relationship between population change and real incomes must also have followed a familiar pattern. After the Dark Age, Greece appears to have experienced what Jack Goldstone calls an 'efflorescence' – an outburst of economic expansion and creative innovation that temporarily enabled gains in output to outpace increases in populations size, thereby engendering intensive growth.[87] Even so, there is no good reason to suspect that ongoing demographic growth did not eventually impel a decline in productivity. Signs of population pressure in the Classical period tend to corroborate this theoretical assumption. The demographic consequences of political egalitarianism remain elusive: although comparatively high normative living standards may conceivably have caused population number to equilibrate farther below the upper limit set by physiological subsistence levels than in other traditional societies, Classical Greece was unlikely to have found a lasting solution to the ever-present threat of declining marginal productivity. But this would be a subject for another paper.

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[83] Livi-Bacci (1991); Johansson (1994).

[84] Livi-Bacci (1991) 63-78 (Europe); Lee, Wang and Campbell (1999) 400-3 (China). For high mortality in the Roman élite, *cf.* Scheidel (1999).

[85] *Cf.* Purcell (1990); Horden and Purcell (2000).

[86] While the scale of slave imports is obviously unknown, even a Classical free-to-slave ratio of as high as 20 to 1 would imply a six-digit figure for the grand total of all imports. For the likely number of emigrants, compare above, section 3.

[87] Morris (in preparation). For comparable episodes in the High Middle Ages, 'Golden Age' Holland, eighteenth-century England and Qing China, see Goldstone (2002). In all these cases, demographic growth eventually caught up with economic growth. Goldstone's observation that efflorescences were often preceded by periods of collapse or restructuring is of obvious relevance to our understanding of post-Dark Age Greece.

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