

**SOURCE MATERIAL FOR STUDYING
THE SLAVE TRADE AND THE AFRICAN
DIASPORA:**

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The **Advantages and Limitations of
Simulation in Analysing the Slave Trade**

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This paper is a modest, interim report on demographic simulation in the analysis of the African slave trade. My initial work on simulation took place in the 1980s, and I have reported on it in various publications.¹ That work has, I think, the value of proposing specific theses on the changing size and composition of African populations in the eighteenth and nineteenth centuries. I have now developed a revised simulation, and am part way through applying it and projecting its historical implications.² In this interim report, I can restate the principles and results published earlier; and I can advertise what will come later.

Modeling

The shortage of demographic data documenting life on the African continent could lead, and indeed has led to the impression that the continent experienced little demographic change before the colonial era.³ Still, the long struggle over the abolition of the overseas slave trade brought the beginnings of a debate about African demographic change. Malthus applied his thesis to some areas of Africa, notably Senegambia and Ethiopia, and concluded that the slave trade and famine brought serious checks to population growth, but that African population continued to press against those checks. Thomas Fowell Buxton contributed to the parliamentary debate of the 1830s by offering global calculations of the populations lost to Africa through the slave trade.⁴ After abolition and emancipation, W.E.B. Du Bois proposed a cumulative total figure for the number of Africans sent into American slavery. This type of figure remained the basis for discussion of the slave trade into the 1970s, and remains significant today.⁵ Whether the figure is 10 million, 15 million, or 50 million, the problem from a demographic point of view is that it is given as a flat total, without a breakdown by time period, and without a breakdown by age and sex composition.

Philip Curtin's *Census* launched a whole new discussion - most obviously of the volume of the Atlantic trade, but also of its composition and its demographic and social implications.⁶ I was drawn into the discussion by way of an attempt to calculate the number of slaves exported from the Bight of Benin, supplemented by an attempt to distinguish their distribution by ethnic group of sub-region of origin.⁷ In this work I found that of the many slaves exported from the region, especially between 1690-1740, virtually all were Gbe-speakers, and hence from

a region within 200 kilometres of the coast. This led me to offer crude estimates of the regional population, which in turn led me to the conclusion that some 3% of the Gbe-speaking population per year were sent out as slaves. From there, having recently had a brief introduction to demography, I moved on to proposing a general model of the impact of the slave trade on African population. In writing out that model, I found myself drawn into thinking a bit more systematically about the age and sex composition of slave populations. I noted at the time, that a number of the contributions to the debate on the volume of the slave trade reflected little effort at reporting the breakdown of slaves by age or sex. To highlight the importance of a 'disaggregated' approach to the slave trade, the demographic model I published in 1981 emphasizes a breakdown by age, sex, price, time, and by points of origin and destination of those enslaved.⁸

The model, rather than serving to wrap up what I had to say on the subject, led to posing a research agenda. That agenda was to process existing data on the volume and composition of slave exports, show the implications of those data according to the assumptions of the model, pose these implications as historical hypotheses for investigation, and seek out new types of data to verify or reject the hypothesis.

In one sense the projections of the model and the succeeding simulation are wild speculations which cannot be supported by existing data. But one might compare this situation to that of Malthus, who began his own modeling in a time when it was not known whether the population of England was growing. The debate launched by Malthus led to the development of techniques (by others) which ultimately constructed new data and provided us with considerable information on eighteenth-century English population.⁹ It is perhaps not idle to hope that, through the development of other techniques, we may some day have more data on the population of eighteenth-century Africa.

In advance of my first demographic efforts, but equally in response to the debate on the volume of the slave trade, other scholars developed models of the demographic impact of the slave trade, which they applied to the regions they studied. With the exception of John Thornton, however, they proposed models that were very simple - too simple, arguably. More to the point, they did not proceed to the step of simulating, and therefore did not see the importance of adding such factors as the age and sex distribution of the population to their analysis.

This John Fage noted that, for West Africa, the number of persons exported as slaves was less than the net natural population growth of the region, assuming a given level of population and a growth rate of about 5 per thousand per year.¹⁰ From this he concluded that slave exports did not halt population growth in West Africa, though they might have done so in Central Africa. Roger Anstey and David Northrup, in subsequent years, made somewhat similar calculations for

regions of West and Central Africa: they estimated the population that each region should have had to avoid decline as a result of slave exports, and concluded generally that population decline was avoided.¹¹ The problem in each case was that the authors did not take into account the change in age and sex composition of the population that must have resulted from the export of young adults.

