

QUANTIFYING THE SOURCES OF SLAVES IN THE EARLY ROMAN EMPIRE*

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I. ARGUMENT

The relative importance of different sources of slaves in the Roman Empire during the Principate cannot be gauged from ancient texts. However, simple demographic models show that, for purely statistical reasons, natural reproduction made a greater contribution to the Roman slave supply than child exposure, warfare, and the slave trade taken together and was in all probability several times as important as any other single source. The most plausible projections also suggest that on average the incidence of manumission was rather low. By implication, overall fertility of ex-slaves in general and of freedwomen in particular would be low as well, which must have reduced their chances of acquiring legal privileges that accrued from sexual reproduction.

II. PREVIOUS APPROACHES

When Harris addressed the question of the 'relative importance of the various sources of slaves in the Roman Empire' some twenty years ago, he correctly pointed out that 'the topic is not new'.¹ Even so, neither his paper nor subsequent studies have brought us any closer to a plausible estimate of roughly how many slaves were born to slaves and how many were enslaved at some stage of their lives. As I will try to show, this impasse is solely due to a consistent lack of demographic conceptualization. Harris, for instance, in what is introduced as a mere 'surmise' puts the total number of slaves in the early Roman Empire at ten million, a figure thought to represent between one-sixth and one-fifth of the entire population. He concludes his discussion of the factors favouring and impeding the natural reproduction of slavery with the assertion that while 'more than half a million new slaves were needed every single year',² 'slave-born slaves alone will have left a deficiency of several hundred thousand a year in the empire's supply of new slaves'.³ Taken at face value, these statements imply that at least half, and probably more than half, of all slaves were not the offspring of slaves and that all other sources combined accounted for at least one-half of the Roman slave supply. Harris identifies these sources as enslavement in war, the raising of exposed or sold children, and the cross-border slave trade, but singles out child exposure as the only source capable of meeting overall demand.⁴

Bradley, in his paper on the Roman slave supply, from the outset takes it as a given that the question of how Roman slave-owners satisfied their needs and requirements is not only 'colossal', which is undeniably true, but 'in the absence of quantifiable data can only be answered impressionistically on the basis of mechanisms of supply known to

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¹ W. V. Harris, 'Towards a study of the Roman slave trade', in J. H. D'Arms and E. C. Kopff (eds), *The Seaborne Commerce of Ancient Rome* (1980), 117. There would be little point in embarking on a comprehensive overview of previous research on this

issue, which is why I will refer to only some of the most recent pertinent work.

² Harris, *op. cit.* (n. 1), 118, based on the assumption of a 'social life expectancy' of fewer than 20 years for 10 million slaves.

³ *op. cit.* (n. 1), 121. For a restatement of this view, see *idem*, 'Child-exposure in the Roman Empire', *JRS* 84 (1994), 18.

⁴ Harris, *op. cit.* (n. 1), 121–5, esp. 123–4. In his later article, *op. cit.* (n. 3), 10, Harris assumes that most exposed infants would die, while most of the survivors were enslaved. On the implications of this scenario see the text below at nn. 36–9.

have existed in the Roman world', which seems far less obvious.⁵ He rightly argues against an overly schematic scenario that juxtaposes 'warfare under the Republic and breeding under the Empire as the two respective principal sources of supply' and gives natural reproduction its due as 'the only dependable possibility for providing a steady source of new slaves over time, even if in and of itself it cannot have met total demand'.⁶ While recourse to 'a model of sources of supply acting and reacting on each other in conjunction' is as a matter of course the only sensible approach, it does not give us any idea of the likely contribution of each source.⁷ In the most recent restatement of his views, Bradley claims that 'the rate of natural reproduction among Roman slaves cannot be measured',⁸ which is correct in a strict sense but does not necessarily forestall a rough estimate at least for the post-Republican period. His conclusion that 'no single source ever completely dominated the rest'⁹ thus lacks a quantitative basis.

The same reluctance to embark on controlled speculation pervades the recent massive study of *vernae* by Herrmann-Otto, who repeatedly rejects a demographic approach to her topic entailing any quantification, however tentative.¹⁰ She is right in concluding that the study of the ancient evidence of *vernae* only documents the fact that some slaves engaged in reproduction but cannot reveal the significance and scope of this phenomenon.¹¹ It does not follow from this assessment, however, that we have to confine ourselves to the unhelpfully vague notion that natural reproduction was an 'important' element of Roman slave society.¹²

The problem of slave reproduction is succinctly brought into focus by Patterson in his comparative study *Slavery and Social Death* where he distinguishes between 'biological' reproduction — the capacity of a slave population to produce a number of persons equal to or greater than itself — and 'social' reproduction — the ability of a slave population to reproduce itself if non-biological attrition factors such as manumission and migration are taken into account.¹³ High rates of manumission can render a biologically reproducing slave population socially non-reproductive. Two of his observations warrant particular attention. First, a large influx of slaves of a given age or sex can make any claim, however outwardly correct, that such a population is non-reproductive misleading in that this failure fully to reproduce themselves is a function of the age or sex structure created by import rather than of the mating behaviour of the slaves.¹⁴ And second, he points out that 'even if a slave population is biologically nonreproductive, birth may still remain the single most important source of slaves'. That reproduction does not meet total demand need not mean that other sources are more important than unfree birth or even come close to being as important. It is often, in Patterson's words, 'the simple mathematics of reproduction' that militate against any such notion.¹⁵

⁵ K. R. Bradley, 'On the Roman slave supply and slave breeding', in M. I. Finley (ed.), *Classical Slavery* (1987), 42.

⁶ *ibid.*, 59.

⁷ *ibid.* In his (generally excellent) book *Slavery and Society at Rome* (1994), similar weight — in terms of space allotted — is given to different sources of vastly different potential, ranging from breeding to kidnapping of travellers (32–8).

⁸ Bradley, *op. cit.* (n. 7), 34.

⁹ *op. cit.* (n. 7), 43.

¹⁰ E. Herrmann-Otto, *Ex ancilla natus: Untersuchungen zu den "hausgeborenen" Sklaven und Sklavinnen im Westen des römischen Kaiserreiches* (1994), e.g., 3, 3 n. 7, 6, and see below. Not having given enough thought to the matter, I adopted a comparably pessimistic stance in my 'Columellas privates *ius liberorum*', *Latomus* 53 (1994), 513–27. Cf. also T. G. Parkin, *Demography and Roman Society* (1992), 122: 'a slave population is far from a natural one, and its demographic regime, which probably varied sharply over space and time, remains difficult to elucidate or even to make conjectures about' (my italics), or P. R. C.

Weaver, 'Children of freedmen (and freedwomen)', in B. Rawson (ed.), *Marriage, Divorce, and Children in Ancient Rome* (1991), 176: 'Slave origin comprises both those born as slaves (including *vernae*, born in the *familia*) and those who were born free but subsequently enslaved (from whatever cause or source). There are no means available of determining even approximately what proportion fell into each category' (last italics mine).

¹¹ Herrmann-Otto, *op. cit.* (n. 10), 227. Cf. my review in *Tyche* 11 (1996), 274–8.

¹² Thus Herrmann-Otto, *op. cit.* (n. 10), 287, 411.

¹³ O. Patterson, *Slavery and Social Death* (1982), 132.

¹⁴ *op. cit.* (n. 13), 133. One might therefore wonder to what extent the slave populations of the Caribbean and Latin America which were shaped by continuous selective import and failed fully to reproduce themselves were intrinsically more 'typical' than the self-contained and highly reproductive slave population of the United States. See below, in the appendix.

