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Agriculture and the 'Taxes-and-Trade' Model in Roman Egypt

aus: Zeitschrift für Papyrologie und Epigraphik 133 (2000) 205–220

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In recent years the study of the economy of the Roman empire has stagnated. To write a satisfactory economic history of a region of the Roman empire we need series of relevant data. These we find in Egyptian papyri which allow us to construct a 'taxes-and-trade' model for early Roman Egypt with real figures and to write a detailed history of Egyptian agriculture in the Roman period. First I shall discuss the reasons for the stagnation and then I shall explain how papyri fit into a 'taxes-and-trade' model and how to write an agrarian history of Egypt.

1. The economy of the Roman empire after *The Ancient Economy*

In 1973 the first edition of *The Ancient Economy* by Moses Finley appeared.[1] According to Finley the ancient economy differed fundamentally from that of later periods, and to describe it properly we need an appropriate terminology. Finley based himself on the work of Karl Polanyi and his followers (sometimes dubbed 'primitivists'). The ancient economy was embedded in society at large, and that society differed substantially from that of later periods. *The Ancient Economy* divided ancient historians into two camps, on the one hand Finley and his followers ('Moses und die Propheten'), on the other hand those who felt that Finley underestimated ('minimalized') the achievements of the ancient economy and ignored ('reduced') significant developments within antiquity. A lot of attention was paid to the ideas of Michael Rostovtzeff and his followers (sometimes dubbed 'modernists'), who thought they could detect trade and industry where this seemed excluded on a priori grounds (in the context of the embedded economy).

According to Finley the ideal of autarky pervaded and shaped the ancient economy. There was no trade in goods which could be produced everywhere in sufficient quantities, only trade in luxuries and cereals (the latter in case of local and temporary shortages). This, however, does not seem to be the case. Take vinegar. From Athenaeus II 67 c–e it appears that by the fourth century B.C. Egyptian (and Cnidian) vinegar had ousted other, local types of vinegar in Greece. Vinegar is the cheapest kind of undrinkable wine (sort of). It is used as a condiment and to keep perishable foodstuffs. Why was a sufficient quantity of vinegar not produced everywhere? This would have been cheaper than hauling vinegar from Egypt because of the transport costs involved. The answer is simple: elsewhere they preferred to turn their grapes into more expensive wine.

Transport costs for vinegar are as high as those for wine. The extra costs involved in hauling vinegar from Egypt do not make economic sense unless vinegar is either an expensive luxury or a cheap bulk commodity. Egyptian vinegar was clearly a cheap bulk commodity. Vineyards on flat soil such as in Egypt produce a relatively large volume of grapes. Unless one 'dries' the juice in the open air (to make it sweeter, not drier), it will not result in a very tasty wine. One might as well turn it into vinegar. Egyptian vineyards produced lots of vinegar, which is not always appreciated in the literature on the subject.[2] Did Egyptian wine perhaps also end up on markets abroad? The bulk of Egyptian wine was not very tasty. Now, most people cannot distinguish an 'appellation contrôlée' from wine in a waxed cardboard

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* Translation and adaptation of an article originally published in Dutch as 'Landbouw en het "taxes-and-trade model" in Romeins Egypte', *Lampas* 31 (1998), 290–305.

[1] Second edition, London 1985, reissued with a new preface by I. Morris, Berkeley 1999.

[2] D. Rathbone, Prices and price formation in Roman Egypt, in *Économie antique. Prix et formation des prix dans les économies antiques*, Saint-Bertrand-de-Comminges 1997, 241, note 35, ignores both the drying process for the best wine and the role of vinegar in his calculations of the profitability of vineyards in Roman Egypt. The drying process produced less wine than Rathbone thinks, and a lot of wine was in fact vinegar and sold at lower prices. Consequently Rathbone exaggerates the share of viticulture in the agrarian economy, which was nevertheless substantial.

box (I can't). According to Martial XIII 122 Egyptian wine was even cheaper than Egyptian vinegar (*vilior*, not only cheaper, but also meaner). Did the masses in Rome perhaps drink Egyptian wine?

In the wake of *The Ancient Economy* a lot of energy was wasted. Scholarly meetings to discuss the merits of Finley's views resulted in often superficial publications (such as the issue of *Lampas* in which the present article originally appeared in Dutch). Finley and his followers often seemed to attack René Goscinny and Albert Uderzo (the creators of *Astérix*) rather than more moderate 'modernists'. Finley's opponents focussed on the catalogue of things he claimed were lacking in antiquity: economic growth, technical progress, economic rationalism; productive investments; involvement of the elite in trade and industry; and participation of craftsmen and traders in municipal government. According to Finley ancient cities ('consumption cities') were not in the habit of producing for export. All this cannot be upheld without qualification, and the implicit comparison with later periods in Europe (where all this is supposed to be pertinent) has been made explicit by Harry Pleket.[3] If later medieval and early modern Europe differed fundamentally from the ancient world, a sustained comparison between the two can be very illuminating. Similarities are less helpful in this respect, but in reaction to Finley a lot of attention has been paid to similarities between the ancient economy and that of Europe in later periods. A comparison with non-European cultures has not been pursued.[4] The economy of India or China in the past is less familiar than that of Europe and about as controversial as that of the Roman empire.

