THE SPREAD OF ROMAN CITIZENSHIP, 14-212 CE:

QUANTIFICATION IN THE FACE OF HIGH UNCERTAINTY*

Myles Lavan

This paper borrows an analytical method from the sciences to solve an important problem in Roman history which has long seemed intractable: estimating the proportion of provincials who had Roman citizenship before Caracalla's general grant of 212/213 CE. The scale of enfranchisement in the early empire has important ramifications for our understanding of the significance of Roman citizenship in that period and the impact of Caracalla's grant. Yet it has so far eluded quantification entirely. Previous efforts have focussed on counting names on inscriptions and other documents and failed to produce any robust conclusions. The problem demands a new approach. This paper starts from the fact that we know that there was a limited number of mechanisms by which new citizens were created and shows that there are limits to the number of citizens those mechanisms can have created over two centuries. There is of course considerable uncertainty about many of the relevant variables, but this can be managed thanks to well-established probabilistic techniques for the estimation and propagation of uncertainty. Given what we already know about the mechanisms of enfranchisement and the demography of the provinces, I will show, it is extremely unlikely that more than one third of the free population of the provinces were Roman citizens on the eve of Caracalla's grant.

These are the preliminary results of an ongoing research project. Future publications will refine the estimate, provide more detailed discussion of the underlying assumptions and further explore the historical implications of the result. Here, the focus is on methodology, demonstrating that the uncertainty about the individual mechanisms of enfranchisement does not preclude a useful quantitative estimate of the overall level of enfranchisement. The analytical method described here could be a useful tool in attempts to solve many other historical problems that seem similarly beset by insuperable uncertainty.

i. The problem

It is a commonplace of Roman history that Rome's generosity with its citizenship distinguished it from other ancient city states and played an important role in its success as an imperial power. From an early period the Romans enfranchised immigrants and the populations of some conquered territories, as well as their own freed slaves. But Roman citizens remained a minority of the total population of Italy until the mass revolt by the Italian allies in 91-88 BCE (the Social War), when citizenship was granted to all free inhabitants of peninsular Italy (and later extended to Cisalpine Gaul by Caesar in 49 BCE). The next stage was the provinces. The citizen body had already spread beyond the borders of Italy over the previous two centuries, as hundreds of thousands of veterans and other opportunistic Italians settled abroad. Their numbers swelled during the first century BC, thanks to the colonial foundations of Julius Caesar and Augustus (which settled somewhere between half a million and a million Italians in the provinces) and also a surge in grants of citizenship to prominent provincials and even whole communities by rival Roman aristocrats. By the death of Augustus in 14 CE, around four to seven per cent of the free population of the provinces were

Roman citizens.[2] The spread of citizenship continued under the emperors as more provincials became Roman citizens by serving in the Roman army, holding magistracies in privileged cities, benefitting from grants from the emperor (who enfranchised individuals, families and even whole cities) or as ex-slaves freed by Roman citizens. It reached a conclusion in 212 or early 213 CE, when the emperor Caracalla issued an edict, the so-called *constitutio Antoniniana* (CA), granting citizenship to all or almost all the free inhabitants of the empire.[3] This apparently straightforward narrative is complicated by one massive gap in our knowledge. We still have no firm idea of how far the process of enfranchisement had advanced by 212 and hence the scope of Caracalla's grant.

One of the most surprising features of the CA is the paucity of references to it in contemporary sources. Besides a fragmentary papyrus which probably contains the text of the edict itself (*P. Giss.* 40 I), it is attested only by brief notices by the contemporary historian Cassius Dio (78[77].9.5) and the Severan jurist Ulpian (excerpted at *Digest* 1.55.17) and a few scattered references in much later texts, several of them wrongly attributing it to other emperors.[4] The silence of contemporaries was long taken as an indication that Caracalla's grant had little impact, because citizenship was already widespread and had lost much of its significance by that point. In what is still the authoritative study of the historical development of Roman citizenship, A. N. Sherwin-White studiously avoids questions of demography and

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[2] Assumes a total of 1.9 million Roman citizens in the provinces (provisionally following Peter Brunt, *Italian Manpower, 225* B.C.-A.D. *14* (Oxford, 1971), 265; see Appendix n. 4) in a total population of 33-48 m of whom 6-20% were slaves (see Appendix nn. 1 and 23). I intend to revisit this estimate using the probabilistic method developed here.

[3] On the date, see especially Hartmut Wolff, *Die Constitutio Antoniniana und Papyrus Gissensis 40 I* (Cologne, 1976), 13-24, Kostas Buraselis, *THEIA DÔREA: Meletes pano stin politiki tis dynastias ton Severon kai tin Constitutio Antoniniana* (Athens, 1989), translated as *THEIA DÔREA: Das göttlich-kaiserliche Geschenk: Studien zur Politik der Severer und zur Constitutio Antoniniana* (Vienna, 2007), 1 (all page references are to the German translation) and most recently T. D. Barnes, 'The Date of the *Constitutio Antoniniana* Once More', in Barbara Pferdehirt and Markus Scholz (eds.), *Bürgerrecht und Krise. Die Constitutio Antoniniana 212 n. Chr. und ihre innenpolitischen Folgen* (Mainz, 2012), though his arguments for 212 are still subject to the caveats in Wolff. On the near-universality of the grant, see François Jacques and John Scheid, *Rome et l'intégration de l'Empire (44 av. J.-C.-260 ap. J.-C.). 1, Les structures de l'empire romain* (Paris, 1990), 284-6 and Valerio Marotta, *La cittadinanza romana in età imperiale (secoli I-III d.C.)* (Turin, 2009), 120-23.

[4] See Marotta, *La cittadinanza romana*, 101-3.

quantification, but repeatedly uses language suggesting accelerating and cumulatively far-reaching enfranchisement before 212. He writes of the accelerating operations of a 'great machine' and describes the process of enfranchisement as becoming a 'flood tide' by the late first century CE.[5] As a result, he suggests, Roman citizenship lost much of its value over the course of the two centuries before the CA.[6] Caracalla's grant was merely the predictable 'final act' of this 'vast process'.[7] The mutually reinforcing hypotheses of extensive enfranchisement, the progressive devaluation of Roman citizenship and the near-irrelevance of the CA remain influential. In one of the most important recent studies of citizenship in the early empire, Tullio Spagnuolo Vigorita writes of the mass integration of provincials into the citizen body and concomitant dilution of the content of citizenship.[8] His assessment of the CA is devastating: Caracalla himself accorded it little importance, its beneficiaries received it without enthusiasm, and jurists, historians and later emperors showed little interest in it. It merely ratified citizenship's final loss of significance.[9]

All three elements of this model have been questioned. But the paucity of evidence for the changing legal content of citizenship in the early empire and the difficulty of isolating the impact of the CA in the turbulent and poorly documented third century has meant that the hypothesis of widespread enfranchisement has always borne most of the weight in this interpretive structure.[10] It has proved difficult to dislodge, though it has been challenged by a growing number of scholars in recent decades. They were influenced by mounting evidence

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[5] A. N. Sherwin-White, *The Roman Citizenship*, 2nd edn (Oxford, 1973), e.g. 251 and 264.
[6] *Ibid*. 221-4 and 264-74.
[7] *Ibid*. 279.
[8] Tullio Spagnuolo Vigorita, 'Cittadini e sudditi tra II e III secolo', in Andrea Carandini, Lellia Cracco Ruggini and Andrea Giardina (eds.), *Storia di Roma III: L'età tardoantica. 1. Crisi e trasformazioni* (Milan, 1993), 15 and 12.
[9] *Ibid*. 7.
[10] For a critique of the evidence for the supposed decline in the legal privileges of citizenship, see Buraselis, *THEIA DÔREA*, 120-154. On the potentially transformative effects of the CA, see *Ibid*., especially 132-57, Olivier Hekster, *Rome and its empire, AD 193-284* (Edinburgh, 2008), ch. 3 and Clifford Ando, *Imperial Rome AD 193 to 284 : The Critical Century* (Edinburgh, 2012), ch. 4 (positing an 'Antonine revolution' in the legal sphere).

for the prominence of the *nomen* Aurelius in the East of the empire in the third and fourth centuries CE.[11] Many of these Aurelii must have been new citizens who took their name from the emperor we call 'Caracalla' (M. Aurelius Antoninus) or their descendants. A key intervention was a monograph-length study of the CA by Kostas Buraselis which suggested, on the basis of the number of Aurelii, that there was still 'a large number' of non-citizens in 212 and made a case for the political significance of the CA.[12] François Jacques subsequently presented an important synthesis of the onomastic evidence and concluded that enfranchisement was still 'limited' in 212 and that the CA was revolutionary, not inevitable.[13] Peter Garnsey has suggested that 'a very substantial number of people in the eastern part of the empire (in city and countryside) and in the West (especially in the countryside)' lacked citizenship in 212.[14] But it should be obvious that all these revisionist interventions remain deliberately vague. This vagueness reflects the limitations of the evidence on which they are based.

All research to date has focussed on the onomastic evidence from inscriptions and papyri. Scholars have sought to measure the representation of Aurelii after 212 and/or the relative proportion of citizen and peregrine names in populations before 212 (on the not unproblematic hypothesis that certain name-forms are unique to Roman citizens).[15] This

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[11] See most recently Athanase D. Rizakis, 'La diffusion des processus d'adaptation onomastique: les Aurelii dans les provinces orientales de l'Empire', in Monique Dondin-Payre (ed.), *Les noms de personnes dans l'Empire romain. Transformations, adaptation, évolution* (Bordeaux, 2011), 253-262 and Janken Kracker and Markus Scholz, 'Zur Reaktion auf die *Constitutio Antoniniana* und zum Umfang der Bürgerrechtsverleihungen anhand des kaiserlichen Familiennamens Aurelius', in Barbara Pferdehirt and Markus Scholz (eds.), *Bürgerrecht und Krise. Die Constitutio Antoniniana 212 n. Chr. und ihre innenpolitischen Folgen* (Mainz, 2012).

[12] Buraselis, *THEIA* DÔREA, 154.

[13] Jacques and Scheid, *Rome et l'intégration de l'Empire* i, 289.

[14] Peter Garnsey, 'Roman Citizenship and Roman Law in the Late Empire', in Simon Swain and Mark Edwards (eds.), *Approaching Late Antiquity: The Transformation from Early to Late Empire* (Oxford, 2004), 137.

[15] Jacques and Scheid, *Rome et l'intégration de l'Empire*, 282-4 remains the best overview of the evidence. For the latest analyses of the Aurelii, see n. 10 above. Hartmut Wolff, 'Zum Erkenntniswert von Namensstatistiken für die römische Bürgerrechtspolitik der Kaiserzeit', in Werner Eck, Hartmut Galsterer and Hartmut Wolff (eds.), *Studien zur antiken Sozialgeschichte: Festschrift Friedrich Vittinghoff* (Cologne, 1980), 229-55 surveys some of the methodological problems.

evidence usefully demonstrates that there were still significant numbers of non-citizens in some areas, especially in the Eastern provinces. But it also reveals a high degree of variation – between East and West, between different provinces, and between different communities within each province. Moreover, outside Egypt the evidence can only show us the epigraphically visible segment of the population and tells us nothing about those (presumably the majority) whose names were not monumentalised on stone, because their families lacked the wealth to do so or did not participate in Roman-style funerary commemoration. And there are numerous problems complicating any attempt to deduce an individual's citizen status from his or her name. Onomastic evidence will remain important for local histories of enfranchisement, but it gives at best a partial picture of the community in question and is a flimsy basis for extrapolation to the level of whole provinces, regions or the empire as a whole.