¹⁵ *op. cit.* (n. 13), 133.

III. A MODEL AND THREE SCENARIOS

In the case of the early Roman Empire, the required mathematics are relatively simple indeed. What percentage of the slaves were born to slaves (within the Empire) and how many of them were enslaved within the Empire or imported from outside? A model of slave supply in the early Roman Empire rests on four variables: the size of the slave population, both in absolute numbers and in relation to the total population; the development of the slave population over time; the size of the demographic pool on which slave traders could draw; and the frequency of manumission.

Concerning the first of these variables, I will reckon with six million slaves in a population of sixty million, who thus made up 10 per cent of the total population.¹⁶ In this context, the term 'slave' is narrowly defined, excluding free but dependent populations in the provinces. This estimate gives us about two to three million slaves for Italy and three to four million for the provinces.¹⁷ After adding the freedmen, the population of current slaves and ex-slaves taken together would be somewhat higher, perhaps in the order of seven million (see below). The 'surmise' of ten million slaves offered by Harris seems rather high to begin with and does not take account of freedmen: as a consequence, in his scenario between one-fourth and one-fifth of the entire population would have been enslaved or of servile descent, which implies a staggering amount of social mobility (in either direction) in each generation. The selection of a rather 'low' estimate also serves to strengthen the argument: the smaller the slave population had been, the more significant would have been the contribution to the slave supply from sources other than natural reproduction. On the other hand, as we will see below, the larger the share of slaves in the total population is assumed to be (as in the case of ten million slaves), the more necessary it is to postulate the predominance of natural reproduction.

We may furthermore assume that during the Principate, a period of some ten to twelve generations, the overall size of the slave population did not undergo any dramatic changes. I hasten to add that some amount of change would inevitably have occurred: total population figures must have kept oscillating though whether these fluctuations in the long run followed a consistent empire-wide trend (never mind regional differences) is impossible to tell. However, two qualifications need to be made. Unless the overall direction of population change had indeed been constant, regional and temporal fluctuations would at least partly have offset one another. More importantly, even very low rates of increase or (a more popular assumption) decrease would have resulted in a massive transformation of the slave population within the period under review. Thus, a rate of increase of not more than 0.3 per cent per annum would have doubled the population while an analogous rate of decrease would have halved it. Both continuous

¹⁶ For the total size of the population and a tentative breakdown according to provinces, see B. W. Frier, 'The demography of the early Roman empire', in *CAH* 11 (2nd edn, forthcoming): between 45 million in A.D. 14 and 60 million before the Antonine plague. The much higher estimate implied by E. Lo Cascio, 'The size of the Roman population: Beloch and the meaning of the Augustan census figures', *JRS* 84 (1994), 23–40, is unconvincing; cf. briefly my *Measuring Sex, Age and Death in the Roman Empire: Explorations in Ancient Demography* (1996), 167–8 (also in *Arachnion* (forthcoming)). About 11 per cent of the individuals in the census returns from Roman Egypt are slaves (118 of 1,084): R. S. Bagnall and B. W. Frier, *The Demography of Roman Egypt* (1994), 48 (and cf. 48 n. 61 for similar estimates on the basis of other sources). This is the only yardstick for the extent of slave-ownership outside the central areas of Roman 'slave society'. Hence, reckoning with a much higher proportion of slaves in Italy, my estimate of 10

per cent for the Empire as a whole seems rather a lower limit than a reasonable average. The larger the overall share of slaves was, the less likely extraneous sources would have been to meet the demand for replacement slaves: from a methodological point of view, my low estimate serves the useful purpose of making it more difficult for me to argue my case for a high incidence of natural reproduction (see below).

¹⁷ It is hard to tell whether J. Beloch, *Die Bevölkerung der griechisch-römischen Welt* (1886), 416, 418 (2 million slaves in Italy) or P. A. Brunt, *Italian Manpower 225 B.C.–A.D. 14* (1971), 121–30 (3 million) is closer to the mark. In favour of Beloch's figure, see my 'The demography of Roman slavery and manumission', proceedings of *Premier colloque international de démographie de l'antiquité* (Arras, November 1996) (forthcoming). Despite its title, G. Pereira Menaut, 'El número de esclavos en las provincias romanas del Mediterráneo occidental, en el Imperio', *Klio* 63 (1981), 373–99, is rather unhelpful.

growth from, for example, six to twelve million and a decline from, for example, six to three million slaves between the late first century B.C. and the mid-third century A.D. will seem *a priori* unlikely. For this reason, in the context of a rough model at least, we may operate on the assumption that the total size of the slave population remained relatively unchanged from any one generation to the next. However, even *if* the slave population had indeed dropped from, say, six to three million during the period in question, the surmise of relative lack of change would still be valid since an annual rate of decrease in the order of a fraction of one per cent is a negligible quantity in the context of the rough models presented below. In other words, a steady rate of increase or decrease of that size is wholly irrelevant to estimates of the relative share of various sources of slaves.¹⁸ This enables us to adopt the appropriate model life tables of a *stationary* population as an *approximation* of what the slave population would have looked like had it shown a natural age and sex distribution — which of course it did not, as manumission alone precludes the mere possibility. The demographic model simply provides an idea of the required levels of reproductive performance, which in the case of the slave population could be met only with recourse to some amount of extraneous supply.

Strictly speaking, a population which may have been affected by imbalanced sex ratios and in which certain age-cohorts were reduced through manumission would on average be a much younger population characterized by rates of birth and death per 1,000 population very different from those predicted by standard model life tables. However, as manumitted slaves did not die but lived on in a different legally defined subset of the same biological group, all slaves and all freedmen constitute a single population that can be studied as such, even when we look at only one legal category at a time. It is also true that while manumission has no bearing on the selection of a model life table, lower intrinsic rates of reproductivity attributable to other causes would in principle call for the application of life tables that are not based on the assumption of a stationary population and therefore predict different birth rates and death rates.¹⁹ In projections as rough as those discussed below, such fine-tuning would seem unnecessary, all the more so as a large share of decrease will invariably be attributed to manumission. It will therefore be assumed that any deficit of births (that in reality would change the death rate and other elements of population structure also) was filled from extraneous sources *at age 0*, thereby maintaining the characteristics of a stationary population.²⁰

As to the third variable, estimates of the size of the pool of 'enslavables' both within and outside the Empire inevitably rest on guesswork. The number of potential suppliers of slaves, mainly via child exposure and sale, within the Empire might be put at forty million or about three-quarters of the non-slave population which should seem a generous estimate. Populations beyond but within reach of the borders were limited in size: one would think in the first instance of the peoples of Ireland, Scotland, Germania, South Russia, the Caucasus, the Arabian peninsula, and the Sudan (broadly defined). While Mesopotamia and Iran could have been another source, demand for slaves within the Parthian Empire has to be taken into account as well. Needless to say, the inhabitants of most or all the other areas listed above would also make use of slaves themselves which must have limited the scope of export. Largely excluding the Parthian sphere of influence, the population of these regions combined should be put at not more than

¹⁸ The significance of these different sources is (virtually) the same irrespective of whether the size of the slave population remained stable or decreased by one half over three centuries. At the same time, no demographic model can help to determine the existence, direction, and extent of any long-term changes.

¹⁹ cf. A. J. Coale and P. Demeny, *Regional Model Life Tables and Stable Populations* (2nd edn, 1983), 56, 81.