By now there are few partisans of Finley left who believe that ordinary economic concepts should not be applied to the ancient world. Many now think that there was economic growth in antiquity and that the economy of the Roman empire requires a somewhat different approach from that of classical Greece. Taking a monolithic view of the economy of the Roman empire has also lost its attraction, because there were clearly huge differences between the various regions. The interaction between town and countryside (mainly through property relations) and between town and state (mainly through taxes) differed from region to region. Such differences give us a sense of *how* towns were embedded. Many think that the elite was indirectly involved in non-agricultural activities, through loans, ships, workshops and slaves.[5] The different status of craftsmen and traders in antiquity and later periods in Europe can be explained by differences in the make-up of society. The Romans had definitely brought big landowners to power everywhere, and this did not make it easy for craftsmen and traders to join in (unless they invested part of their profits in land). In medieval Europe the power structure was totally different.

There thus seems to be enough scope for progress in research into the economy of the Roman empire. Yet such research is presently in a quagmire. Two reasons can be adduced for this. In the first place the target group consists mainly of general classicists. Although they have some notion of the economic basis of classical civilization and would readily agree that our appreciation of that civilization would hang in the air if we did not understand that basis, they are no longer interested in the by now very technical discussions about most of the ancient economy. Where things are still in a flux, such as in the case of archaic and classical Greece, the scholarly discussions can still command the interest of a

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[3] See especially H. W. Pleket, Wirtschaftsgeschichte der römischen Kaiserzeit, in F. Vittinghoff (ed.), *Handbuch der Europäischen Wirtschafts- und Sozialgeschichte* 1, Stuttgart 1990, 25–160. See now also P. Horden and N. Purcell, *The Corrupting Sea: A Study of Mediterranean History*, Oxford 2000.

[4] For a comparison between Roman Egypt and British India see J. Hatschek, *Römisches und britisches Weltreich*, München and Berlin 1921. Hatschek (1872–1926) specialized in comparing public institutions.

[5] Wealthy Italians invested heavily in trade with the east in the earliest imperial period, which explains the high concentration of testimonia (apart from literary texts especially inscriptions from the eastern desert of Egypt) from that period. These investments were curtailed in 33 when Tiberius enforced an equilibrium between the value of the land wealthy Italians owned in Italy proper and the amount of money they invested in other kinds of ventures. See A. Tchernia, Moussons et monnaies: les voies du commerce entre le monde gréco-romain et l'Inde, *Annales. Histoire, Sciences Sociales* 50 (1995), 991–1009. See also F. De Romanis, *Cassia, cinnamomo, ossidiana. Uomini e merci tra oceano indiano e mediterraneo*, Roma 1996, especially 203–259.

wide range of scholars.[6] Where there is controversy, there is excitement. Once the controversy has ground to a halt, dullness sets in.

The second reason for the stagnation in the study of the economy of the Roman empire is the nature of the sources. Literary and documentary texts and archaeological finds are hardly ever representative. When we extrapolate individual data, we enter the realm of speculation. Because we do not have the right data, the answers to economic questions we formulate with the help of even abundant sources do not impose themselves. Especially those areas of research for which an enormous scholarly apparatus exists, such as Italian agriculture in the early imperial period, are completely stuck because everything is possible and therefore nothing is certain.[7] Archaeology will continue to expand our knowledge, but the step from surveys to economic history remains precarious.[8] When a *synchronic* study of the economy of the early imperial period already poses such problems, a *diachronic* study multiplies the uncertainties. A diachronic approach can, however, help us sober up: if our view of the economy of a certain period does not square with our view of that of the immediately following period, such as in the case of independent (local) and Roman (international) Delos,[9] something is bound to be wrong.

2. The 'taxes-and-trade' model for the economy of the Roman empire

We must have recourse to a historical model which has to be dynamic enough to accomodate long-term changes and variable enough to accomodate local circumstances. Finley thought everything in the ancient economy remained essentially as it was, whatever happened. Nowadays we want to integrate growth and decline into our model of an ancient economy. For that we need figures, which we can sometimes derive from the sources or more often have to make up ourselves. In the latter case we enter the realm of speculation, where the unavoidable margin of error is perhaps too large to yield meaningful results. If figures are mentioned in the sources, we have in fact the same problem on our hands, because once we integrate some figures into our model we cannot avoid speculating on the missing figures. Yet I think the 'taxes-and-trade' model of Keith Hopkins is a good point of departure for further research.[10] By using models without figures such as Finley's we are also fooling ourselves.