The question of what proportion of the free population of the provinces had citizenship by 212 thus remains wide open. While some scholars remain committed to a vision of widespread enfranchisement and others embrace the new minimalist view, most prefer a politic but unhelpful vagueness. This has made it impossible to reach any consensus about the changing significance of citizenship over the first two centuries CE or the likely impact of Caracalla's grant. It also undermines research into the many other questions in the political, social and cultural history of the early empire for which the process of enfranchisement has ramifications, such as the relationship between political integration and the transformation of material culture and identities in the provinces, the spread of Roman legal forms and its consequences or the impact of citizenship and legal institutions on economic performance. For too long historians have had to resign themselves to writing the history of the early empire without a firm understanding of this important process.

ii. A new approach

This paper takes a different approach. Citizenship could be acquired through five specific mechanisms: (i) regular grants to non-citizens who served in the Roman army, (ii) the automatic promotion of men who held magistracies in communities with the Latin right, (iii) other discretionary grants to individuals, (iii) block grants to whole communities and (v) the manumission of slaves by Roman citizens.[16] I call these the mechanisms of enfranchisement to emphasise the fact that they did not work at random. The number of new citizens created by the army, for example, must be a function *inter alia* of the size of the army and the discharge rate. The reason this is helpful is that we have a better understanding of many of those variables than we do of the level of enfranchisement. This makes it possible to disaggregate the problem into component parts which are more tractable individually.

The key parameter I need to estimate in order to understand the scale of enfranchisement before Caracalla's grant is the proportion of the free population of the provinces who were citizens in 212 (the *level of enfranchisement* in the provinces). This calculation excludes Italy, because we know Italians were already citizens, and slaves, becauseonly the free could be citizens. This unknown quantity can be represented as a function of the total provincial population and the number of citizens in the provinces in that year. The latter is in turn a function of the number of citizens in 14, the cumulative contribution of each of the five mechanisms of enfranchisement over the period 14-212, net migration of citizens between Italy and the provinces and natural growth in the citizen body (including newly enfranchised citizens). The contributions of each of the mechanisms of enfranchisement can be disaggregated further into a few key variables such as the size of the

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[16] On the law of enfranchisement, see Marotta, *Cittadinanza romana,* ch. 3. There were a handful of other mechanisms by which citizenship could be acquired (e.g. Junian Latins could claim the franchise by building ships to transport grain to Rome), but they are of little significance overall.

army and the discharge rate. All told, there are approximately forty distinct parameters that will together have determined the level of enfranchisement in 212.

If I knew the historical value of those parameters, I would be able to produce a very good estimate of the level of enfranchisement. Setting aside for the moment the profound problem that in many cases I do not know the historical value, it is a purely technical matter to build a computational algorithm or model which will simulate the progress of enfranchisement based on any given set of values for the component parameters. The construction of the model requires knowledge of the mechanisms of enfranchisement, to identify the key parameters, and some technical skill, both to correctly compute the interaction of the input parameters and to allow them all to be variable inputs (rather than having a single value hard-wired into the model). The constraints of this paper limit me to a brief overview of the model and its parameters.[17] Readers who are willing to accept the identification of the key parameters and design of the model as conceptually straightforward may prefer to skip to Section iv where I discuss the more interesting question of how to apply the model to the problem at hand.

iii. Modelling enfranchisement

The model simulates the evolution of both the total provincial population and the citizen population of the provinces on a year-by-year basis from 14 through to 212, allowing for natural growth in both populations, the operation of the five mechanisms of enfranchisement and migration between Italy and the provinces. The selection of 14 as a starting point is pragmatic, exploiting Peter Brunt's existing estimate that there were 1,870,000 Roman citizens outside Italy in that year – the product of two centuries of private

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[17] The algorithm is too complex to publish in detail here. I intend to publish the final version of the model at the conclusion of the project.

migration and the mass settlement of veterans by Caesar and Augustus.[18] The figure is implausibly precise, but it is of the right order of magnitude.[19] I intend to revisit it using the same methodology applied to the later period in this paper.

The total provincial population is modelled as a function of a starting population in 14 (parameter no. 1) and a peak population on the eve of the outbreak of the Antonine plague in 165 (2). Given these two fixed points (and making a minor adjustment for annexations by Claudius and Trajan), the model calculates the implied annual growth rate over this period – somewhere between 0.0 and 0.4 per cent – and hence interpolates to the intervening years. The Antonine plague is provisionally modelled as a net population loss over the period 165-189 (3), with growth then resuming (after the mortality crisis and immediate fertility response) at the rate calculated for the period 14-165. Given the starting population of provincial citizens in 14 (4), the stock of citizens (including new citizens) is assumed to grow naturally from its level in 14 at around the same annual growth rate as that calculated for the total population, allowing for a difference of some percentage points in either direction (5). The Antonine plague is assumed to have the same impact on the citizen population as on the provinces as a whole – a conservative assumption since citizens are likely to have to have been over-represented in cities, militarised zones and other areas likely to have experienced elevated mortality – and hence has relatively little impact on the level of enfranchisement as calculated by the model.

The most straightforward mechanism of enfranchisement is the army. After Claudius regularised auxiliary enfranchisement, soldiers who served in the *auxilia* or fleet normally received citizenship for themselves and their offspring after 25 years of service (normally 26

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[18] Brunt, *Italian Manpower, 225* B.C.-A.D. *14* (Oxford, 1971), 265.
[19] See Appendix n. 4.

in the fleets).[20] The enfranchisement of offspring was discontinued in 140. To estimate the number of new citizens created by the army each year, the model first calculates the total manpower of the *auxilia* and fleet given the paper strength of the *auxilia* in each year (6), the ratio of actual to paper strength (7) and the effective strength of the fleets (8). It then estimates the number of soldiers completing 25/26 years of service given that total manpower, the average length of service before discharge (9) and survival rates (10). Finally it calculates the total number of enfranchisements based on the average number of offspring per enfranchised veteran (11). A further unknown is the scale of auxiliary enfranchisement before Claudius; it is modelled as being some fraction of the number of citizens that would have been created by the Claudian regime (12).

The next mechanism of enfranchisement is the Latin right. Magistrates and later senators in Latin communities were able to secure citizenship for themselves and their relatives by holding office. The model calculates the number of qualifying magistrates each year on the basis of the total number of Latin communities in each year (13) and the average number of first-time magistrates per community per year – itself a function of the average number of qualifying magistracies per community (14) and the average number of offices held over the course of a career (15). To accommodate the likelihood that the rate of enfranchisement will have fallen off after the first generation as some families succeeded in maintaining a leading position over several generations, it calculates the number of enfranchised magistrates as a function of the proportion of magistrates who were *not* sons of magistrates (16) and then estimates the total number of grants based on the average number of qualifying dependants per enfranchised magistrate (17). It deals with the difficult problem of the invention and dissemination of *Latium maius* – a superior form of Latinity, usually ascribed to Hadrian, under which enfranchisement was acquired by entering into the local

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[20] It is possible that soldiers in the praetorian fleets were enfranchised on recruitment. See Appendix n. 9.

senate rather than holding a magistracy – by assuming that some proportion (18) of Latin cities acquired this status between 117 (the beginning of Hadrian's reign) and 212 and calculating its impact as a function of the average size of senates in Latin cities (19) and the average annual attrition rate within them (20) which together determine how many non-magistrates there will have been in local senates, given the above assumptions about magistrates.

A third mechanism of enfranchisement was collective grants to whole communities.. The model calculates its impact given a count of provincial cities promoted to Roman status under each emperor (21), all dated to the middle of the reign for simplicity, and the average enfranchised population, estimated based on the average total population of promoted communities (22) and the proportion of those who were free (given 23 below) – provisionally assuming that all free members of the existing community became citizens of the new Roman *colonia* or *municipium.* Veteran colonies (usually imposed on existing communities in this period) are provisionally treated in the same way, on the very conservative assumption that that all natives were enfranchised at the foundation. The settlers themselves are accounted for in the context of migration below.

The degree of uncertainty increases dramatically with manumission. 'Formally' manumitted slaves of Roman citizen masters became citizens themselves. I estimate the number of slaves owned by Roman citizens in each year as a function of the total provincial population in that year (1-2 above), the share of slaves in the total population (23) and the representation of Roman citizens among slave-owners, estimated separately for the wealthiest 1-2 per cent (24), provisionally assumed to own 50 per cent of slaves, and the remaining 98-99 per cent (25).

Estimating the proportion of slaves freed each year is a particularly complex problem. To accommodate the massive uncertainty about this topic, the manumission regime is modelled as a function of three independent parameters. First, the overall *scale* of manumission, operationalized as the percentage of the servile population who were free by age 60 (26). Second, the *timing* of manumission for men, operationalized as the percentage of slaves free at 60 who were already free at age 30, the minimum age for formal manumission under the Augustan regime (27). A low percentage means late manumission predominates; a high percentage means early manumission predominates. (The model extrapolates to other years, assuming linear annual increase from 15 to 30 and 30 to 60). Third, the *delay in female manumission* during childbearing age, since both *a priori* reasoning (masters having an obvious incentive to ensure most of their children were born as slaves) and the available evidence suggests that the average age at manumission was significantly later for women. This is modelled by representing the proportion of women free by age 30 as a fraction of the proportion of men free at that age (28); thereafter women catch up with men to reach the same level by age 60. Every permutation of these three parameters will produce a unique set of age-specific manumission rates for both men and women, allowing for the simulation of a wide range of possible manumission regimes. Given a few key demographic parameters – the contribution of natural reproduction to the slave supply (29), the sex ratio (30) and mortality rates in the servile population (31) – the model calculates the number of slaves manumitted by Roman citizens in that year and the age profile of the new *liberti*.

Not all slaves freed by Roman masters became Roman citizens. Those who were manumitted 'informally' or in violation of certain limitations established by Augustus (notably a minimum age of 30 for freed slaves) became Junian Latins instead – a personal status short of citizenship invented on the analogy of Latin communities. There were a number of avenues by which some Junian Latins could secure promotion to Roman

citizenship later in their lives. The model adjusts for the proportion of freed slaves who became *and remained* Junian Latins – estimated separately for those freed before, and those freed after age 30, the minimum age established by the Augustan regime (32 and 33) – to calculate the number of new citizen freedmen in that year.

This still significantly over-estimates manumission's net contribution to the citizen body. Because their existing children remained slaves, freed slaves' contribution to reproducing themselves biologically was split between their two social roles, slave and citizen. In theory, one could imagine a scenario where there was a high number of manumissions per year and yet manumission made a negligible net contribution to the citizen body, because most of the ex-slaves' children were born before they were manumitted. New freedmen would simply be replenishing the existing stock of *liberti* as others died, without translating into any net growth of the citizen body overall. Hence the flow that matters for the growth of the citizen body is not the number of manumissions per year, but the number of citizen children born to freedmen. The model calculates this based on the number of new citizen freedmen per year and their age profile (as calculated above) and assumptions about the age-specific reproductive potential of men and women (34 and 35) to arrive at manumission's annual contribution to the citizen body.

The final mechanism of enfranchisement was discretionary grants to individuals and sometimes their families by the emperor ('viritane' grants). This is the most obscure mechanism and the one where the strategy of disaggregation offers least leverage. Individual grants are modelled as a function of the average number of grants per day (36) and the average number of beneficiaries per grant (37).