²⁰ While this seems a reasonable premise in the case of enslaved foundlings, the import of grown-up slaves would have left its mark on the rates of birth and death. However, given the relatively small contribu-

tion of this group overall, any such effects are bound to be negligible within a rough model. Moreover, everyone is born at age 0. Therefore, if the average age of the replacement slaves were put at, say, five years instead of zero, my figures would remain unchanged. If, say, half of all children died between birth and age five, n children enslaved at age five equal $2n$ children enslaved at birth, or, in other words, for every 1,000 children enslaved at age five, 2,000 would have been born five years previously. On the supply side, the actual average age at enslavement is immaterial.

twenty million and may well have fallen short of this number.²¹ Fifteen million or thereabouts might be more reasonable. Even so, for the sake of argument I will give preference to the higher estimate of twenty million that increases the likelihood of imports from those areas and that again makes it more difficult for me to demonstrate the paramount importance of natural reproduction. If we suppose in the most general manner an average birth rate of about 45 per 1,000 population,²² each year 1,800,000 babies born within and another 900,000 born outside the Empire would have provided a pool of 2,700,000 individuals from whom future slaves could be drawn. I ought to stress again that because of the underlying estimates, these figures appear rather high; lower figures would translate into a more limited availability of potential slaves.

This leaves the last variable, the pattern of manumission. In the following, I will adopt three different rates, dubbed low, intermediate, and high. The 'intermediate' rate is based on the assumption that 10 per cent of all slaves were manumitted at age twenty-five, 10 per cent of the remainder still alive five years later were manumitted at age thirty, and so on every five years up to age eighty-five. It will be obvious that this model is nothing more than a schematic computational device: the frequency of manumission could just as well have been put at 2 per cent per annum from age twenty-five to eighty-five without significantly affecting the results, and it is possible to construct a broad range of alternative non-linear projections. I certainly do not claim that the Romans manumitted slaves at that rate or at any stable rate at all. Rather, the main purpose of this and the following scenarios is to correlate a certain overall reduction of slave fertility to a schematic temporal pattern of manumission. To assume a rate of manumission of 10 per cent every five years is just another way of saying that the overall fertility of female slaves was 13 per cent lower (see below) than it would have been in the complete absence of manumission. The adoption of various schematic rates of manumission simply helps to illustrate a given reduction of fertility, and vice versa. It is only by means of such purely computational procedures that we can test our impressions of Roman slave society against a quantitative framework.

As it is, this scenario allows for a substantial number of manumissions around age thirty as well as for a lot of slaves who were not manumitted at all or not until shortly before the end of their lives.²³ Given the shortcomings of our sources, it is difficult to relate this (or almost any other) hypothesized pattern to ancient evidence. It has been argued, persuasively in my view, that there is no reason to believe in indiscriminate manumission of a huge proportion of young adult slaves in Roman society.²⁴ The census returns from Roman Egypt, which reflect the actual population infinitely more accurately than any sample of inscriptions, indicate that 'females were not commonly manumitted while still of childbearing age'.²⁵ In the context of my model, the manumission of male slaves in Roman Egypt, most of whom seem to have been freed

²¹ J.-N. Biraben, 'Essai sur l'évolution de nombre des hommes', *Population* 34 (1979), 16 tab. 2, puts the total population of Europe (without Russia) and North Africa around A.D. 200 at forty-four and sixteen million, respectively. If both these and Frier's (op. cit. (n. 16)) guesstimates as to the size of the population of various provinces are anywhere near correct, about 80 per cent of all Europeans and North Africans may have lived within the Roman Empire. Again excluding most of the Middle East, this would make twenty million seem too high an estimate for the total number of 'neighbours'.

²² Based on a life expectancy of 22.5 years at birth for females (Model West Females Mortality Level 2 in Coale and Demeny, op. cit. (n. 19), 56); for that mortality level, see B. W. Frier, 'Roman life expectancy: Ulpian's evidence', *HSCP* 86 (1982), 213-51 (on Ulp., *Dig.* 35.2.68 *pr.*); it might be particularly appropriate for slaves, cf. R. Duncan-Jones, *Structure*

and Scale in the Roman Economy (1990), 100-1. On Mortality Level 3 for Roman Egypt and the Empire in general, cf. Frier, op. cit. (n. 16), also Bagnall and Frier, op. cit. (n. 16), 84, 90, 100.

²³ On the last notion, see Bradley, op. cit. (n. 7), 164.

²⁴ See T. E. J. Wiedemann, 'The regularity of manumission at Rome', *CQ* 35 (1985), 162-75, who rightly dismisses the view of G. Alföldy, 'Die Freilassung von Sklaven und die Struktur der Sklaverei in der römischen Kaiserzeit', *RSA* 2 (1972), 97-129 (various reprints), who on the basis of epigraphical attestation that must have been limited to a small fraction of privileged slaves and freedmen argues for habitual manumission around age thirty: see below, n. 38. Weaver, op. cit. (n. 10), 181, also tends to put too much weight on the epigraphic evidence.

²⁵ Bagnall and Frier, op. cit. (n. 16), 158; cf. also tab. D 342-3.

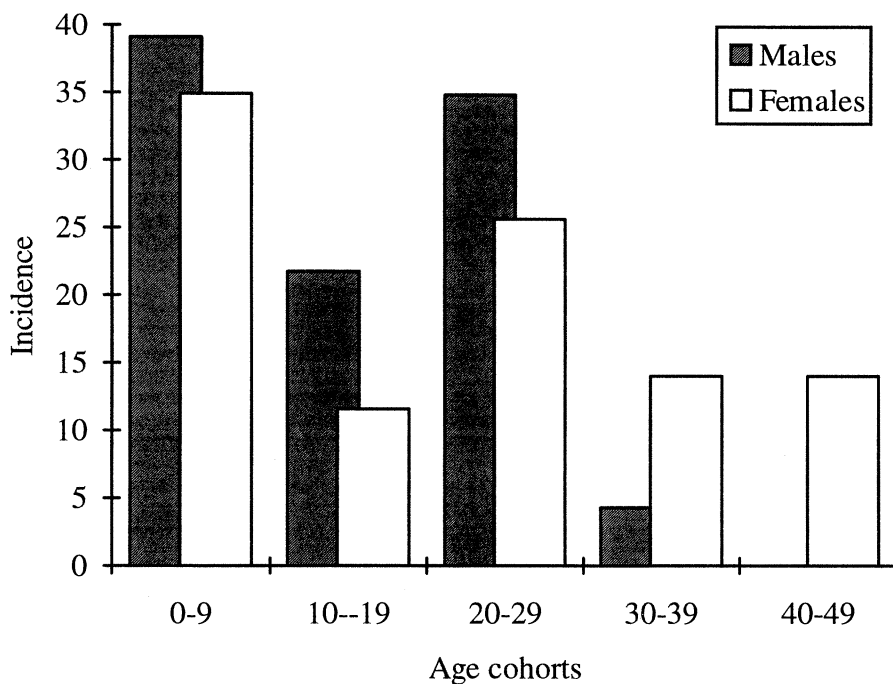


FIG. 1. ATTESTED AGE-DISTRIBUTION OF SLAVES IN THE EGYPTIAN CENSUS RETURNS
(SOURCE: BAGNALL AND FRIER, *OP. CIT.* (N. 16), 342-3, TAB. D).