John Thornton, in contrast, undertook more detailed empirical work, which led him to more sophisticated modeling of the slave trade and its impact. In particular, his use of Portuguese census reports for Angola, published for 1773 and 1774, drew his attention to the substantial shortage of adult males in comparison to females. Based on this and other empirical work on baptisms in Kongo and Angola, Thornton estimated rates of birth and death which led him to the conclusion that, even with the high rate of slave exports from the region, the Angolan women remaining had enough children to avoid population decline.¹² Focusing on the sex composition of exports, Thornton went on to propose calculations along the lines of Northrup and Anstey, and again concluded that African populations generally avoided decline because of slave exports. The next step for Thornton might have been a more detailed application of his ideas, perhaps through simulation, but his research turned to other topics at this point.

Meanwhile Joseph Miller in 1988 and Jan Vansina in 1992 returned to the issue, Miller for Angola and Vansina for the Equatorial forest.¹³ Both carried out simple additive calculations, and both concluded that population decline was avoided in the area of Central Africa in which they focused. As I will argue below, demographic reasoning based on simulation makes these conclusions very difficult to accept. Since neither of the authors pursued the issue in any demographic depth, it appears that their conclusion was based on their reading of the qualitative sources.

Simulation

Every scholar who has addressed the demographic impact of the slave trade on Africa can be said to have applied a model - some logic, systematic or not, on the relationship between slave exports and domestic population size and structure. But while a model sets out the logic of an analysis, a simulation implements that logic in detail.

Especially with the development of accessible computers, the strong (but not simply determinate) relations in demography lent themselves to simulation. My initial simulation focused on age and sex distinctions; on distinguishing time by one-year periods; on distinctions between free, captive and slave populations; and on some elementary geographical divisions. The simulation included price considerations as well, in the sense that I ran two sets of simulations for two different sets of relative prices - one for what I called the Occidental trade and one for the Oriental trade.

Constructing the simulation, as with constructing the model before, caused me to make many specific decisions: for instance, to create captive populations, with a distinct and higher mortality. I had to set age-specific schedules for capture and for partition (the division of captives into those destined for sale overseas and those destined for sale in Africa). I had to make assumptions on the normal levels of African birth and death rates, and also to set age-specific mortality schedules for captives in Africa and on the Atlantic crossing. One measure to guide me in these choices was that the results of the simulation had to produce slave populations crossing the Atlantic and surviving in the Americas which corresponded to the available evidence. I therefore divided the combinations of assumed data into those which were 'admissible', in that they led to results which were within the range of known characteristics of Atlantic slave cargoes and American slave populations, and those which were 'non-admissible' in that they led to results which were demographically logical but not observed in the historical record.¹⁴ In this way, known observations of the Atlantic slave trade and American slavery served to limit the speculations one could make about the associated demography of the African continent.

Benefits

Perhaps the primary advantage of the simulation approach is that it has served to sustain a focus of analytical attention on the populations of the African continent. Too often, the unobserved complexities of demography in Africa have remained outside discussion. For example, I once attended a conference on the Caribbean in which it became clear to me that some scholars focusing on the Caribbean, in considering immigrants to that region both from Europe and from Africa, considered the two movements in different fashions. That is, in analysing English indentured servants, they considered the lives of their subjects from the moment of birth, including their movements within England and their decision to emigrate. At the same time, in analysing the slave trade, they began with their subjects only once they were loaded on board ship. In contrast to this inconsistency, the approach of simulation encourages us, if only at the level of imagination, to include all of African life and death as part of the Atlantic system, on a basis fully analogous to that of people in Europe and the Americas.

The second benefit of simulation is that it encourages the application of existing typology and theory in detail. Through linking formal theory to available data by filling in data where they are missing, it enables us to use all the knowledge we have (though at the risk of adding some that we do not have).

A third benefit of simulation is that it has drawn attention to variables and elements of the model left vague or unattended to in initial work. In particular, constructing the simulation drew attention to the logical distinction between captive and slave, and thereby drew attention to the size and composition of

captive populations at each stage in the process of enslavement.