The last component in the analysis is net migration of citizens between Italy and the provinces. I assume that the principal driver of citizen migration was veteran settlement, with

civilian migration from Italy to the provinces being at least counterbalanced by civilian migration from the provinces into Italy over the whole of my period. The number of Italians serving in the legions in any given year is estimated based on the number of legions in service in that year (39), the nominal strength of a legion (40), the ratio of actual to nominal strength (as assumed for the *auxilia*, 7 above) and the 25-year survival rate (again as assumed for the *auxilia*, 10 above). Formal colonial settlement represents only a part of legionary settlement in the provinces, so I forego modelling it separately (though I have allowed for the enfranchisement of natives in those *coloniae* above). Instead I assume that some proportion (38) of all discharged veterans settled in the provinces in one form or another. Not all legionaries were Italian, so I control for the declining representation of Italians in the legions (41) in order to estimate annual migration through veteran settlement.

It probably bears repeating that the model simulates the trajectory of the citizen and non-citizen populations on a year-by-year basis. Beginning with the starting stock of citizens and provincials in 14, the model calculates the contribution of each of the five mechanisms and migration in that year on the basis of the value of the relevant parameters at the beginning of the year. It then calculates the natural growth in the total provincial population and the citizen body (including citizens enfranchised during that year, at a proportionately reduced rate) to determine the citizen and non-citizen populations at the end of the year. It then moves to the next year, repeats the process, and so on until it reaches 212.

It is also worth noting that the parameters have been modelled as a mix of dynamic and static variables. In reality, the value all parameters will have fluctuated to at least some extent over the course of the two hundred years I am analysing. But it is only feasible to model such change in a few this fluctuation in a few well documented cases (e.g. the size of the *auxilia*, the number of Latin cities and the number of cities promoted to Roman status). In the majority of cases, where I see no evidence on which to estimate change over time or

where any change is dwarfed by the degree of uncertainty about the average value, I have resorted to the simplification of modelling the parameter as static. In those cases, the modelled parameter represents the estimated mean value over the whole period.

iv. Bounding scenarios

The model I have described is just a mechanical tool. Its utility would be obvious if the historical value of all the input parameters was known. Provided I have identified the most important parameters and designed the algorithm correctly, it would produce a good estimate of the level of enfranchisement. (The simplifying assumptions inherent in the structure of the model would still introduce some error). But it is worth no more than the assumptions entered into it. The question is how best to use the model when many of the parameters are highly uncertain.

The conventional approach would be to input my best estimate for each individual parameter into the model and thus produce a *best estimate* of the level of enfranchisement. The result can be seen in Figure 1. The total population of the provinces grows from 39 m in 14 to 51 m in 212, with slaves making up 13 per cent. The citizen population of the provinces starts off at 2 m (Peter Brunt's estimate) and grows to 10 m in 212. By subtracting the slaves from the total population, I can calculate the free population and hence the level of enfranchisement (citizens as a proportion of the free population, the black dashed line). It grows from 6 per cent in 14 to 22 per cent in 212.

The reason I have not specified my assumptions is that I do not expect this analysis to command any credibility – though it should at least illustrate some of the mechanics of the model. I have had to estimate more than forty different parameters, many of them highly uncertain. There are a handful of cases, such as the paper strength of the *auxilia*, where we are in a position to produce reliable point estimates (thanks in that case to the painstaking

work of historians of the Roman army). In many or most cases, however, any point estimate would merely obscure considerable uncertainty. Think only of the difficulty in estimating the rate of manumission or the scale of individual grants. The proliferation of highly uncertain variables ought to provoke the scepticism of even the most generous reader. Under the circumstances, any 'best estimate' is hardly likely to be a very good one. It is almost certainly wrong. That is not in itself a problem, since all estimates are wrong. The problem is that I have no idea of the margin of error.

FIGURE 1
'BEST ESTIMATE' OF ENFRANCHISEMENT, 14-212 CE
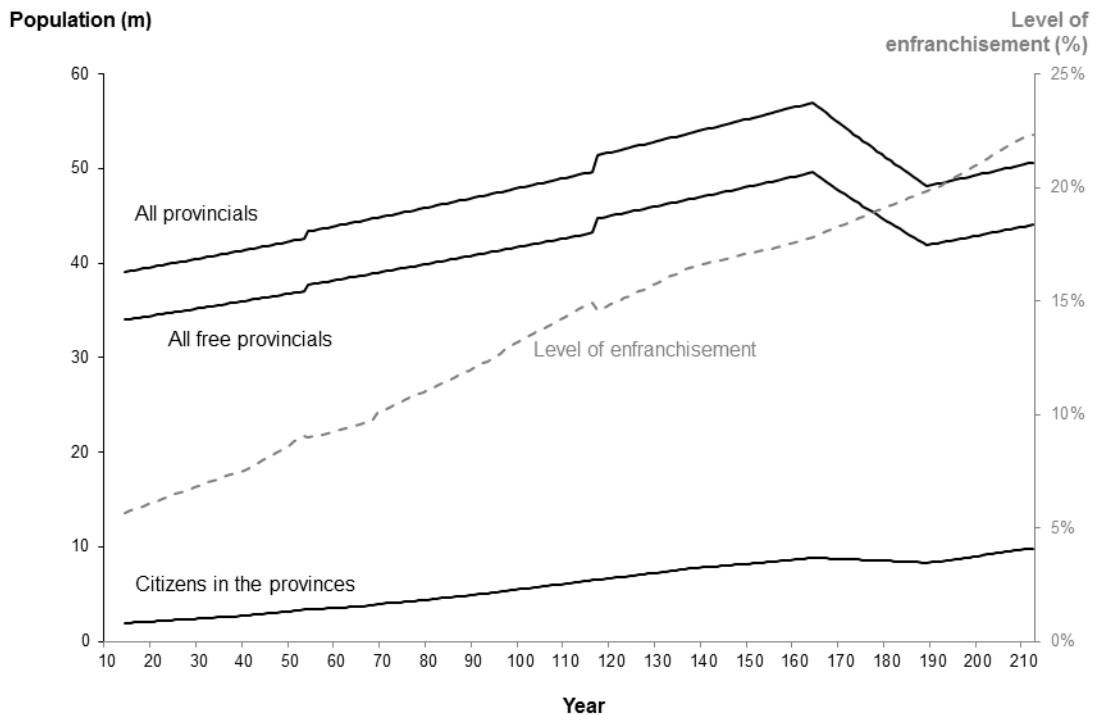
It would not avail much to establish some arbitrary range around it, say 21-25 per cent (+/- 10 per cent) – though that is a common concession to uncertainty. A range is at least more honest than a point estimate, but it is of little real value if it is established arbitrarily. In more rigorous fields, range estimates are always grounded in a quantifiable measure of confidence – the norm being to calculate the range necessary to permit 95 or 99 per cent

confidence that it contains the actual value. What is lacking at this point is any measure of the accuracy of my best estimate. I cannot know how wide a range I would have to allow in order to be confident of encompassing the actual value.

An obvious alternative is the simulation of *multiple scenarios* to illustrate the range of possible outcomes for the level of enfranchisement in 212. The problem with scenario analysis in a case with so many uncertain variables is that it is very difficult to assess the likelihood of individual scenarios. Any 'most likely' scenario would be subject to all the limitations of a best estimate approach. And it would be difficult to assess the likelihood of an outcome produced by a 'high' or 'low' scenario where all parameters were set to some less likely high or low value. The particular permutations of input values selected may seem unlikely, but one could not rule out the possibility of arriving at the same or even a higher/lower level of enfranchisement with some other, more plausible permutation of inputs. The key problem is that there are many different permutations which might produce any given outcome. The only robust approach is to establish genuine *bounding scenarios* by setting all variables to implausibly high/low values simultaneously, such that one can be confident that none of them could have had a higher/lower value.

In establishing theoretical minimum and maximum values for each of the input parameters, I have born in mind the substantial literature on the psychology of probability estimation. Ancient history is certainly not the only field in which assumptions have to be based on the subjective judgement of experts rather than hard data (more on this in the next section). There is an extensive literature about the heuristic procedures we use in estimating uncertain quantities and the cognitive biases they produce.[21] The most important biases for current purposes are *overconfidence* and the *anchoring effect*. Overconfidence is the tendency

[21] For an introduction, see Ward Edwards, Ralph F. Miles, Jr. and Detlof von Winterfeldt, *Advances in Decision Analysis: From Foundations to Applications* (Cambridge and New York, 2007), 141-5.

to underestimate the range of possible of values. The anchoring effect is a tendency for the estimate to be biased towards some initial reference point – such as some existing estimate. Of course knowing the cognitive biases to which we are subject does not inoculate against them, but it is an essential starting point.

Take for example the problem of estimating the scale of slave-holding relative to the total provincial population (parameter no. 23 in the model). I suspect that an early guesstimate by Peter Brunt that slaves made up more than 40 per cent of the population of Republican Italy exerted an anchoring effect on early estimates of the scale of slave holding.[22] His estimate has been rightly questioned by Walter Scheidel, who suggested a figure of around 20 per cent for Italy (and much less for the provinces).[23] But Scheidel's incisive presentation of a minimalist case seems to have become a new anchor. The recent ancient volume of the *Cambridge World History of Slavery* allows the new minimalism to stand unchallenged.[24] Scheidel's most recent estimate puts the slave population of the provinces at 6-12 per cent of the total population.[25] But there are still scholars committed to a much higher figure. William Harris has repeatedly argued for a figure of 17-20 per cent.[26] Without being able to go into the evidence here, I will just observe that the possibility space (i.e. the range of possible values) is wider than either of those estimates allows. The arguments for a relatively low figure of *c.* 10 per cent are compelling, but we are not yet in a position to say that a figure of 16-20 per cent is impossible – though it may be unlikely. What Scheidel and Harris are really disputing is where the most likely value lies. Neither makes

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[22] Brunt, *Italian manpower*, 124 (3.0 m slaves in a population of no more than 7.5 m)

[23] Walter Scheidel, 'Human Mobility in Roman Italy, II: The slave population', *Journal of Roman Studies* xcv (2005) and 'The Roman Slave Supply', in Keith Bradley and Paul Cartledge, *The Cambridge World History of Slavery, Volume 1: The Ancient Mediterranean World* (Cambridge, 2011), 292.

[24] Bradley and Cartledge, *Cambridge World History of Slavery* i, 251, 284 and 288-92. Cf Kyle Harper, *Slavery in the Late Roman World, AD 275-425* (Cambridge, 2011), 60, estimating the slave population in the fourth century at 10% of the total population.

[25] Scheidel, 'Roman Slave Supply', 292 (total for 'Egypt' and 'Others').

[26] W. V. Harris, 'Demography, Geography and the Sources of Slaves', *Journal of Roman Studies* 89 (1999), 65.

any claim about their level of confidence in the range they give (i.e. how likely it is to contain the actual value). To be confident that I am accommodating all possible values, I need to allow for a much wider range of values. Hence I provisionally allow the level of slave holding to be anywhere between 6 and 20 per cent of the total provincial population.

Even in the case of the most uncertain parameters, it is at possible to proceed in this fashion and bracket the possibility space between values that are implausibly low and implausibly high, with the range being narrower or broader depending on the quality of our knowledge in each case. I outline my assumptions about minimum and maximum possible values for the other variables in the Appendix and provide very brief explanations in the Notes. My estimates draw widely on scholarship on demography, the army and slavery (to mention just a few of the sub-disciplines involved), the sheer quantity of which precludes full citation in this article. But I must emphasise that I am building on the accumulated insights of scholars in many sub-disciplines. What is currently lacking is a methodology that can bring all those bibliographies to bear on the problem of enfranchisement without ignoring or obscuring the massive uncertainties in each field.