before age thirty (Fig. 1), is largely irrelevant.²⁶ Only slave women were capable of bearing children, and since they did not necessarily require an equal number of male slaves to conceive, only *their* reproductive potential matters here. While, for the sake of simplicity, I will reckon with a single rate of manumission for both men and women, the relation of this estimate to the *actual* rate of manumission of male slaves is largely irrelevant. A different pattern of manumission for males might alter the population numbers posited in my scenarios but would have no bearing on slave fertility. It also deserves notice that a higher rate of manumission of young adult males would reduce the average age of the slave population as a whole, thereby increasing the required number of replacement slaves at age 0. For that reason, and in much the same way as my estimates of the total size of the Roman slave population and of the pool of potential slaves discussed above, the supposition of rather low levels of male manumission once again makes it easier for sources other than natural reproduction to account for a sizeable share of the total slave supply. When reviewing the figures that highlight the pivotal role of slave breeding in this and the following scenarios, one needs to remember that the underlying variables have repeatedly been biased in favour of alternative sources of slaves. By necessity, estimates which some might well consider somewhat more realistic would invariably translate into an even more dominant position of slaves by birth: the larger the slave population, or the smaller the number of 'barbarians', or the higher the incidence of (male) manumission, the larger the share of natural reproduction.

The low incidence of manumission of female slaves of childbearing age assumed in my model seems consistent with the Egyptian census returns. It is true that the number of attested ages of slaves is small and insufficient to support elaborate statistics (forty-four females, twenty-three males, and six individuals of uncertain sex). The raw data for

²⁶ In Diocletian's Price Edict, elderly slaves were still envisioned as subject to sale, even though they appear vastly overpriced: see my 'Reflections on the

differential valuation of slaves in Diocletian's price edict and in the United States', *MBAH* 15, 1 (1996), 67-79.

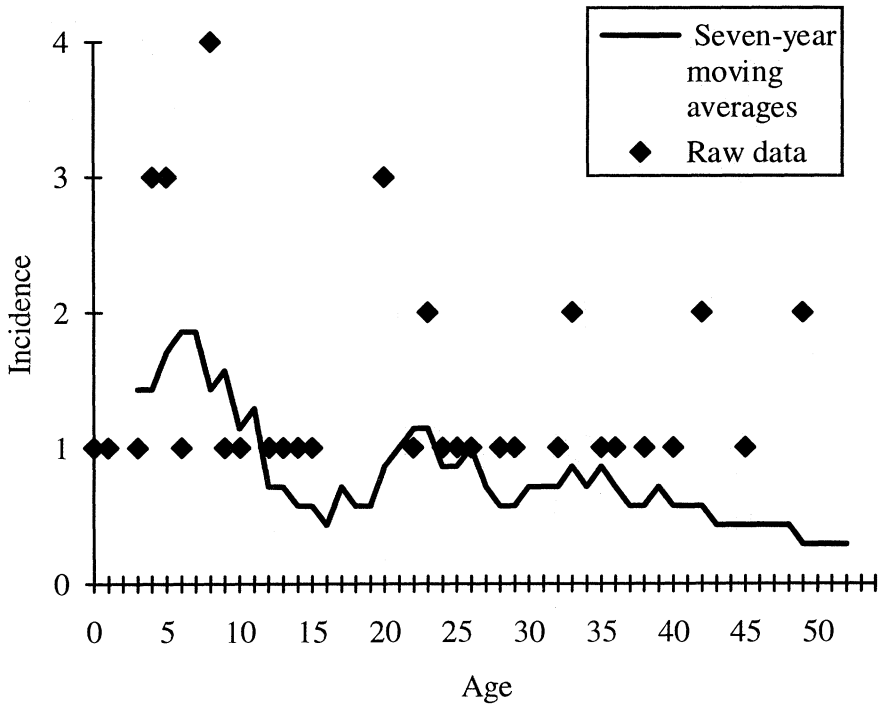


FIG. 2. ATTESTED AND SMOOTHED AGE-DISTRIBUTION OF FEMALE SLAVES IN THE EGYPTIAN CENSUS RETURNS (SOURCE: BAGNALL AND FRIER, *OP. CIT.* (N. 16), 342–3, TAB. D)

female slaves inevitably fall into a very jagged pattern, yet when converted into seven-year moving averages they reveal a relatively consistent distribution (apart from an inexplicable drop during the teens) (Fig. 2). What is more, the distribution of seven-year moving averages from age twenty to the early fifties closely follows the age-distribution predicted by the appropriate model life table (Fig. 3). Other than mortality, there is hardly any room for an attrition factor such as manumission. Since the sample on which Figs 2 and 3 are based consists of only twenty-three individuals, it would be inadvisable to overestimate the significance of this correlation, not to mention its representative value for the Empire as a whole.²⁷ Suffice it to say that the evidence for adult female slaves in the census returns does not support the idea of widespread manumission prior to menopause. That these documents do not record any slave women older than forty-nine (with the single exception of a woman aged sixty-eight) could be taken to imply that female slaves, too, would eventually benefit from manumission once they had discharged their reproductive duties.

The 'intermediate' scenario implies that one-third of all slaves surviving to age twenty-five were subsequently freed while the remaining two-thirds died as slaves. As a consequence, fertility within the unfree population — had it followed the age-specific fertility rates of a stationary population²⁸ — would have been reduced by about 13 per cent. Six million slaves would have been complemented by 1.1 million freedmen.

²⁷ If anything, these records may give us a rough idea of manumission patterns outside the city of Rome and other major urban centres; see below in the text following n. 39.

²⁸ Following Bagnall and Frier, *op. cit.* (n. 16), 143 tab. 7.1 (predicted female fertility rates at different ages). On the underlying assumptions, see above in

text at nn. 19–20. Under conditions of natural fertility, which prevailed in ancient societies (B. W. Frier, 'Natural fertility and family limitation in Roman marriage', *CPh* 89 (1994), 318–33; on slave fertility, see in the appendix), there is no need to consider significantly different age-specific fertility rates.

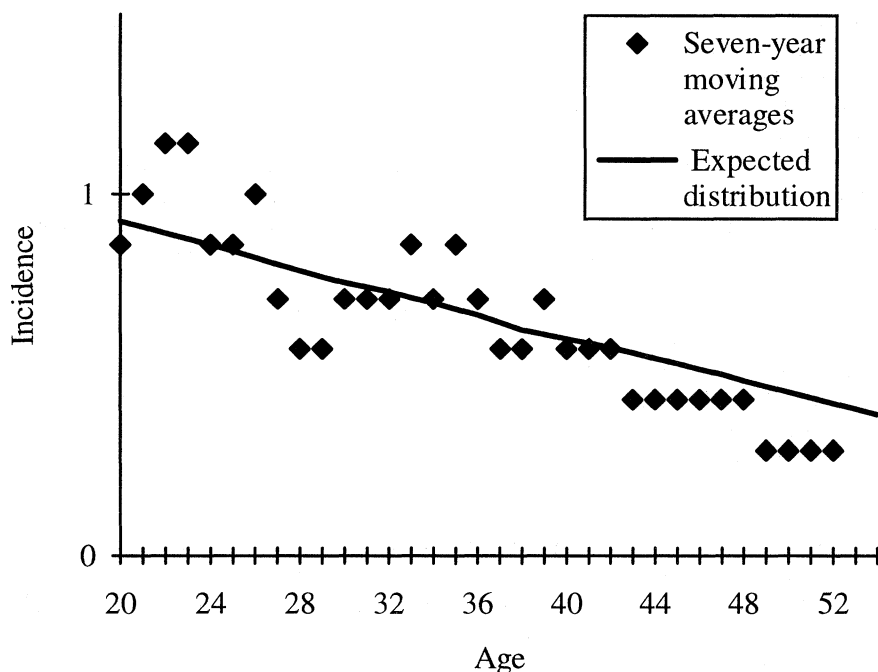


FIG. 3. SMOOTHED AND EXPECTED AGE-DISTRIBUTION OF FEMALE SLAVES IN THE EGYPTIAN CENSUS RETURNS (SOURCES: BAGNALL AND FRIER, *OP. CIT.* (N. 16), 342-3, TAB. D; COALE AND DEMENY, *OP. CIT.* (N. 19), 56).