Fourth, the simulation has drawn attention to the actual values of variables included in the analysis, and has encouraged a reconsideration of earlier empirical work. In particular, it has encouraged me to review the earlier demographic work of John Thornton. In various articles on Kongo and Angola, Thornton argued that the empirical record for the seventeenth and eighteenth century in that region was consistent with an expectation of life at birth of 27.5 years, with a birth rate as high as 48 per thousand, and with an intrinsic growth rate of 7.5 per thousand.¹⁵ In my initial simulation, I set aside the last two figures as too high, but accepted the figure for expectation of life at birth, and used it in my simulations. Faced with general disbelief of that figure by demographers, however, I went back to Thornton's articles, recalculated the data he presented there, and concluded that he had not in fact demonstrated the validity of the results he proposed. The full discussion on this issue is to be presented elsewhere; the point here is that the simulation, by drawing attention to the specifics of the values of these demographic variables, encouraged a more critical approach to the available data and interpretations.

A fifth benefit of simulation lies in its explicit handling of the factor of time. Models can be expressed in cross-sectional terms, not clearly indicating the changing compositions of populations with time. The precise way in which time is utilized in the initial simulation is not necessarily the best, but at least one is forced to see what that formulation is. For instance, the simulation began in its first year with a slave population of zero, and then builds it up.

A sixth advantage is that simulation permits analysis of interactions of variables within the analysis. For each variable, I set middle, high and low levels, then varied them one at a time and two at a time, to see how the results varied. (Results were measured through three 'criterion variables', as I called them: the growth rate of the African regional population, the adult sex ratio within Africa, and the proportion of slave exports to African regional population.) I then used multiple regression analysis to see which independent variables caused the most variation in results. The consequences were that the analysis identified as key variables the intrinsic African growth rate, the size and composition of the captive population, and the partition of captives into those sent abroad and those maintained locally.¹⁶

One further characteristic of the simulation approach, which may turn out to be an advantage, is that it encourages the making of additional distinctions within the category of 'data'. We begin with directly recorded data, such as figures on the numbers of persons carried on slaving voyages, and the number and origins of slaves inhabiting various areas of America: examples here include the slave trade figures of Mettas, and the slave population figures of Higman.¹⁷ From there we move to transformed data, in which raw data have been summed and

organized, including the addition of estimates to fill obvious lacunae - figures such as the estimates of Curtin and Eltis on totals in the flow of slaves across the Atlantic.¹⁸ In the simulation, these 'historical' data have been combined with hypothetical data. The types of hypotheses from which such data are developed vary significantly. Some of the hypothetical data are based on demographic theory (the age structure of population, the age structure of women's fertility). Some are developed from projections based on assumed growth rates (the African population sizes). Some are based on projections from historical evidence (the overall rates of capture and captive mortality). And still other data are pieced together from insights stemming from several of these premises: thus, the estimates of the age and sex composition of the captive populations, and their partition into those retained in Africa and those sent abroad, draw in some measure on all of the above premises. In another sense, however, they are just guesses.¹⁹

Overall, therefore, the exercise of simulation reveals the difficulty of making clear distinctions between the primary historical data, data constructed out of primary data, and speculative data included for purposes of completing the logic of the analysis. Perhaps none of it can be labeled absolutely as 'true', and perhaps all of it has some basis in the empirical record. But the distinctions at each stage of the analysis remain worthy of note, as summation, interpolation, analogy, theory, and the intuitive judgement of the researcher add to the empirical base, as the researcher seeks to develop a coherent picture of the past.

On the one hand, this reality may be used to portray the work of this simulation study as an analytical house of cards, ready to collapse because of the narrowness of its base in the slim collection of recorded evidence surviving from the actual events and processes of the past. On the other hand, the development of an overall coherence in the resulting global picture becomes a new sort of data itself, which may verify, in a certain sense, the many speculative gaps in between. That is, the theses proposed for the western coast of Africa in the eighteenth century - population decline, development of a substantial shortage of adult males, and contemporaneous development of a widespread system of female slavery - may be examined in the light of the logic and evidence of the slave trade, and this examination may through light on the speculative demographic calculations which give rise to the theses.²⁰

Limitations

The danger of error in calculations and therefore in reported results is present in simulation, as in any sort of research. For instance, the current version of my simulation contains, in one version, a result indicating a very high death rate among infants - exceeding the number of infants captured. This strange result is theoretically possible, since new infants were born in the aftermath of capture, and if enough of them died then the number of infant deaths could exceed the

number of infants captured. On the other hand, the result may also result from an error in calculation resulting perhaps from an invisible error in one of the data files. This example should serve to indicate that, in the numerous and complex calculations of a simulation such as this, a great deal of time is spent in chasing down and eliminating small but significant errors.