Some of my ranges may seem very wide to scholars who have more faith in the accuracy of existing estimates than I do, but my goal has been to accommodate the full extent of uncertainty. Far more effort has been devoted to establishing 'best estimates' for these parameters than to establishing the limits of the possible. One of the aims of this paper is to urge a move away from the rhetoric of certainty that dominates current scholarship (for pragmatic reasons related to the reliance on best estimate modelling techniques) and show that acknowledging the full extent of uncertainty does not have to preclude useful analysis. In fact it is precisely the confidence that I have come close to exhausting the possibility space in the case of each individual variable that will make it possible to derive robust conclusions at the level of the model as a whole.

I take it that the key demonstrandum is how *low* the level of enfranchisement was in 212. The substantive contribution of this paper can essentially be boiled down to an argument that it is highly implausible that more than a third of the free population of the provinces were Roman citizens on the eve of Caracalla's grant. To make this argument as robust as possible, I systematically err on the side of exaggerating the impact of enfranchisement and/or the range of possible values. Both biases work against my efforts to establish an upper limit on the level of enfranchisement. Hence whenever I describe an assumption as 'conservative', I mean that it tends to overestimate the proportion of citizens in 212 and/or the likelihood of extremely high or low results.

Having established limits to the possible value of each of the input parameters, I am now in a position to establish bounding scenarios for the level of enfranchisement in 212. The level of enfranchisement is maximised when the total provincial population is set at a minimum (taking the minimum peak population in 165 and the maximum impact of the Antonine plague), while otherwise maximising the impact of enfranchisement and migration. On the most optimistic assumptions, the level of enfranchisement could have grown to 85 per cent in 212. Conversely, on the most pessimistic assumptions (maximising the total population and otherwise minimising the contribution of enfranchisement), citizens would make up only 7 per cent of the free population in 212. See Figure 4, ignoring the shaded area for now. The high level of enfranchisement in the 'maximum' scenario is largely driven by a very high estimate for the contribution by manumission, which accounts for about 60 per cent of all new citizens in this scenario. That high estimate for manumission in turn depends on a particularly implausible combination of circumstances which I hope in future to be able to

rule out as demographically unsustainable, because of the pressure it would have placed on the slave supply.[27]

It should be clear that this analysis is more robust than the best estimate approach I outlined above, but it has probably gone too far in the opposite direction since it is too wide to be of much historical value (beyond ruling out some extreme scenarios). It is probably also more generous than I really need for practical purposes. It is sufficiently wide for me to be almost certain that it contains the actual value. I say 'almost certain' because absolute certainty is a chimaera in all fields where knowledge is probabilistic. Not even with my minimum and maximum scenarios can I be certain that I have exhausted all possibilities. On the other hand, that range must come very close to 100 per cent certainty. The range includes at its outer limits outcomes that can only be produced by scenarios that are vanishingly unlikely. Researchers in the natural and social sciences often work with a 95 per cent threshold for confidence in a range estimate. That is, the limits of the range are set so that that the range will include the actual value 95 per cent of the time. This is a pragmatic concession to the fact that pushing that confidence to 98, 99 or even 99.9 per cent requires ever great expansion of the range. A similarly pragmatic approach to my problem would be to ask how much I could narrow my estimate while still retaining a comparable level of confidence that it contains the historical value.

v. A stochastic model

Ancient historians are hardly unique in having to model the interaction of uncertain parameters. Nor is there anything special about the fact that the uncertainty we face is the result of our ignorance rather than natural variability – that it is *epistemic* rather than *aleatory*

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[27] See nn. on parameters 26-28 in the Appendix.

in the conventional terminology (an example of the latter being the outcome of a coin toss). Indeed it is has been argued that all uncertainty is ultimately epistemic, since what we consider aleatory uncertainty is usually a result of imperfect information about the initial conditions. A coin toss is a chaotic process (where the outcome is highly sensitive to minute changes in the initial conditions), not a random one.[28]

Fields such as risk analysis have developed sophisticated methodologies for producing quantitative estimates in the face of such uncertainty. The most powerful is the use of *stochastic* rather than *deterministic* models – models whose inputs and outputs are probability distributions rather than discrete values. The underlying principle is that one first represents the uncertainty about the underlying processes or input variables mathematically and then calculates the implied uncertainty about the outcome measure – a method called the *forward propagation of uncertainty*. The approach was pioneered in the context of nuclear reactor safety analysis in the 1970s and is now widely used in risk and decision analysis in fields as diverse as finance, meteorology and radiation oncology.[29] These fields share with ancient history the need for a pragmatic approach which can derive useful conclusions in the face of significant epistemic uncertainty, but they have developed more sophisticated methods for doing so. Despite the ubiquity of these methods in other disciplines, application in the field of history has so far been limited to a few niche subjects in historical demography and (modern) economic history.[30] This paper aims to demonstrate that they offer leverage on a much wider range of historical problems.

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[28] See further M. Granger Morgan and Max Henrion, *Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis* (Cambridge, 1990), 57-60.
[29] Useful introductions in three different disciplinary traditions: Morgan and Henrion, *Uncertainty*, Tim Bedford and Roger Cooke, *Probabilistic Risk Analysis: Foundations and Methods* (Cambridge, 2001), Keith Beven, *Environmental Modelling: An Uncertain Future?* (Oxford, 2009).
[30] An early application of stochastic modelling to aleatory uncertainty in historical demography was the CAMSIM model for simulating kinship patterns (familiar to Roman historians as the source of the surviving-kin estimates in Richard P Saller, *Patriarchy, Property and Death in the Roman Family* (Cambridge, 1994), ch. 3):
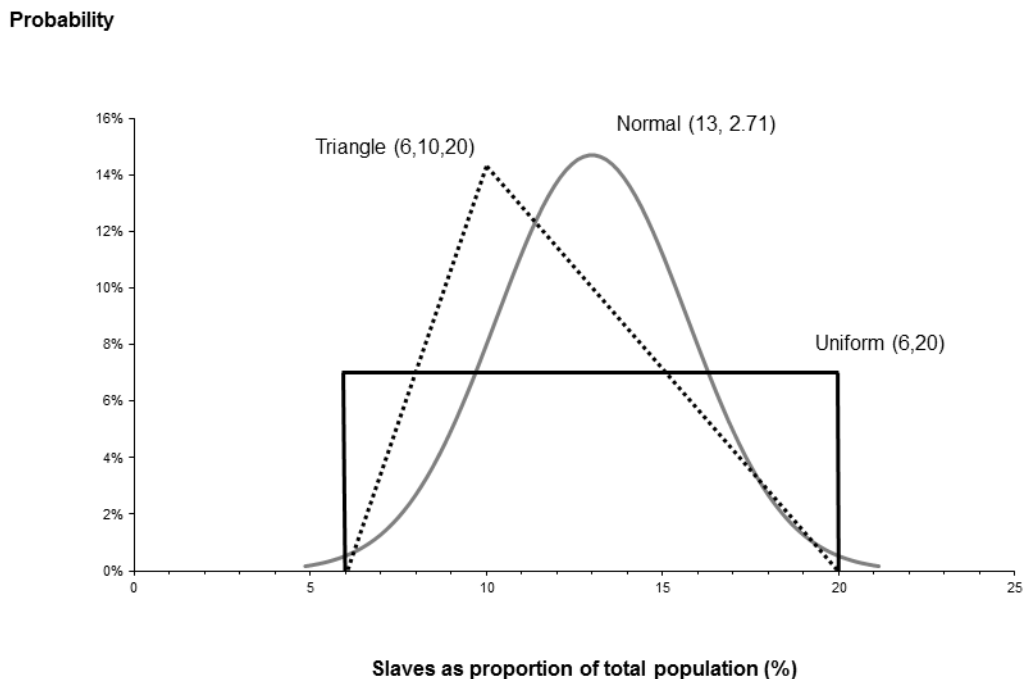
Estimating probability distributions

The first step in implementing a stochastic model is to establish probability distributions for the input variables. The issues are best illustrated with a concrete example: the scale of slavery in the provinces (parameter 23). I have allowed that slaves might have made up anywhere between 6 and 20 percent of the provincial population. There are an infinite number of possible values between those limits, which is another way of saying that this is a *continuous variable*. In probability theory, continuous variables have an infinite number of possible values each of which has probability zero; only intervals (i.e. ranges of values) can be assigned a discrete probability. That probability is described by the variable's probability distribution or *probability density function*. In all cases, the total area under the curve is 1.0 and the probability of the variable being between any two values is equal to the area under the curve between those two points.

I have illustrated three ideal-type probability distributions applied to the question of the slave population in Figure 2. The first is a *uniform* distribution (uniquely determined by its minimum and maximum), in which all values are equally likely. In this case, it implies that an extreme value of 6-7 per cent is just as likely as a middling value of 12-13 per cent. The second is a *normal* distribution, one of the most versatile probability distribution, used to model random variables in many contexts. A normal distribution is uniquely determined by its midpoint and standard deviation. In this case it implies that a value of 12-13 per cent is more than twenty times more likely than one of 6-7 per cent. The third is a *triangle* distribution (uniquely determined by mode and lower and upper limits), the simplest way of representing a skewed probability distribution (i.e. one where the most likely value is not in

J. E. Smith and J. Oeppen, 'Estimating Numbers of Kin in Historical England using Demographic Microsimulation', in D. S. Reher and R. S. Schofield (eds.), *Old and new methods in historical demography* (Oxford, 1993), 413-25. For applications in economic history, see Donald Schaefer and Thomas Weiss, 'The Use of Simulation Techniques in Historical Analysis: Railroads versus Canals', *Journal of Economic History* 31 (1971), 854-884 and subsequent articles in the same journal.

the middle of the range). These are only three of a wide range of ideal-type distributions that can be used in simulation.[31]

FIGURE 2
PROBABILITY DENSITY FUNCTIONS

Probability

Slaves as proportion of total population (%)

The purpose of the probability distribution is to represent *a state of knowledge*. It describes my *degree of belief* in different possible values of a particular, historical quantity. My goal in establishing minimum and maximum values for the input variables was to come close to exhausting the possibility space in each case. By definition, this means that I believe that values close to the minimum and maximum are extremely unlikely and that the most likely value is somewhere in between – though not necessarily at the midpoint. In this case, I think the most likely value is in the region of 10 per cent (though I cannot discuss the

[31] See e.g. Beven, *Environmental Modelling*, 55.

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evidence here). The challenge is how to represent my beliefs mathematically so that they can be incorporated in the model.

In future, I intend to use three-point estimation techniques (based on minimum, maximum and most likely values) to reflect my knowledge about where the most likely value lies. For now, however, I limit myself to the simplest and most conservative representation of my belief – a uniform distribution. It has the virtue of being easy to understand (it implies that all possible values are equally likely) and it will enable a simple intuitive interpretation of the outcome of my simulation to which I will return at the end of this section. The simplification involved is conservative for my purposes. Given my starting assumption that a value of 19-20 per cent is less likely than any middling value, modelling all possible values as equally likely must exaggerate the likelihood of very high (and very low) values. Applied across all variables, it must also exaggerate the likelihood of extreme values of the output variable, since these only occur when many input variables are at extremely high or extremely low values simultaneously. The assumption is thus conservative in the sense that it will exaggerate the dispersion of the probability distribution of outcomes compared to that implied by my starting assumptions.