Manumission as projected here would have two major consequences. The slave population would have shrunk with age at a much faster pace than by way of mortality alone. Moreover, if fertility had been reduced by 13 per cent, the annual birth rate of about 44.4 per 1,000 population (Model West Females Mortality Level 2) would have dropped to about 38.6 per 1,000. In addition to a reduction of fertility caused by the manumission of fecund females, the natural reproduction of slavery may also have been hampered by a whole range of factors including imbalanced sex ratios (skewed in favour of men), lack of mating opportunities, forcible separation from spouses and offspring, deprivation and harsh treatment in general, flight, and perhaps even a weakened desire to procreate.²⁹

Comparative evidence from some of the 'harsher' slave societies of the New World gives us an idea of the likely rates of loss arising from these conditions. Annual rates of decrease from 2 to 5 per cent in parts of the Caribbean and Latin America are considered high and can be attributed in the first instance to the selective character of the slave trade in terms of age and sex and to extreme climatic and epidemiological conditions that were without parallel in the Roman Empire.³⁰

If we completely disregard, in the context of the intermediate scenario, the possibility of decrease by other causes, manumission alone would account for an annual rate of decrease of 5.7 per 1,000. Under these conditions, a population would be halved every 122 years. In the absence of any replenishment from outside, the slave population of the Roman Empire would have shrunk from 6 to 5.2 million within one generation of

²⁹ For a recent discussion of determinants of slave fertility, see Herrmann-Otto, *op. cit.* (n. 10), 235-68. It should be noted, however, that in the Old South, frequent separation of slave families through sale was perfectly compatible with sustained population growth: M. Tadman, *Speculators and Slaves* (1989),

passim; cf. P. J. Parish, *Slavery* (1989), 86 (one-third to one-fourth of all slave marriages in the Upper South were broken).

³⁰ For this important point, see the appendix, and below, n. 31.

twenty-five years. An annual rate of decrease of 1 per cent from other causes as indicated above would, in a non-stationary population, translate to a drop in the birth rate of 10 per 1,000.³¹ Adding this reduction to the loss incurred by manumission, we can put the annual deficit of the overall birth rate at about 36 per cent, a shortfall that would in theory result in an annual Crude Rate of Decrease (that in this case equals the Intrinsic Rate of Natural Decrease) of some 1.57 per cent.³² Barring extraneous supply, the number of slaves would have shrunk from six to four million within a single generation, an assumption that seems *a priori* implausible. Every year, 202,000 slaves would have been born to slaves while an additional 113,000 newborns were needed to stop the decline and to break even. Yet even in this scenario of low slave fertility, two-thirds of all slaves are the offspring of slaves. Natural reproduction would therefore still be by far the most important source of slaves.

Where could the required number of 'new' slaves have come from? On the assumption that the inhabitants of the Empire and the barbarians contributed evenly to the Roman slave trade, at least two-thirds of freeborn slaves would have originated from within the Empire. If we prefer to believe that the strain on outsiders was twice as high as on the population of the Empire, every other freeborn slave would have hailed from beyond the borders. Adopting the latter scenario (while choosing the other one would not make a great difference), within the Empire some 57,000 babies per year would have been turned into slaves, either through exposure or sale after birth. Under prevailing levels of fertility, this figure equals about 3 per cent of all annual births or 1.4 births per 1,000 population. Reckoning with six babies per woman surviving to age fifty, one mother out of every five would have had a baby destined to become a slave. Even in the absence of any tangible evidence this might seem a rather high frequency of child enslavement. If the majority of exposed babies died,³³ this implies that on average, every other mother would have exposed at least one of her children, another premise that strains credulity. Assuming that barbarians were more likely to be imported as young adults rather than in infancy, about 40,000 individuals in their teens and twenties would have crossed the borders year after year. As far as we can tell, this, too, appears to be an implausibly high figure.³⁴ If two-thirds of total demand had been met from within the Empire, one child out of twenty-four and hence one mother out of four would have had to contribute to the slave trade. Even then, more than 25,000 barbarians would have been required as well. All in all, this 'intermediate' scenario, while confirming the predominance of natural reproduction, puts a massive strain on other sources of slaves both within and outside the Empire.

³¹ That this rate is considerably lower than the highest rates attested for the Americas (see appendix) seems justified by the fact that in general, the slave population of the Principate was not a 'young' population in the sense that it was in the process of being created or had only recently been built up. Thus, the age-structure would not have been as skewed as in the emerging slave societies of the Americas. In addition, some extreme hardships characteristic of the Caribbean such as those connected with the cultivation of sugar cane in hostile environments (see B. W. Higman, *Slave Populations of the British Caribbean 1807-1834* (1984), 260-302) would have been largely unknown in the Roman Empire. A. M. John, *The Plantation Slaves of Trinidad, 1783-1816* (1988), 159, finds that in that environment, slaves failed to reproduce themselves owing to extreme levels of mortality, notwithstanding substantial fertility, a phenomenon that could be ascribed to a 'brutal slave system' or the 'appalling conditions prevalent in rural tropical areas' (p. 156).

³² On these two terms, see C. Newell, *Methods and Models in Demography* (1988), 122-3. For a rate of decrease of 15 per 1,000, cf. Coale and Demeny, op. cit. (n. 19), 81.

³³ cf. above, n. 4.

³⁴ For occasional mass enslavement under the Empire, see the references in Bradley, op. cit. (n. 7), 33, 40. Frier, op. cit. (n. 16), reckons with an influx of 20,000 slaves per annum (who contrary to his tacit assumption need not have contributed to population net growth; they are not assumed to do so in any of my models). The occidental slave trade to the Americas reached an annual average of 70,000 in the late eighteenth century, roughly at the rate of two males per one female, thereby creating sex ratios of between 50 and 80 males to 100 females in the most affected parts of Africa: P. Manning, 'The slave trade: the formal demography of a global system', in J. E. Inikori and S. L. Engerman (eds), *The Atlantic Slave Trade* (1992), 120. More than ten million Africans reached the New World as slaves from 1500 to 1900 (p. 119). The rate of intake for the Roman Empire assumed here would have been considerably larger in the long run (at four million per century) — once again, a rather unlikely supposition. (For the problems of estimating the effects of the modern slave trade on African populations, cf. D. Henige, 'Measuring the immeasurable: the Atlantic slave trade, West African population and the Pyrrhonic critic', *Journal of African History* 27 (1986), 295-313.)