A second limitation on the validity of this simulation is that it requires figures for the stock of population of each African region, at each time, to be related to the flow of slaves exported from that region. The approach I have followed is to begin with twentieth-century populations and project them backwards in time to the mid-nineteenth century. In the first version of the simulation I used a common growth rate for all African regions; in the second version, I am proposing specific growth rates for each region, based on the available evidence for the demographic history of that region.²¹

This leads us to a more general limitation of the simulation approach: the complexity of the calculations and relationships it includes. This complexity includes not only the mechanical details of the simulation itself, but the additional steps necessary to link it to the historical record it is supposed to elucidate. For instance, while the simulation projects the composition and growth rate for each region of African within each decade, the linkages among the various periods are made by hand calculation. The population for each region is projected backward from the recent past to the period when slave exports were last significant in each region, and then the growth rate resulting from comparison of those figures is used to project the population of the previous period.

Thus, a further danger of the simulation is if one begins to believe, in any detail, the numbers it produces. Computers are happy to produce numbers with several figures past the decimal, and it is up those who use them to emphasize the margin of error in any projections of African demography. Curtin proposed a margin of 20%, more or less, in appreciating any figures he offered for the volume of the slave trade. A somewhat larger margin of error should be understood for demographic estimates on the African continent.²² Nevertheless, certain of the conclusions resulting from the simulation analysis are so robust that they may be accepted as verified even with a large margin of error. So we do not know what the population of Central Africa was from 1750 to 1850, but we may be certain that it was prevented from growing, and was possibly decreased substantially, by the drain of captives across the Atlantic.

So far, simulation work on African demography has been done with a single model. The second model, on which I am working, is rather similar to the first. Other models of quite different structure, emphasizing other dimensions of the slave trade and African demography, could be developed and applied. Only when and if we have results of several models will we have a clear sense of the degree to which simulation adds to our understanding of the history of the slave trade.

One other area of slave-trade history in which simulation might be applied is in the history of changing prices. David Richardson and Paul Lovejoy have launched a major initiative in collecting slave prices in the interior of the African continent as well as along the coast, and these data might conceivably be fitted into a model which would project quantities of slaves bought and sold to go with these prices.²³ But the relationships in demography are more tightly limited than those in economics: prices vary more, and in response to a wider range of factors, than do rates of birth and death.

In the work I have done, the simulation can limit 'admissible' outcomes, and thus eliminate consideration of many combinations of hypothetical data. Beyond that set of limits, however, the simulation cannot choose which of the admissible outcomes (or accompanying input data) are the best guesses as to what actually happened. This work must be done by the historian.

Similarly, the simulation can pose questions and topics for research, but cannot suggest how best to carry out the research. Thus, the sensitivity analysis conducted in the first simulation clearly identified certain historical variables as those which had the greatest impact on the demographic outcome of the slave trade, and on which further information would therefore be most significant. These were, as noted earlier, the inherent growth rate of African populations, the age and sex composition of the captives, and the division of captives by age and sex into those retained in Africa and those sent abroad. Finding new data on these key variables is a matter of research into written documents, oral sources, and perhaps even linguistic analysis.

One further difficulty with the simulation approach, and a serious one, has been its inaccessibility, of two sorts. By that I mean not only the inaccessibility that comes because many scholars are unfamiliar with the details of demographic analysis and the particular approach used in this case, but more seriously, the inability to get to the actual calculations - to follow them through and verify them, or to suggest specific alternatives. To my mind, the biggest problem with what I have presented so far is that, while I have been able to lay out the principles of the analysis with some care, the details of the analysis have not yet been laid open to scrutiny.

Fortunately, the development of the Internet is resolving this problem. A version of my second simulation is now set up on the Internet, and five distinct sets of results can be accessed and viewed through Netscape or other browsing programmes.²⁴ In addition, the site includes the new simulations of both the Occidental and Oriental slave trades, enabling users to select a wide range of input data, and observe the output which comes with each. An associated e-mail bulletin board is available for commentary on the simulation and its results, thus permitting the discussion and critique of the technique and methodology which has previously been impossible to carry on.