Interdependence

The second issue I need to consider is the possibility of interdependence between variables. The issue is specifically one of *epistemic interdependence*. I need to ask a hypothetical question: if I somehow discovered the historical value of one variable, would that change my estimate for any other variables? If I believed that a high value for one variable would make a high value for another variable more likely, for example, this would make extremely high and low outcomes more likely, because they depend on multiple variables being at very high or very low values simultaneously. In fact, most of the variables

are clearly independent in this sense. I see no reason to expect any significant epistemic interdependence in my estimates of e.g. mortality rates in the army, the average number of magistracies in communities with the Latin right, and/or the manumission rate. That is to say, even if I somehow discovered the actual historical value of one of these variables, it would not change my estimate for any of the others.

There are, however, a number of parameter pairs which are interdependent. In some cases the relationship is positive: between the total population of the provinces (1 and 2) and the average population of enfranchised communities (22), between the proportion of Junian Latins among slaves freed before the age of 30 (32) and among those freed at a later age (33) and between the number of enfranchised dependents of auxiliaries (11) and those of Latin magistrates (17). In these cases, a higher value for one would make a higher value for the other more likely. In many other cases, the expected relationship is a negative one. For example the likelihood of an extremely generous manumission regime must decrease as the total number of slaves increases, if only because very high early manumission would place much greater pressure on the slave supply in a world where 20 per cent of the population are slaves than in one where only 6 per cent are. This means that a relatively high slave population would probably have been offset by a relatively low rate of manumission (and vice versa). The problem in all these cases is that I have no firm idea of the strength of the correlation. The solution is to adopt two simplifying but conservative assumptions. Where I expect a positive relationship, I exaggerate it by assuming a *perfect linear correlation* between the variables (so that if one is at its maximum value, the other will be too). Where I expect a negative relationship, I underestimate it by assuming *no correlation* at all.[32] These assumptions are conservative because the first exaggerates a phenomenon tending to increase

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[32] The procedure is reversed when one of the variables is negatively correlated with the level of enfranchisement.

the dispersion of outcomes (i.e. making extreme outcomes more likely) and the second ignores a phenomenon tending to reduce the dispersion of outcomes (i.e. making extreme results less likely). Both work to overestimate the likelihood of extremely high and low outcomes.

Propagating uncertainty

Having represented my state of knowledge about the independent variables as a set of probability distributions, the next step is to establish what these assumptions imply about the probability distribution of the dependent variable, the level of enfranchisement in 212. If a model is very simple, it may be possible to aggregate the input probability distributions analytically and thus arrive at an exact solution for the probability distribution over the output. In most cases, however, *analytic solutions* are impossible or impractical and it is necessary to resort to sampling methods to approximate the probability distribution of the output. The simplest and best known is *Monte Carlo simulation* (the link to gambling will become obvious).

Imagine a mechanical process which begins by dividing the theoretical range into percentage point intervals (11-12, 12-13, etc.) and creates a scoring bin for each interval. Next it employs a random number generator to generate a unique random number between 0 and 1 for each variable and uses that number to assign the variable a random value within its respective range, such that a value of 0 would return the minimum and 1 would return the maximum value (a uniform distribution is assumed; interdependence between two variables is allowed for by applying the same random number to both). It enters those randomly assigned values into the model, notes the resulting output (i.e. the level of enfranchisement in 212) and enters a mark in the appropriate scoring bin. It does this a very large number of times. As the sample size increases, the frequency distribution of outcomes in the sample (i.e.

the proportion of marks in each scoring bin) will begin to converge on the distribution of the population (i.e. the infinite number of possible pasts).

FIGURE 3
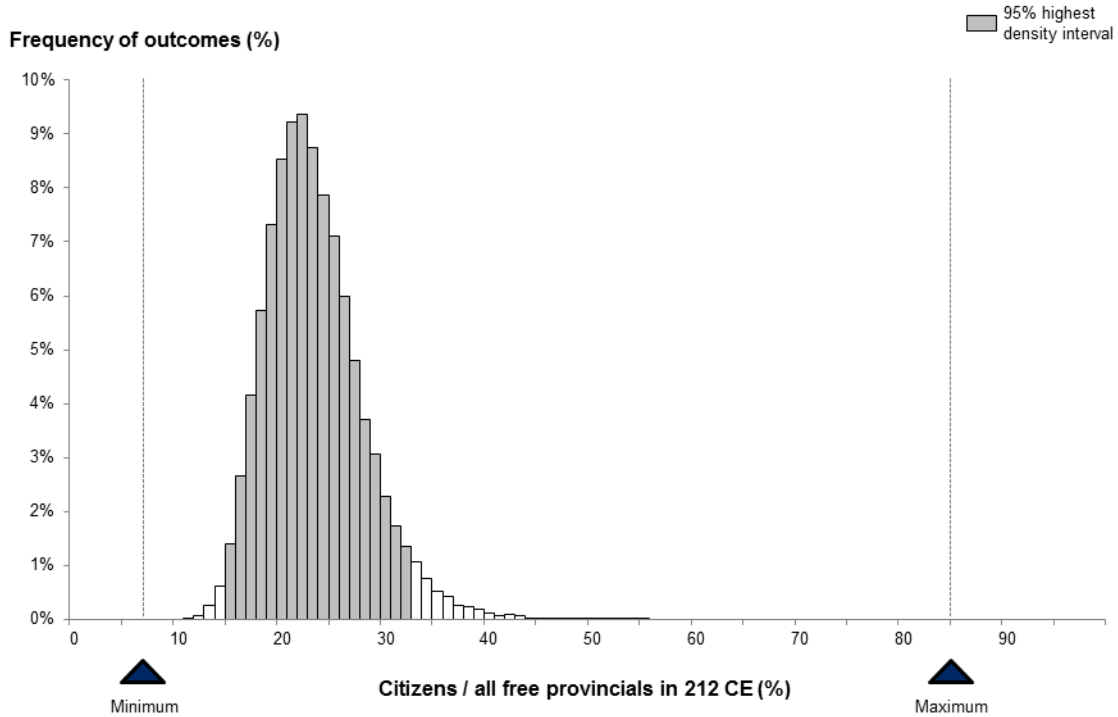RESULT OF MONTE CARLO ANALYSIS (50,000 ITERATIONS)

Figure 3 shows the frequency distribution of outcomes after 50,000 iterations. This sample of 50,000 possible scenarios is highly diverse, including instances of very high and very low provincial populations, very high and very low levels of enslavement, very generous and very restrictive manumission regimes, etc. – in all sorts of different combinations. Despite this massive variation in the input variables, the chart shows significant clustering in the resulting level of enfranchisement. The mode (22-23 per cent), median (23 per cent) and mean (23 per cent) of this distribution provide alternative and more robust bases for establishing the most likely value than a best estimate approach. More useful, however, is the insight that the simulation offers into the dispersion of possible values. It shows that I would need to allow for a significant range of possible values to be confident of encompassing 95

per cent of all possible outcomes – but nowhere near as wide a range as implied by my bounding scenarios. The range between my Minimum and Maximum scenarios was 7-85 per cent. In the Monte-Carlo simulation, however, 95 per cent of all simulated scenarios remained within the much narrower interval 15-33 per cent (that being the 95 per cent *highest density interval*). That range offers the best balance of pragmatism and rigour in estimating the value of this highly uncertain parameter. Figure 4 estimates the progress of enfranchisement from 14 to 212 by capturing the 95 per cent range not just at the end of the period, but for every year between 14 and 212 (based this time on 10,000 iterations).[33]

FIGURE 4
SIMULATED PROGRESS OF ENFRANCHISEMENT, 14-212 CE

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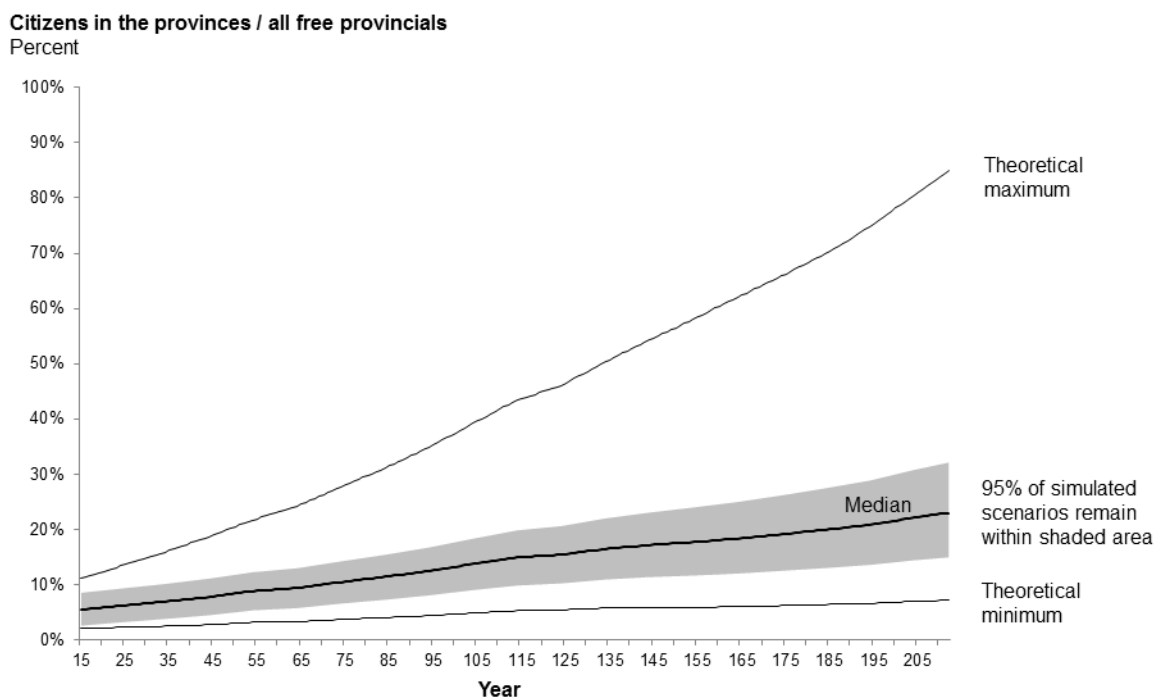
[33] The number of iterations required depends on the statistic being estimated. 1,000 iterations would have sufficed to estimate the mean or standard deviation, because the sampling error of those parameters drops quickly as the sample size increases. The sampling error of the outer percentiles drops much more slowly., but 10,000 iterations is sufficient to estimate the upper and lower limits of the 95% highest density interval with a 99% confidence interval of +/- 0.4%. For the calculation, see Morris H. DeGroot and Mark J. Schervish, *Probability and statistics*, 4th edn (Boston, 2012), 797. An even larger sample of 50,000 iterations was required to produce the smooth histogram in Figure 3.

For the benefit of any readers uncomfortable with the concept of propagating uncertainty, it may be worth pointing out an alternative interpretation of my analysis. Because it used uniform distributions to assign values to the independent variables, the Monte Carlo simulation was sampling directly from the population of possible permutations, after controlling for interdependence between variables. There are an infinite number of possible permutations of the input variables between the extremes of the Minimum and Maximum scenarios. One of these is the closest approximation to the actual past, but I do not know which one. It should be intuitively obvious that there are more possible permutations that will produce a middling result of 23 per cent than will produce any extreme result. The brute force of modern computing – the Monte Carlo simulation I have just performed – allows me to go further and determine that only 5 per cent *of all the possible permutations* will produce an outcome outside the range 15-33 per cent. This is a useful conclusion in itself, while still being conceptually straightforward. It is worth noting that the size and location of the 95 per cent range relative to the total range could not have been assumed in advance. The distribution might have been more or less dispersed and/or differently skewed, because the shape of the distribution is determined by the number of variables and the mathematical relationships between them. The Monte Carlo simulation is essential in order to establish the size and location of the 95 per cent range.