Even so, and solely for the sake of argument, I will introduce an even more extreme scenario, the 'high' estimate. In this case, 20 per cent of all slaves are assumed to be manumitted at age twenty-five, thirty, etc. Fertility during slavery would drop by about 24 per cent, and there would have been two million freedmen. About 55 per cent of slaves surviving to age twenty-five would eventually have been manumitted. If we again add a steady rate of decline of about 1 per cent a year we arrive at a total annual decrease of 26 per 1,000. This population would have been halved every generation. Only slightly more than one-half of the demand for slaves could have been met by unfree births (c. 190,000) while another 165,000 births were necessary to break even. Had two-thirds of these 'new' slaves come from within the Empire, one child out of sixteen would have had to be enslaved. More than every third mother would have lost one child to slavery and every mother would on average have exposed one child. On top of that, some 40,000 barbarians would have had to be imported. The unrealistic character of this scenario or indeed of anything that comes close seems obvious.

Nevertheless, this second scenario serves a twofold purpose. It shows that the suggestion advanced by Harris that at least one-half or rather more than one-half of all slaves would not have been born to slaves is very unlikely to be correct even if the slave population is put at six million. At ten million, or one-sixth to one-fifth of the total population, the implications of this idea are necessarily even more extreme. If a free population of forty million had been expected to provide some 250,000 babies per year for enslavement,³⁵ about one live-born baby out of seven would have had to be first exposed and then recovered alive in order to be raised as a slave. Thus, on the theory that the majority of all exposed babies died,³⁶ at least one-third or perhaps one-half of all babies born in the Empire would have had to suffer exposure which is obviously impossible.³⁷ At the same time, the 'high' estimate casts further doubt on Alföldy's thesis that the rates of manumission which can be reconstructed on the basis of tombstone inscriptions are of any broader relevance for Roman slavery at large.³⁸ That two-thirds of all epigraphically attested ex-slaves in Italy were manumitted before age thirty all but *proves* that at least as far as women are concerned, these individuals cannot

³⁵ See above in the text at nn. 2–4.

³⁶ See above, Harris, *op. cit.* (n. 3), 10. J. Boswell, *The Kindness of Strangers* (1988), 129–31, unpersuasively argues against this assumption: *contra*, L. A. Tilly *et al.*, 'Child abandonment in European history: a symposium', *Journal of Family History* 17 (1992), 12, 18. At any rate, a considerable proportion of all exposed babies would have died. In the context of my rough model, it does not make a great difference whether 20, 40, or 60 per cent of them did not survive; even on the basis of the lower estimates, as many as one child out of four or five would have had to be exposed.

³⁷ It is true that in some places in Europe in the nineteenth century, a considerable proportion of all newborn children were abandoned. In the city of Milan in 1842, perhaps the most extreme case, 30 per cent of all babies were abandoned; the corresponding rate for the whole province of Milan is 10 per cent: V. Hunecke, 'Intensità e fluttuazioni degli abbandoni dal XV al XIX secolo', in *Enfance abandonnée et société en Europe XIVe-XXe siècle* (1991), 53. The situation was similar in a few other metropolises such as Paris, Vienna, Florence, Moscow, and St Petersburg (Tilly *et al.*, *op. cit.* (n. 36), 15). In most cases, however, even urban rates did not normally exceed 10 per cent while average rates for entire regions were lower by far (Regno di Napoli, 1836: 4.34 per cent; Lombardy, 1842: 4.81 per cent; Veneto, 1817/27: 2.2 per cent; Dipartimento di Reno, 1811: 3.02 per cent; France, 1846: 2.68 per cent): see Hunecke, *op. cit.*, 52–4 tab.

5. Numbers aside, the background of this practice in early modern Europe is strikingly different from that in antiquity: most babies were not simply exposed and thus put at the mercy of the elements, predators, and slavers, but anonymously deposited in foundling homes. The extent of abandonment was clearly linked to the availability of such institutions. Moreover, the populations in question experienced steady net growth during this period and could therefore easily accommodate a certain degree of child abandonment (and frequent subsequent death in the foundling homes). Hence there is nothing to suggest that the modern data could be of much relevance for antiquity (but cf. below, n. 42). Boswell, *op. cit.* (n. 36), 133 n. 158, 135 n. 167, suggesting an overall rate of abandonment of urban children of 20 to 40 per cent in the Roman Empire (p. 135), places too much confidence in dubious premises advanced by J. C. Russell, *Late Ancient and Medieval Populations* (1985), xii–xiii.

³⁸ He concludes, *op. cit.* (n. 24), 117, 128–9, that most urban slaves during the Empire would be manumitted. The most crucial observation made in his paper, *viz.*, 'Das epigraphische Quellenmaterial ergibt ebenfalls keine genauen Zahlen, aus denen der Proporz der Freigelassenen im Verhältnis zu jenen Sklaven ersichtlich wäre, die die Freiheit nie erlangten' (p. 107), is unduly euphemistic (instead of 'genaue Zahlen', 'precise figures', read 'no figures whatsoever'), and its powerful implications are more-over completely disregarded.

represent more than a relatively small sample of all individuals of servile origin.³⁹ This is not to say that manumission did not play an important social role, above all in uncoupling the most 'efficient' slaves from the bulk of the servile element. Moreover, a slave population as large as, say, six million could easily accommodate a few hundred thousand individuals who benefited from much more generous rates of manumission as long as many others remained unfree forever. This helps to reconcile the urbanocentric epigraphic evidence from Italy and the West and the parochial census returns from Roman Egypt: these two sets of data can simply be seen as representative of different environments, contrasting the socially important but quantitatively minor group of upwardly mobile and epigraphically vociferous freedmen of the urban centres with an otherwise muted majority outside these areas.

My third scenario, the 'low' estimate, is still somewhat pessimistic in that it does not allow for natural reproduction at replacement level, let alone for net growth. In this scenario, manumission before age thirty is altogether disregarded and starts at age thirty at the quinquennial rate of 10 per cent. While there can be no doubt that some manumission occurred prior to age thirty, this assumption is introduced for computational purposes only. One could just as well operate with smaller rates from age twenty or twenty-five onwards, such as 5 or 7 per cent instead of 10. Again, it is only the total effect on fertility that counts here. In this case, almost one-third of slaves surviving to age thirty would have been freed.⁴⁰ Fertility would have been reduced by not more than 7 per cent. In conjunction with a rate of decrease from other causes of 0.5 per 1,000 (somewhat more optimistic than the rate of 1 per cent assumed before), the overall annual rate of decrease can be put at 0.8 per cent a year. The total number of freedmen would amount to about 830,000.⁴¹ 82 per cent of all slaves would have been born to slaves. The deficit of some 55,000 births per year could have been filled by enslaving one child out of every fifty born within the Empire. One out of every eight mothers surviving to menopause would thus have contributed to the slave supply. Every year, some 14,000 young adult barbarians would have been imported. On the face of it, this scenario might seem more plausible than the 'intermediate' estimate. It still requires an influx of some 1.4 million barbarians per century, a rate which roughly equals half the average rate of imports to the Americas during the period from 1500 to 1900. This scenario is also consistent with child exposure (or sale) at the rate of one child per three (average) mothers or so.⁴²

Regardless of whether this last scenario offers a rough approximation of reality or is still somewhat off the mark in one way or the other, in conjunction with the other two scenarios it serves to elucidate some fundamental characteristics of Roman slave society. Manumission of females cannot have peaked around age thirty unless the overall

³⁹ In the context of the 'intermediate' estimate, an attested rate of manumission before age thirty of 67 per cent would be almost seven times as high as the predicted rate of 10 per cent. This could be taken to indicate, no doubt overly schematically, that only one-seventh of all slaves could hope to be commemorated in inscriptions. A slave population thus 'privileged' of close to one million might still seem quite large. As usual, there is no way of arriving at a precise estimate. However, given the impact of slave fertility on the slave supply, manumission before age thirty is unlikely to have benefited more than 5 per cent of all female slaves. This does not preclude significant differences between regions or generally between city and countryside; see below. (For such differences in Brazil, cf., e.g., M. C. Karasch, *Slave Life in Rio de Janeiro 1808-1850* (1987), 345.) Sex-specific differences may have been even more considerable (cf. above on Roman Egypt).