NOTES:

- 1 Patrick Manning and William S. Griffiths, 'Divining the unprovable: simulating the demography of African slavery', *Journal of Interdisciplinary History*, 19/2 (1988), 177-201; Manning, 'The impact of slave trade exports on the population of the Western Coast of Africa', in Serge Daget (ed.), *De la traite à l'esclavage* (Paris, 1988), II, 111-34; Manning, *Slavery and African Life: Occidental, Oriental and African Slave Trades* (Cambridge, 1990).
- 2 Patrick Manning, 'The demography of African slavery: a global model', *Social Science History*, 14/2 (1990), 225-79.
- 3 John D. Fage, 'Slavery and the slave trade in the context of West African history', *Journal of African History*, 10 (1969), 393-404; John C. Caldwell, 'The social repercussions of colonial rule: demographic aspects', *UNESCO General History of Africa*, VII (Berkeley, 1985), 458-87.
- 4 Thomas Malthus, *An Essay on the Principle of Population* (2nd ed., London, 1803); Thomas Fowell Buxton, *The African Slave Trade and its Remedy* (London, 1968).
- 5 Philip D. Curtin, *The African Slave Trade: a census* (Madison, 1969).
- 6 Ibid.
- 7 Patrick Manning, *Slavery, Colonialism and Economic Growth in Dahomey, 1640-1890* (Cambridge, 1982).
- 8 Patrick Manning, 'The enslavement of Africans: a demographic model', *Journal of African Studies*, 15/3 (1981), 499-526.
- 9 Malthus, *Population: the first essay* (Ann Arbor, 1959; first published 1793); for recent estimates, see E.A. Wrigley and R.S. Schofield, *The Population History of England, 1541-1871* (Cambridge, MA, 1981).
- 10 Fage, 'Slavery and the slave trade'.
- 11 Roger Anstey, *The Atlantic Slave Trade and Abolition, 1760-1810* (Cambridge, 1975); David Northrup, *Trade without Rulers: precolonial economic development in South-Eastern Nigeria* (Oxford, 1978).
- 12 John Thornton, 'The slave trade in eighteenth-century Angola: effects on demographic structures', *Canadian Journal of African Studies*, 14 (1980), 417-22.
- 13 Joseph C. Miller, *Way of Death: merchant capitalism and the Angolan slave trade, 1730-1830* (Madison, 1988); Jan Vansina, *Paths in the Rainforests: Toward a history of political tradition in the Equatorial Forest* (Madison, 1992).

- 14 Manning and Griffiths, 'Divining the unprovable'.
- 15 John Thornton, 'An eighteenth-century baptismal register and the demographic history of Manguenzo', in C. Fyfe and D. McMaster (eds), *African Historical Demography*, I (Edinburgh, 1977), 405-15; 'Demography and history in the Kingdom of Kongo, 1550-1750', *Journal of African History* 18 (1977), 507-30; 'The demographic effect of the slave trade in Western Africa, 1500-1850', in C. Fyfe and D. McMaster (eds), *African Historical Demography*, II (Edinburgh, 1981), 691-720.
- 16 Manning, 'Impact of the slave trade'.
- 17 Jean Mettas, *Répertoire des expéditions négrières françaises au XVIIe siècle* (ed. Serge Daget, 2 vols, Paris 1978-84); B.W. Higman, *Slave Populations of the British Caribbean 1807-1834* (Baltimore, 1984).
- 18 Curtin, *Atlantic Slave Trade*; David Eltis, *Economic Growth and the Ending of the Atlantic Slave Trade* (New York, 1987).
- 19 Joseph Greenberg, in attempting to assess to relative age of the divergence between various language groups in Africa, suggested in informal conversation (in 1969) that part of the way he reached his conclusions was by 'feel'. To my knowledge, however, he never published his results based on this criterion.
- 20 The historical hypotheses themselves may be seen as an additional benefit of simulation analysis. The hypotheses noted here are set forth in various places, but most conveniently in Manning, *Slavery and African Life*.
- 21 For some useful guidance on the handling of colonial demographic data, see Bruce Fetter (ed.), *Demography with Scanty Evidence* (Boulder, 1993).
- 22 Curtin, *African Slave Trade*; Manning, *Slavery and African Life*.
- 23 Paul E. Lovejoy and David Richardson, 'Competing markets for male and female slaves: prices in the interior of West Africa, 1780-1850', *International Journal of African Historical Studies*, 28 (1995), 261-93.
- 24 The address of the simulation is: <http://www.whc.neu.edu/simulation/afrintro.html>