The goal of model building is as much to better understand a problem as to 'solve' it. The Monte Carlo simulation makes it possible to identify the most important sources of uncertainty in the estimate. Sensitivity tests can be used to determine the sensitivity of the overall result (the level of enfranchisement in 212) to the estimates for individual parameters. Just eight of the forty-one different parameters account for more than half the uncertainty in the estimate: the total population (parameters 1 and 2), the deviation of the natural growth rate of the citizen population from that of the total population (5), the number and average

size of enfranchised communities (21 and 22), the slave population (23), the scale of manumission (26) and the average number of *viritim* grants per day (36). If these eight parameters are arbitrarily fixed at the mid-point of their possible ranges, the 95 per cent range of the Monte Carlo simulation shrinks to 19 to 27 per cent (a reduction of 56 per cent). Conversely, so long as they remain uncertain, fixing all the remaining variables has relatively little impact on the overall result. Even with thirty-three variables fixed, the 95 per cent range remains 16 to 31 percent, almost as wide as in the original estimate. This sensitivity analysis helps to clarify where further work can be expected to refine the estimate – and where it will not.

Caveats

The analysis I have outlined shows that there is only a 5 per cent chance that the level of enfranchisement in 212 was outside the range 15-33 per cent, *given my starting assumptions*. That is of course an important qualification. All the Monte Carlo simulation can do is translate a set of beliefs about (i) the possible values of the inputs and (ii) how they interact to determine the level of enfranchisement (as encoded in the structure of the model) into an inferred belief about the level of enfranchisement. The resulting probability distribution describes the belief about the level of enfranchisement that should be held by any mathematically rational person who shares my starting assumptions. Everything thus rests on my subjective assessment of the likely values of the input variables. That is obviously problematic, but it is a pragmatic solution adopted in many other fields. Moreover it is a problem shared by the vast majority of statements about ancient history, whether quantitative or qualitative: all are based on subjective assessments of likelihood. Ancient historians use arguments from likelihood all the time. Yet the use of terms like 'probable', and 'improbable', 'likely' and 'unlikely' is woefully imprecise. In most cases, of course, this is a trap from which there is no escape. Though we may throw around claims about likelihood

when discussing questions of motivation or causation (the sorts of questions that arise in trying to explain Caracalla's grant as opposed to quantifying its impact), such likelihood is hardly amenable to quantification. But quantitative estimates are different and this paper aims to show that there are more robust methods for establishing the 'likely' level of enfranchisement in 212 than those currently used in ancient history.

The model inputs are a conservative representation of the current state of knowledge. I was forced to make some simplifying assumptions in order to convert qualitative beliefs (e.g. that middling values are 'more likely' than extreme values or that one variable is positively correlated with another) into quantitative form. The conversion was necessary so that I could manipulate those beliefs mathematically in order to infer the belief that I should hold about the level of enfranchisement. I have ensured that those simplifying assumptions were systematically conservative. Whenever I have been forced to simplify – in establishing ranges of possible values for each input variable, in estimating probability distributions for those variables and in allowing for interdependence between the variables – I have erred on the side of exaggerating the dispersion of results and/or the mean value. It is worth emphasising that I have thereby deliberately ignored two important dynamics that work to make extreme outcomes even less likely: (i) the fact that middling values are more likely than extreme values for most, if not all, of the component variables and (ii) the fact that I expect some significant negative correlation between several pairs of variables.

In any case, the bar is low. Whatever its limitations, the Monte Carlo simulation is a significant advance over the existing alternatives. On the one hand, it is better than the prevailing consensus that the overall level of enfranchisement is unknowable given the current evidence base. That underestimates the quality of our knowledge. We already know enough about the mechanisms of enfranchisement and the demography of the empire to be able to rule out much of the theoretical possibility space. On the other hand, a probabilistic

approach is also superior to the deterministic modelling techniques that currently dominate analysis in ancient history. Given the massive uncertainty surrounding many of the input variables, any attempt at a best estimate would vastly overestimate the quality of our knowledge. Only a probabilistic approach can produce an estimate without obfuscating that uncertainty.

Conclusion

As a contribution to methodology, this paper proposes a more sophisticated approach to quantitative analysis in periods from which little data survives. Too much faith is currently placed in point estimates which lack any measure of error. I could easily have concluded that the level of enfranchisement in 212 was 'probably around 22 per cent' by inputting best estimates of the component variables into my model – or suggested some arbitrary range around that figure. But it should by now be clear that any such 'best estimate' would be of relatively little value. Contrary to what one might expect, a more realistic assessment of the uncertainty about the input parameters is not an obstacle to generating significant results. By taking a probabilistic approach, I was able to produce a useful estimate of the level of enfranchisement without having to commit to minimalist or maximalist visions of slavery, manumission or any of the other contentious topics on which I have touched. The method has much wider application. It offers powerful leverage on other complex problems where the unknown quantity can be disaggregated into a number of independent variables – precisely the sort of problem that might seem intractable at first sight.

The analysis presented here is preliminary and deliberately conservative. But it should suffice to demonstrate that the current *aporia* about the overall level of enfranchisement in the Roman empire is far too pessimistic. There may be massive uncertainty about the population of the provinces, the scale of slavery, the manumission regime and many of the

other parameters that will have governed the rate of enfranchisement, but the range of plausible outcomes is still narrow. The simulations show that the spread of Roman citizenship over the course of the first two centuries CE was a steady but limited process. With 67-85 per cent of the free population of the provinces still non-citizens on the eve of Caracalla's grant, the cumulative impact of enfranchisement was modest – though not trivial. (The upwards bias built into the analysis means that the lower limit is less significant than the upper, but the result still suggests that citizenship extended far beyond the so-called curial class – the privileged propertied elite which dominated local politics and on which the Roman state depended for much of the business of governance – which can have made up only 1-2 per cent of the free population.) This confirms the growing suspicion that the quantitative impact of Caracalla's grant was much greater than earlier scholarship had allowed. The citizen population was not, of course, evenly distributed across the empire. It has become conventional to note that citizenship was more widespread in the Western provinces. But there are limits to the possible concentration. Given what we know about the deployment of the army and the distribution of Latin and Roman communities, the model allows a crude assessment of the geographical distribution of the citizen population. Though I cannot go into detail here, simulations show that citizens almost certainly remained a minority even in the West. The impact of Caracalla's grant was not limited to the East of the empire.

The analysis also undermines a widely held assumption that the process of enfranchisement accelerated significantly over the course of the second century, building up towards Caracalla's general grant. The simulations show no such acceleration. On the contrary, a glance at Figure 4 will show that in most simulations the rate of enfranchisement actually slows over the course of the second century. The key drivers of this deceleration are the abolition of grants to auxiliary veterans' existing children under Antoninus Pius and a drop in the number of attested communal grants. Together they significantly outweigh the

introduction of the greater Latin right during the second century. The trajectory of manumissions and individual grants is less clear, but the greatest acceleration in manumissions must have been in the first century (as the wealthiest families with the largest slave-holdings acquired Roman citizenship) while individual grants were too limited for any acceleration in the second century to offset the slow-down of other mechanisms. It has become a convention of Roman history to write vaguely of a process of enfranchisement which 'culminated' in Caracalla's grant, obscuring the uncertainty about the spread of citizenship before 212 and implying that the CA was the natural outcome of earlier developments. This paper reveals the poverty of that view by establishing both the limited cumulative impact of enfranchisement and the implausibility of significant acceleration in the decades before 212. The CA was clearly a sharp break from earlier practice.

A better understanding of the limited scale of enfranchisement before 212 makes it much harder to believe that the CA had as little impact as some have suggested. It must have been an important inflection point in several important arcs of Roman imperial history, including the reconfiguration of provincial identities and loyalties and the spread of Roman law. It is of course essential to avoid a facile equation of citizenship with identity.[34] Roman citizens need not identify with Rome (as the citizen leaders of many of the provincial revolts of the first century attest), while non-citizens could still imagine themselves as part of a wider, imperial community. But it is not implausible that a massive expansion of the citizen body, effected in the context of narratives and practices that gave citizenship meaning, changed how many provincials saw their place in the imperial order, reinforcing loyalty to the Roman state and perhaps contributing to the empire's remarkable resistance to centrifugal forces in the face of the many political crises of the third century. Despite the silence of the literary sources, there is enough circumstantial evidence to suggest a widespread positive

[34] Clifford Ando, *Imperial Ideology and Provincial Loyalty in the Roman Empire* (Berkeley, 2000), 10-13.

response to Caracalla's grant – most notably the wide diffusion of the *nomen* Aurelius if, (as seems likely) the many new citizens who took the emperor's name did so by choice rather than legal requirement and again chose to use their full Roman names rather than their existing idionyms on inscriptions.[35] The relationship between the spread of citizenship and the diffusion of Roman law is similarly complex.[36] Before the CA, Roman citizens could be subject to non-Roman legal systems in non-citizen communities, Roman courts developed ways of bringing non-citizens under Roman law and various non-citizen communities chose to adopt and adapt some Roman legal forms for their own purposes. The CA itself did not immediately establish legal uniformity. Idiosyncratic local practices persisted and were recognised as valid by Roman law. Nevertheless, the two processes are correlated and the massive extension of the citizen body effected by the CA must have been an important discontinuity in the trajectory from the clearly pluralist legal regime of the early empire to the impressive, if imperfect, uniformity of the fourth and fifth centuries.

A better grasp of the scale of enfranchisement also undermines the influential hypothesis that citizenship had already lost much of its value before 212.[37] This depends partly on reading a few texts as evidence for a deterioration in the privileges enjoyed by Roman citizens in criminal law (the key evidence being the treatment of Roman citizens in the cases of St Paul under Claudius, Bithynian Christians under Trajan and Gallic Christians under Marcus Aurelius) and a diminution of the fiscal privileges enjoyed by Roman citizens living in peregrine communities (contrasting the cases of Seleukos of Rhosos, a Greek sea captain enfranchised in 42-30 BCE, and Iulianus, a Mauretanian chieftain enfranchised in 177

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[35] Wolff, *Constitutio Antoniniana*, 19. See Buraselis, *THEIA DÔREA*, 108-20 for other indirect evidence.

[36] Ando, *Imperial Rome AD 193 to 284* ch. 4, Clifford Ando, *Law, language, and empire in the Roman tradition. Empire and after* (Philadelphia, 2011), Marotta, *La cittadinanza romana* ch. 7, Claude Lepelley, 'Le nivellement juridique du monde romain à partir du IIIe siècle et la marginalisation des droits locaux ', *Mélanges de l'École française de Rome. Moyen âge*, cxiii (2001), Spagnuolo Vigorita, 'Cittadini e sudditi', 33-39.

[37] Thesis of decline: Sherwin-White, *Roman Citizenship*, especially ch 11. Restated in more nuanced form by Spagnuolo Vigorita, 'Cittadini e sudditi', especially 39-43. Critique of the legal evidence by Marotta, *La cittadinanza romana* 38-43 and 58-60 and Buraselis, *THEIA DÔREA*, 120-57.