⁴⁰ T. Frank, *Economic Survey of Ancient Rome I* (1933), 384, estimates that from 81 to 49 B.C., c. 500,000 slaves were manumitted in Roman Italy. Although Brunt, op. cit. (n. 17), 549-50, rightly

points out that the underlying argument is methodologically unsound, Frank's figure as such need not be wide of the mark. Reckoning with an average slave population of 1,700,000 in Italy during that period (based on the schematic assumption of a linear increase from 500,000 slaves in 225 B.C. to 2,000,000 in 25 B.C.; cf. Brunt, 67), the rates of manumission posited in my 'low' estimate translate to about 16,000 manumissions per year, while the 'intermediate' scenario would yield about 19,000.

⁴¹ The ratio of freedmen to slaves would thus be roughly one to seven. As Bradley, op. cit. (n. 7), 163-4, points out, in Rio de Janeiro in 1849 (a society that with respect to slavery may have been quite similar to ancient Rome), under a regime of frequent and well-attested manumission, current slaves were about seven times as numerous as ex-slaves (based on Karasch, op. cit. (n. 39), 66 tab. 3.6).

⁴² For what it is worth (which is probably rather little), a rate of child exposure in the order of 5 per cent does not differ widely from respective rates attested in nineteenth-century Europe: see above, n. 37. Cf. also Harris, op. cit. (n. 3), 3.

incidence of manumission was fairly low.⁴³ Enslavement of freeborn inhabitants of the Empire was unlikely to affect more than a relatively small number of mothers and presumably an even smaller percentage of wives in any given generation. Allowing for occasional and unrepresentative peaks in wartime, the regular slave trade across the borders probably involved not more than 10,000 to 15,000 individuals per year. Any intrinsic decrease of the slave population would be low which suggests that the sex and age structure of all slaves and freedmen combined closely followed a natural distribution. This is exactly what we would expect in the case of an 'old', well-established slave society. Most importantly, drawing the lower limit halfway between the 'intermediate' and the 'low' estimate, *at least* three-fourths of all slaves would have been born to slaves. The actual proportion was likely to have been higher still. This contribution makes natural reproduction at least five or six times as important as any other single source of slaves.⁴⁴

IV. FURTHER IMPLICATIONS

These observations also help to deepen our understanding of Roman manumission.⁴⁵ As slave women were relatively rarely manumitted during the period of prime fecundity, the population of freedwomen could not nearly reproduce itself. It was only their freeborn offspring who could hope to resume a regime of natural fertility and reproduction at replacement level. Thus, the population of female ex-slaves inevitably had to pass through a demographic bottleneck that severely curtailed their genetic contribution to the next and all following generations of *ingenui*. For this reason, manumission as practised by the Romans resulted in the first instance in net growth of the freeborn population and at the same time limited the proportion of all citizens who were ultimately the descendants of slaves.⁴⁶ Augustus' Lex Aelia Sentia of A.D. 4 that was meant to discourage masters from freeing their slaves before the age of thirty may well have had some additional negative effect on the fertility of freedwomen. Even so, as my models suggest, manumission before age thirty must, on average, have been relatively rare in any case so that, in general, actual practice would not be completely at variance with legal rules.⁴⁷ Only the most fortunate freedwomen would have been released from guardianship after giving birth to four children under the provisions of the Lex Papia Poppaea.⁴⁸

For purely biological reasons, the fertility of male ex-slaves was presumably considerably less affected by deferment of manumission. But even so, postponement of paternity of freeborn children until after the age of thirty in combination with low life expectancy would have made it rather difficult, in the context of monogamy, for the

⁴³ Both the 'intermediate' and the 'low scenario' suggest something like 60,000 manumissions per year for the whole Empire, or about 1 per cent of a slave population of six million.

⁴⁴ For a discussion of the conditions during the late Republic and the late Empire, see my paper cited in n. 17.

⁴⁵ The gist of the following argument has been anticipated by Brunt, *op. cit.* (n. 17), 143–6, who, however, does not attempt a quantitative appraisal. See also J. Andreau, 'The freedman', in A. Giardina (ed.), *The Romans* (1993), 182–3; P. L. Barja de Quiroga, 'Freedmen social mobility in Roman Italy', *Historia* 44 (1995), 329.

⁴⁶ Manumission was, therefore, unlikely to make a massive contribution to net growth of the free population overall *pace* E. Lo Cascio, 'La dinamica della popolazione in Italia da Augusto al III secolo', in *L'Italie d'Auguste à Dioclétien* (1994), 114, 116. For a recent study of the offspring of *liberti* based on epigraphic material that would have benefited from a demographic perspective, see Weaver, *op. cit.* (n. 10).

⁴⁷ Columella's recommendation (*RR* 1.8.19) to manumit slave women after they had given birth to and raised four children was bound seriously to limit fertility after manumission. (For a discussion of this passage, see my article referred to above, n. 10.) Compare also stipulations in wills such as Salv. Iul., *Dig.* 40.7.3.16: 'si Arethusaeliberta ita sit data, si tres servos pepererit, et per heredem steterit, quo minus pepererit'; also Tryph., *Dig.* 1.5.15. This is reminiscent of the acquisition of freedom through the production of slave children in the manumission inscriptions of Delphi and Calymnos (K. Hopkins, *Conquerors and Slaves* (1978), 155–8).

⁴⁸ Gaius, *Inst.* 1.194; Paul., *Sent.* 4.9.1. The inference drawn by A. Watson, *Roman Slave Law* (1987), 39, that 'under Augustus the procreation of children by freedwomen was officially encouraged' and that the Romans therefore did not find it 'objectionable to have large numbers of freeborn children of freed persons' needs to be qualified in the light of the demographic circumstances.

average freedman to have a large number of recognized offspring with any one woman however young and fecund. These difficulties would likely have been aggravated by the tendency of freedmen to marry within their own group, that is, to marry freedwomen whose marital fertility had in many cases been noticeably reduced.⁴⁹ Therefore, even if the reproductive success of freedmen was much less severely affected than that of their female counterparts, full reproduction after manumission — again *on average* — would be beyond their grasp as well. All this must have made it difficult for many ex-slaves to acquire certain privileges that were contingent on the number of their surviving children. Life expectancy at age thirty would be in the order of twenty-five years.⁵⁰ According to the model reconstruction of Roman family structure in Saller's latest book, the average woman aged fifty-five would have 2.0 living children yet 20 per cent of all women of this age would not have any living children at all.⁵¹ Thus, even reckoning with manumission at the early age of thirty, the concomitant reduction of fertility by about 40 per cent would have left the average freedwoman aged fifty-five with 0.8 living freeborn children while the proportion of childless women would have risen accordingly. Freedmen would be somewhat better off but must also have felt the sting of the self-serving laws of the master class.⁵² 'For if a freedman makes a will he is ordered to make it in such a way that he leaves his patron half of his property (. . .). Natural children avail a freedman to exclude his patron (. . .). From the estate of [a freedman] who leaves a fortune of more than 100,000 sesterces and has fewer than three children, whether he dies testate or intestate, an equal share is due to the patron. (. . .) If he leaves three, the patron is excluded. (. . .) For the number of children whom a freedwoman had at the time of her death an equal share would be due to the patron. Thus, from the estate of a woman who left four surviving children, a fifth share is due to the patron; but if she outlives all her children, the entire estate goes to the patron.'⁵³ As a consequence, masters and their heirs could reasonably expect to acquire by way of inheritance a sizeable share of the possessions of their former slaves.

APPENDIX: ON THE NATURAL REPRODUCTION OF SLAVERY IN THE AMERICAS

According to R. W. Fogel and S. L. Engerman, *Time on the Cross I* (1984), 25–6, the amount of natural decrease in the West Indies ranged from 2 to 5 per cent a year in the eighteenth century but approached zero later on; see in more detail R. W. Fogel, *Without Consent or Contract* (1989), 124 fig. 19. In Brazil, the natural growth rate of the slave population was positive in some areas and negative in others: P. D. Curtin, *The Atlantic Slave Trade* (1969), 29. According to F. W. Knight, *Slave Society in Cuba during the Nineteenth Century* (1970), 83, between 1869 and 1878 the number of slaves fell on average by 5 per cent a year, a decrease at least half of which was due to manumission in the face of imminent abolition. Knight deems an attrition rate due to mortality of 4 per cent a year most plausible (p. 82). H. S. Klein, *African Slavery in Latin America and the Caribbean* (1986), 155, contrasts birth rates in the higher thirties and lower forties (per 1,000 population) among slaves in nineteenth-century Cuba, Brazil, and British Guyana with a birth rate of about 50 per 1,000 in the United States. It is important to note that in the former case, the failure to reproduce is to be attributed not to the sex ratio as such but to the pervasive impact of the slave trade: since mostly adults were imported, the immigrant slave population would inevitably suffer a higher crude death rate than a 'natural' population and hence, given high sex ratios, the birth rate within this group could not possibly balance the full amount of manpower

⁴⁹ See, e.g., P. Huttunen, *The Social Strata in the Imperial City of Rome* (1974), 147, 151; Weaver, op. cit. (n. 10), 179; Barja de Quiroga, op. cit. (n. 45), 345. Cf. also A. Bürge, 'Cum in familia nubas', *ZRG* 105 (1988), 312–33.

⁵⁰ Coale and Demeny, op. cit. (n. 19), 42.

⁵¹ R. P. Saller, *Patriarchy, Property and Death in the Roman Family* (1994), 48 (assuming slightly lower mortality than in my models).

⁵² Under normal conditions, a man aged fifty-five would have 2.6 living children and only 12 per cent would have none (Saller, op. cit. (n. 51), 51–2). If slavery resulted in deferred paternity, the respective

rates for freedmen of that age might have been higher still. Some overall reduction in fertility would, however, have made it rather difficult for many of them to profit from three living children (see below).

⁵³ Gaius, *Inst.* 3.41–4 (transl. Watson, op. cit. (n. 48), 36–7). *Liberti* were released from their duty to perform *operae* for their patron when they had two children of their own in their *potestas* (W. Waldstein, *Operae Libertorum* (1986), 170–1). *Patronae* who were themselves *libertae* were permitted to inherit from their own former slaves only if they had given birth to three children (*Tit. Ulp.* 29.6).

loss (op. cit., 156). This suggests that trade did not merely respond to a pre-existing need for slave imports but at least in part created this need in the first place. Thus also, e.g., F. V. Luna and H. S. Klein, 'Slaves and masters in early nineteenth-century Brazil: Sao Paulo', *Journal of Interdisciplinary History* 21 (1991), 556. On the sex ratios of the slave trade, see D. Eltis and S. L. Engerman, 'Fluctuations in sex and age ratios in the transatlantic slave trade, 1663-1864', *Economic History Review* 46 (1993), 308-23, who note (p. 321) that the overall age and sex structure does not appear exceptional in the light of other long-range migration and that the impact of the two-to-one male-to-female ratio should not be overrated. (Should the same preference for young adult males be presupposed for the Roman slave trade over shorter distances that fed a less market-oriented system?)

High sex ratios would normally even out over time: see Curtin, op. cit., 29-30; O. Patterson, *The Sociology of Slavery* (1975), 107 (Jamaica); D. L. Chandler, 'Family bonds and the bondsman', *Latin American Research Review* 16 (1981), 110-11; A. Kulikoff, *Tobacco and Slaves* (1986), 357-9 (Chesapeake; cf. T. H. Barnett, 'Tobacco, planters, tenants, and slaves', *Maryland Historical Magazine* 89 (1994), 193-4). Even in modern slave societies with an imbalanced sex ratio, natural reproduction would generate a considerable supply of new slaves: Curtin, op. cit., 30; cf. also R. C.-H. Shell, *Children of Bondage* (1994), 46-8 (South Africa). In the British Caribbean, natural growth of the slave population was common in the 'old' colonies while newly developed islands tended to experience decrease after the abolition of the slave trade: Higman, op. cit. (n. 31), 307. That the slave population of the southern United States, in the absence of substantial imports, grew by 2.4 per cent per annum during the period from 1810 and 1860 thus need not have been as exceptional as Harris, op. cit. (n. 1), 121 insinuates. Besides, this is not the only documented case of substantial natural increase: see, e.g., D. Lowenthal and C. G. Clarke, 'Slave-breeding in Barbuda', in V. Rubin and A. Tuden (eds), *Comparative Perspectives on Slavery in New World Plantation Societies* (1977), 510-35; H. E. Lamur, 'Demographic performance of two slave populations of the Dutch speaking Caribbean', in H. Beckles and V. Shepherd (eds), *Caribbean Slave Society and Economy* (1991), 209-20. Cf. also Higman, op. cit. (n. 31), 308-10 tab. 9.1.

Slave fertility in the USA depended to a large extent on family structure: on average, two-parent families had significantly more children than female-headed one-parent families: S. Crawford, 'The slave family', in C. Goldin and H. Rockoff (eds), *Strategic Factors in Nineteenth Century American Economic History* (1993), 339; Fogel, op. cit., 150; for the same link elsewhere, cf., e.g., A. C. Metcalf, 'Searching for the slave family in colonial Brazil', *Journal of Family History* 16 (1991), 283-97. Two-parent slave families were widespread and relatively stable in the USA, which helps to account for the impressive demographic performance of American slaves: Fogel, op. cit., 150 tab. 5, and also R. H. Steckel, *The Economics of U.S. Slave and Southern White Fertility* (1985), 196-202. In the absence of statistical data, structure and fertility of Roman slave families remain obscure. The evidence from the Egyptian census returns suggests that slave fertility was similar to that of all free women, though well below that of all married women: Bagnall and Frier, op. cit. (n. 16), 158. However, this information comes from households with only a few slaves where family formation may have been difficult; moreover, we must allow for the possibility that some children of slave mothers did not appear in the returns because they had already been sold (ibid., 158 n. 85). As for larger slaveholdings in Roman Italy, there is only sparse impressionist evidence: App., *BC* 1.1.7 takes it for granted that slaves on large agricultural estates would have numerous offspring, a notion that is consistent with Varro, *RR* 2.10.6 and Colum., *RR* 1.8.19. The same may have been true for large urban households.

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