CE). But many of these cases are poorly documented and open to divergent interpretations. Moreover, there is an obvious problem with trying to base a narrative of changing administrative practice across an imperial state on a handful of isolated examples. Further support has been sought in an argument that the protections which citizens had once enjoyed against summary and judicial violence by agents of the Roman state were displaced during the second century by a more exclusive set of legal privileges enjoyed by the so-called *honestiores*, a vague category (normally assumed to include the senatorial and equestrian orders, local senators and probably veterans and their families) which is first attested in excerpts from second century jurists. This is a deduction from the prominence of *honestiores* and *humiliores* and the simultaneous absence of citizens and non-citizens in discussions of criminal law in the fifth and sixth century compilations that are our main source for Roman law. But the silence about citizenship proves nothing about the second century. From the masses of earlier legislation and juristic commentary they had available to them, the compilers selected what was necessary to describe the law of their own time. There must have been a substantial body of imperial constitutions and jurisprudence regulating how provincial governors were to treat citizens and non-citizens and it may well have expanded in the second century, but it would have been near irrelevant after Caracalla's edict. In any case, the advantages accorded to the *honestiores* represented a new form of privilege, not a restriction of the existing rights of citizens. What citizens had enjoyed was protection against summary violence and the right of appeal against a capital sentence. Once convicted, however, they were always subject to the penalty of the law. The *honestiores* appear in the context of an emerging dual penalty system which provided additional protection for some, more-privileged persons by exempting them from the harshest penalties. This is in no way inconsistent with Roman citizens continuing to enjoy their existing privileges. Despite the obvious weakness of the positive evidence, the hypothesis of declining importance has

always been buttressed by the assumption that mass enfranchisement must have circumscribed the privileges that the Roman state could afford to extend to its holders and cheapened its value both in the eyes of those who had it and those who did not. The whole edifice can only be toppled by conclusively demonstrating the limits of enfranchisement before Caracalla.

There is still much work to be done on the history of citizenship in the early empire. Any adequate history will need to take account of not just the overall level of enfranchisement, but also its uneven distribution. Citizenship cannot have meant the same thing in Italy (where it was near universal), the minority of citizen communities in the provinces and the more numerous non-citizen communities, which themselves seem to have varied considerably in the extent of enfranchisement. It must have functioned differently in different contexts – whether legal (both criminal and civil), economic or social. And it may have meant different things to different groups – Roman administrators and jurists, old citizens, new citizens, non-citizens. But reaching a broad consensus about the trajectory of enfranchisement before 212 is a prerequisite for that history to be written.

PARAMETERS AND ASSUMPTIONS

Asterisks indicate parameters negatively correlated with the level of enfranchisement

	Minimum scenario	Maximun scenario
Demographic background		
[1] Total provincial population in 14 CE (million)*	48	33
[2] Total provincial population in 165 CE (million)*	63	52
[3] Net impact of the Antonine plague, 165-189 CE (% loss)*	30%	1%
[4] Roman citizens in the provinces in 14 CE (million)	0.9	2.9
[5] Deviation of growth rate of citizens from that of total population (% points)	-0.1%	+0.1%
The army		
[6] Paper strength of *auxilia* (thousand)	100-150 in 14 CE, growing to 218 *c*. 130 CE and 220-260 in 212 CE	
[7] Actual strength of *auxilia* (% of paper strength)	80%	95%
[8] Actual strength of fleets (thousand)	30	45
[9] Term of service (years)	*Auxilia*: 30 until 106, 25 thereafter Fleets: 26	
[10] Proportion of soldiers surviving 25 years	35%	55%
[11] Mean no. of children per enfranchised veteran	0.9 (0 after 140 CE)	1.6
[12] Scale of the pre-Claudian regime (% of Claudian level)	5%	95%
The Latin right		
[13] No. of Latin communities	100-120 in 14 CE growing to 600-1000 by 212 CE	
[14] Mean no. of qualifying magistracies per community	4	6
[15] Mean no. of offices held by each magistrate*	2	1
[16] Proportion of magistrates who were *not* sons of magistrates	18%	45%
[17] Mean no. of qualifying dependants per enfranchised magistrate	2.1	3.5
[18] Proportion of Latin communities granted *Latium maius* by 212 CE	5%	95%
[19] Mean size of *ordo* in Latin communities	60	100
[20] Mean annual attrition rate in the *ordo*	3.7%	4.6%

Grants to communities

[21] No. of promotions to Roman status	100-200 by 212 CE	
[22] Mean population of promoted communities (thousand)	11	30

Manumission

[23] Slaves as proportion of total population	6%	20%
[24] Representation of Roman citizens among the wealthiest 1–2% of slave owners (assumed to own 50% of slaves)	19% in 14 CE growing to 60% in 100 CE and 95% by 212 CE	
[25] Representation of Roman citizens among remaining slave-owners (%)	as in total free population	as in wealthiest 1–2%
[26] Proportion of slaves who were freed by age 60	10%	75%
[27] Proportion of male slaves ever freed who were free by age 30	25%	75%
[28] Lag in manumission of women versus men at age 30 (% of male level)	10%	100%*
[29] Contribution of natural reproduction to the slave supply*	80%	50%
[30] Sex ratio (males/females) among non-*vernae*	66%	150%
[31] Mortality rates in the servile population	Coale and Demeny Model West Level 3	
[32] Proportion of slaves freed before age 30 who died as Junian Latins*	90%	10%
[33] Proportion of slaves freed after age 30 who died as Junian Latins*	20%	5%
[34] Remaining reproductive potential by age for women	99% at age 15 declining to 43% at age 30 and 1% at age 45	
[35] Remaining reproductive potential by age for men	99% at age 15 declining to 50% at age 37 and 2% at age 60	

Viritane grants

[36] Grants per day	0.1	10
[37] Mean beneficiaries per grant	2	4

Migration

[38] Proportion of discharged Italian legionaries who settle in the provinces	50%	99%
[39] Legions in service	25 in 14 CE, 30 by 115 CE, 28 by 140 CE and 33 by 212 CE	
[40] Nominal strength of a legion	4,800	5,300
[41] Representation of Italians in the legions	62% in 14 CE falling to 1% by 117 CE	

Notes to Table

These are by necessity kept to a bare minimum. For economy, wherever possible I cite scholarship to illustrate extreme positions rather than discussing the evidence directly.

[1 and 2] Lower limit for 14 CE: Colin McEvedy and Richard Jones, *Atlas of World Population History* (London, 1978) (33m). Upper limit: Julius Beloch, *Die Bevölkerung der griechisch-römischen Welt* (Leipzig, 1886) (48m); cf Bruce W. Frier, 'Demography', in Alan K. Bowman, Peter Garnsey and Dominic Rathbone (eds.), *The Cambridge Ancient History XI* (Cambridge, 2000) (39 m). Range for 165 CE: Walter Scheidel, 'Demography', in Walter Scheidel, Ian Morris and Richard P. Saller (eds.), *The Cambridge Economic History of the Greco-Roman World* (Cambridge, 2007) (52-63 m). These figures are for the provinces and hence exclude Italy. To ensure this preliminary analysis is conservative, I provisionally rule out the much higher figures suggested by Julius Beloch, 'Die Bevölkerung Galliens zur Zeit Caesars', *Rheinisches Museum für Philologie,* liv (1899), 414-45 (64-74 m in 14 CE growing to *c*. 90 m by 165 CE).

[3] Lower limit: J. F. Gilliam, 'The Plague under Marcus Aurelius', *American Journal of Philology* lxxxii (1961), 225-52 (1-2%). Upper limit: William V. Harris, 'The Great Pestilence and the Complexities of the Antonine-Severan Economy', in Elio Lo Cascio (ed.), *L'impatto della 'peste Antonina'* (Bari, 2012), 336 (26-30%).

[4] Provisionally following Brunt, *Italian Manpower,* 265. Luuk De Ligt, *Peasants, Citizens and Soldiers: Studies in the Demographic History of Roman Italy 225 BC-AD 100* (Cambridge, 2012), 342-4 suggests Brunt's figure is *c*. 33% too high; Alessandro Launaro, *Peasants and Slaves: the Rural Population of Roman Italy (200 BC to AD 100)* (Cambridge, 2011), 24 and 187 suggests it is somewhat too low. I allow for a margin of error of 50% in order to observe the impact of uncertainty on the overall estimate. I have provisionally ruled

out, for reasons I cannot go into here, the much higher estimate of 6-7 m citizens overseas provocatively proposed by Michael Crawford, 'States Waiting in the Wings: Population Distribution and the End of the Roman Republic', in Luuk De Ligt and Simon Northwood (eds.), *People, Land, and Politics: Demographic Developments and the Transformation of Roman Italy 300 BC-AD 14* (Leiden, 2008).

[5] A provisional range, conservative for my purposes since both the disproportionate exposure of citizens to more aggressive disease environments such as cities and the legal regime governing the transmission of citizenship by birth make it very unlikely that the citizen population grew faster than the provincial population in which it was dispersed.

[6] Estimate for 130 CE from Paul Holder, 'Auxiliary Deployment in the Reign of Hadrian', in J. J. Wilkes (ed.), *Documenting the Roman Army* (London, 2003). Lower limit for 14 CE based on Tacitus' statement (*Annals* 4.5.4) that the *auxilia* and fleet together were around the same size as the legions (with a paper strength of 120-130,000 men at that time); upper limit arrived at by adjusting the Trajanic figure for known additions under the Julio-Claudians and Flavians. Lower limit for 212 CE based on estimate for 155 CE by A. R. Birley, 'The Economic Effects of Roman Frontier Policy', in A. King and M. Henig (eds.), *The Roman West in the Third Century* (Oxford, 1981); upper limit established by the count of all units that ever existed by Paul Holder, *The Auxilia from Augustus to Trajan* (Oxford, 1980) 217-40. Note that I provisionally ignore two complicating factors. On the one hand, by the second century CE many auxiliaries were already Roman citizens before recruitment; on the other, some peregrines were recruited to the legions and apparently receiving citizenship on recruitment. The former probably outnumbered the latter, so the net effect of ignoring both should be conservative.

[7] Upper limit: Walter Scheidel, *Measuring Sex, Age and Death in the Roman Empire: Explorations in Ancient Demography, (*Ann Arbor*,* 1996), 120-1 (90-95% in 'the orderly times of budgetary affluence under Hadrian and Antoninus Pius'). Lower limit: Peter Bang, 'The Roman Empire II: The Monarchy', in Peter Bang and Walter Scheidel (eds.), *The Oxford Handbook of the State in the Ancient Near East and Mediterranean* (Oxford, 2013), 419 (~80%).

[8] Lower limit: Chester G. Starr, *The Roman Imperial Navy 31 B.C. - A.D. 32* (Ithaca, 1941) (*c.* 30,000). Upper limit: Michel Reddé, *Mare Nostrum: les infrastructures, le dispositif et l'histoire de la marine militaire sous l'empire romain* (Roma, 1986): 550-4 (conceivably as much as 45,000).

[9] We know of auxiliaries who served as many as 36 years in the first half of the first century. See Eric Birley, 'Before Diplomas, and the Claudian Reform', in Werner Eck and Hartmut Wolff (eds.), *Heer und Integrationspolitik: Die Römischen Militardiplome als historische Quelle* (Cologne, 1986), 253-4. But it is generally assumed that Claudius established an upper limit of 30 and that the limit fell to 25 early in the second century. See Géza Alföldy, 'Zur Beurteilung der Militärdiplome der Auxiliarsoldaten', *Historia* xvii (1968). The term of service in the fleets seems to have remained constant at 26 years. For simplicity, I provisionally exclude the possibility that soldiers in the praetorian (but not provincial) fleets were enfranchised at the beginning of their service.

[10] Scheidel, *Measuring sex, age and death*, 117-8 estimates the 25-year survival rate for legionaries at 45%. The age profile of *auxilia* recruits was very similar (Holder, *Auxilia from Augustus to Trajan*, 138-9). I provisionally allow for the possibility that it might be up to 10 percentage points higher or lower. The upper limit corresponds with the survival rate at mortality rates from Coale and Demeny's 'Model West Level 3'.

[11] The diplomas issued to enfranchised auxiliaries usefully name not only the veterans themselves but also any existing children for whom they had requested citizenship, permitting an estimate of the mean number of dependents. The estimate is based on a sample of 143 diplomas where the recipients section is complete and a 99% confidence interval. The enfranchisement of children was abolished for auxiliaries in 140 CE, though soldiers in the fleets and auxiliary officers continued to receive citizenship for their children.

[12] A wide range to allow for the uncertainty about the pre-Claudian regime. See Franciska Beutler, 'Claudius und der Beginn der Militärdiplome: Einige Gedanken', in M. A. Speidel and H. Lieb (eds.), *Römische Militärdiplome: Die Forschungsbeiträge der Berner Gespräche von 2004* (Stuttgart, 2007) and Birley, 'Before diplomas'.

[13] Estimate based on multiple regional bibliographies, provisionally assuming that all post-Claudian *municipia* were Latin, following André Chastagnol, *La Gaule romaine et le droit Latin* (Lyons, 1995), 81-90 and François Jacques and John Scheid, *Rome et l'intégration de l'empire* (Paris, 1990), 236-7. The range primarily reflects significant uncertainty about the total number of autonomous communities in Spain and North Africa

[14] Most Latin communities had either 4 or 6 senior magistrates. The consensus is that lesser offices did not give title to citizenship: Monique Dondin-Payre, 'Magistratures et administration municipale dans les Trois Gaules', in Monique Dondin-Payre and Marie-Thérèse Raepsaet-Charlier (eds.), *Cités, municipes, colonies*, 2nd edn (Paris, 2009), 143-4.

[15] Provisionally following Brigitte Galsterer-Kröll, 'Zum *ius Latii* in den Keltischen Provinzen des Imperium Romanum', *Chiron* iii (1973), 306, who argues that the normal *cursus* was very short in the Celtic provinces, usually just one magistracy and never more than two – a conservative assumption for my purposes.

[16] I am wary of overestimating the ability of a few families to monopolise wealth and power over several generation, given the dynamics identified by Keith Hopkins, *Death and Renewal* (Cambridge, 1983). I provisionally assume that the rate of Family Status Maintenance among local magistrates was somewhere between that of the 'inner elite' and that of 'ordinary consuls' of the Republic as estimated by Hopkins (weighted average of figures in his Table 2.7), although the cost of political competition relative to family wealth is likely to have been lower in provincial cities than in Republican Rome, making this another conservative assumption.

[17] I provisionally use the estimates of living kin at Richard P. Saller, *Patriarchy, Property and Death in the Roman Family* (Cambridge, 1994), 51 (male, 'ordinary') to estimate the mean number of surviving kin (parents, wives, children and grandchildren in the male line) at age 35 (a conservative estimate of mean age of first-time magistrates, given that 25 is the minimum age for holding office in both the Digest and the *lex Irnitana*), allowing for a margin of error of +/- 25%.

[18] A wide range to allow for the massive uncertainty. *Latium maius* is only attested for two cities (Gigthis and Thisiduo, both in Africa), yet the fact that both are relatively minor makes it unlikely that it was denied to more prestigious communities with stronger patronage networks.

[19] Henrik Mouritsen, 'The *Album* from Canusium and the Town Councils of Roman Italy', *Chiron* xxviii (1998), 236-8.

[20] Expected attrition assuming average age at election to *ordo* of between 25 and 35 (see n. 17 above) under Coale and Demeney's 'Model West Level 3'.

[21] A provisional count based on regional bibliographies, assuming all post-Claudian municipia are Latin (cf n. 13) and allowing for an undercount of up to 50%.

[22] The standard study is Richard Duncan-Jones, *The Economy of the Roman mpire: Quantitative Studies*, 2nd edn (Cambridge, 1982), 259-87, which concludes that the citizen bodies of communities in Italy and Africa ranged from 1,000 to 22,000 with a mean of 8,000. But I am concerned that this might significantly underestimate the mean community size and hence the scale of enfranchisement. An alternative approach is to proceed top-down from what I believe about the total free population of the provinces (80-94% of 33-63 m; see nn. 1-2 and 23) and the total number of autonomous communities (2,000-2,500; based on regional bibliographies). This implies a potentially much higher mean free population of 11-30,000 persons per community. This is conservative for my purposes since it makes no allowance for persons who were not citizens of an autonomous community.

[23] Lower limit: Walter Scheidel, 'The Roman Slave Supply', in Bradley and Cartledge (eds.), *Cambridge World History of Slavery* i, 292 (6-12% in the provinces). Upper limit: Harris, 'Demography, Geography and the Sources of Slaves', 65 (16-20%; this estimate is for the empire as a whole and so should imply a lower figure for the provinces excluding Italy).

[24] A deliberate overestimation (conservative for my purposes) arrived at by estimating the proportion of families with equestrian wealth who had equestrian status based on the data on the representation of Italians and provincials among known *equites* provided by Hubert Devijver, *The Equestrian Officers of the Roman Imperial Army II* (Stuttgart, 1992). The provisional assumption that the wealthiest 1-2% of slave owners own 50% of all slaves is based on the model of slave holding at Kyle Harper, *Slavery in the Late Roman World*

(Cambridge, 2011), 59. This probably underestimates the 'tail' of slave-holding, making it conservative for my purposes.

[25] The model sets the representation of Roman citizens among other slave-owners in any year somewhere between their share of the total provincial population in that year and the higher rate assumed for the wealthiest slave holders for that year (with the proportion fixed in any given scenario).

[26 to 28] The scale of manumission remains one of the great unknowns in the history of Roman slavery. For a recent review of the evidence, see Henrik Mouritsen, *The Freedman in the Roman World* (Cambridge, 2011), 120-41, limiting himself to the qualitative conclusion that 'manumission was both very common and very selective'. Géza Alföldy, *Die römische Gesellschaft. Ausgewählte Beiträge* (Stuttgart, 1986), 286-331 provocatively suggested that manumission was the norm for all urban slaves and that freedom was generally granted before the age of 30 (the restriction to urban slaves qualified more sweeping claims in the 1972 version of the paper). His arguments have been rejected by most scholars, but it must be said that his critics have succeeded in showing that the evidence does not prove his hypothesis, but have not proved his hypothesis false. The most important subsequent attempt to establish plausible limits to manumission is Walter Scheidel, 'Quantifying the Source of Slaves in the Early Roman Empire', *Journal of Roman Studies* lxxxvii (1997), which explores how the demographics of slavery work to constrain the range of possible manumission regimes. Scheidel suggested that even an 'intermediate' manumission regime where 33% of slaves aged 25 were subsequently freed (10% before age 30) would put a 'massive' strain on other sources of slaves both within and outside the empire. But his analysis assumes a total population of 60 m, a slave population of 10%, constant age-specific manumission rates after age 25/30 and an identical regime for male and female slaves. The conclusions would not necessarily hold if the total population was higher, the proportion of

slaves was lower, the annual probability of manumission increased after age 30 and/or there was a significant delay in the manumission of women relative to men. Establishing the limits of demographic sustainability when all of these parameters are allowed to vary simultaneously with the overall scale of manumission is a much more challenging task. In an attempt to delineate a maximum scenario where manumission is high enough to be clearly implausible, without needlessly inflating the range of possible outcomes, I assume that 75% of all slaves (both rural and urban) are eventually freed, that the level of manumission among male slaves is already 75% of that level by age 30 (i.e. 56% of male slaves are free by age 30) and that female manumission by age 30 is at 45% of the male level (i.e. 25% of female slaves are free by age 30). Note that this is much higher than in Scheidel's 'intermediate' scenario, where only 10% of slaves are freed before the age of 30. In the 'minimum' scenario (not necessarily minimal), only 10% of slaves are free by age 60, with 2.5% of men and less than 1% of women free by age 30. To generate random possible scenarios I allow all three dimensions of the manumission regime to vary simultaneously. Since the level of female to male manumission at age 30 could conceivably have been higher than the 45% assumed in the maximum scenario if the overall level of manumission was low or if men were manumitted late, I allow it to be as high as 100% when generating random scenarios. It is thus possible for the model to generate a scenario with even higher manumission than my maximum scenario, though in practice this never happens. In future iterations, I hope to be able to rule out some resulting scenarios as demographically unsustainable.

[29] Scheidel, 'Roman Slave Supply', 308

[30] I assume a balanced sex ratio among those born into slavery, but allow for considerable uncertainty about the sex ratio in the other sources of slave supply. See Harper, *Slavery in the Late Roman World,* 69-71.

[31] Conservative since it probably underestimates slave mortality and hence overestimates the number of *liberti*. Cf Harper, *Slavery in the Late Roman World,* 71 and Scheidel, 'Roman Slave Supply', 307-8.

[32 and 33] There is considerable uncertainty about the proportion of ex-slaves who became Junian Latins and the proportion of those who were able to secure promotion to citizen status later in their lives. See further Paul R. C. Weaver, 'Where Have All the Junian Latins Gone?: Nomenclature and Status in the Early Empire', *Chiron* xx (1990) and Pedro López Barja de Quiroga, 'Junian Latins: Status and Numbers', *Athenaeum* lxxxvi (1998), 133-63 (speculating that Junian Latins may have outnumbered citizen freedmen). 20% is intended as a very conservative upper limit on the proportion of slaves freed after 30 who died as Junian Latins.

[34 and 35] Very provisional estimates based on the census data from Egypt as analysed by Roger S. Bagnall and Bruce W. Frier, *The Demography of Roman Egypt* (Cambridge, 1994), 143 (women) and 146 (men).

[36] I see no way to produce a remotely reliable point estimate for the contribution of viritane grants, but I believe that it is possible to at least establish an upper limit which must over-estimate it. We know that each grant involved significant bureaucracy and required at least minimal involvement by the emperor himself. Thinking in terms of orders of magnitude, an average of one hundred decisions per day seems clearly impossible over any length of time; even an average of 10 per day across every day of the rule of every emperor from 14 to 212 seems implausibly high. The minimum is set two orders of magnitude lower – though there is no reason why it could not have been even lower still.

[37] I provisionally take the central 50% of the range between the extremes of 1.0 (no benefitting kin) and 5.0 (grant extended to all surviving parents, siblings, spouses, children

and grandchildren, estimated from Saller, *Patriarchy, Property and Death*, 51 (male, 'ordinary') taking the average of ages 25 to 55, weighted for representation in the population).

[38] A wide range to accommodate uncertainty. 50% is a conservative lower limit, since a lower figure is far from inconceivable.

[39] J. C. Mann, *Legionary Recruitment and Veteran Settlement During the Principate* (London, 1983).

[40] Scheidel, *Measuring Sex, Age and Death*, 120-1.

[41] Brunt, *Roman Imperial Themes* (Oxford, 1990), 197, on the basis of the tables in G. Forni, *Il reclutamento delle legioni da Augusto a Diocleziano* (Rome, 1953).