What are the advantages of the 'taxes-and-trade' model? It takes account of the fact that the ancient economy was in a constant flux. It also tries to explain economic growth in the early Roman empire. No doubt Finley would have liked to play his trump card here: growth without change. Economic growth in the Roman empire was probably matched by the growth of the population, and in that case there was no growth per capita. This will not do. Substantial growth in the scale of an economy is impossible without qualitative changes. The Roman empire was much larger than the Hellenistic empires and included regions which were completely different from one another. It linked these regions in a practical sense (through a network of routes and through increased mobility of goods and persons), but also integrated them in a larger tax structure. What a given region paid in money taxes it earned through regional and interregional exchanges of various kinds. If the state did not spend as much money there as it exacted in money taxes, the region had to finance the deficit through exchanges with other regions (expecially

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[6] See I. Morris, The Athenian economy twenty years after *The Ancient Economy*, *Classical Philology* 89 (1994), 351–366, and his new preface to Finley, *The Ancient Economy.*

[7] See W. Scheidel, *Grundpacht und Lohnarbeit in der Landwirtschaft des römischen Italien*, Frankfurt 1994.

[8] For one region of the Roman empire see S. E. Alcock, Graecia Capta: *The Landscapes of Roman Greece*, Cambridge, 1993.

[9] G. Reger, *Regionalism and Change in the Economy of Independent Delos, 314–167 B.C.*, Berkeley 1994.

[10] K. Hopkins, Taxes and trade in the Roman empire (200 B.C. – A.D. 400), *Journal of Roman Studies* 70 (1980), 101–125. J. Andreau, *Banking and Business in the Roman World*, Cambridge 1999, 127–138, is rather pessimistic about using figures.

Italy, where the state spent most of the money). Hopkins is thinking mainly of regional trade (especially in foodstuffs) and to a lesser degree of interregional trade (expecially in luxury goods).[11]

Yet there are problems with the 'taxes-and-trade' model. First the margin of error. Hopkins calculates that the state needed 825 million sesterces every year in the first century of the Roman empire.[12] He thinks this money was raised mainly in the form of direct and indirect taxes and that these represented 10% of the value of all economic activities in the Roman empire. The margin of error here is very large: suppose taxes represented only 5% or even 25% of the value of all economic activities? What do we gain by such an elastic figure in a model of the economy of the early Roman empire? Hopkins also presupposes that the regions taxed in money earned the money to pay for their taxes through various forms of trade. Is it not also possible that these regions became poorer and poorer or that they ceded more and more land to wealthy Italians? Trade is only one form of exchange.

While we are at it, why should there be only so much trade as was needed to raise the money to pay for taxes? Is it not possible that there was more trade than was absolutely necessary? This is a major flaw in Hopkins' model: the causality it posits between money taxes and trade. It seems as if trade developed only *because* some regions in the Roman empire had to pay money taxes and therefore had to earn it somehow. It is far more likely that the Romans discovered existing trade in the various regions they conquered and that they wanted to take a share of the profits through taxes (just as they discovered trade on Delos in 167 B.C.).

How important were other forms of exchange? Outright impoverishment of the regions conquered by the Romans does not explain what happened in the long run. Can we measure the acquisition of land by wealthy Italians in the various regions of the Roman empire? In the absence of reliable sources we have to go by impressions. In Asia Minor wealthy Italians do indeed seem to have acquired more and more land. In Egypt, however, we can confirm from papyri that there was no big sell-out of land to wealthy Italians. The acquisition of large tracts of Egyptian land by members of the imperial elite in the early Roman empire was not such a sell-out, because these 'imperial estates' (the former property of the Ptolemies) were parcelled out by Augustus and his immediate successors free of charge to selected individuals and confiscated soon after. Ordinary state land in Egypt was indeed sold by the state on a large scale in the first three centuries of Roman rule, but not to wealthy Italians who were not allowed to acquire land in Egypt. Of course we cannot extrapolate this to other parts of the Roman empire. Egypt enjoyed a 'status aparte' (just as Aruba within the Dutch commonwealth), and the emperors tried to keep wealthy Italians away from Egypt as much as possible for political reasons.

3. The 'taxes-and-trade' model applied to Egypt in the early Roman empire

For Egypt we can make more positive statements than for other regions of the Roman empire. In the first two centuries of Roman rule Egypt had to pay hundreds of millions of its drachmas (equivalent to Roman sesterces) every year in money taxes. Now, Egyptian currency was not allowed to circulate abroad. The government therefore could not spend the money taxes abroad without further ado. If it wished, the government could extract a small quantity of silver from the coins for use abroad, but it did not have a mechanism of its own for bringing sufficient numbers of coins (with a lower silver content, as the case may be) back into circulation, because it spent as little as possible in Egypt itself. In the course of the Roman period Egyptian temples received less and less state support, and taxes raised for

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[11] See K. Hopkins, Models, ships and staples, in P. Garnsey and C. R. Whittaker (eds.), *Trade and Famine in Classical Antiquity*, Cambridge 1983, 84–109. C. R. Whittaker, Markets and fairs, *Journal of Roman Archaeology* 10 (1997), 422, lumps Hopkins with Rostovtzeff. That is absurd, to use a favourite phrase of Hopkins'.

[12] For other calculations see R. W. Goldsmith, *Premodern Financial Systems*, Princeton 1987, 47–56, and H.-U. von Freyberg, *Kapitalverkehr und Handel im römischen Kaiserreich (27 v. Chr. – 235 n. Chr.)*, Freiburg 1989, 111–127.

the upkeep of the irrigation system in Egypt[13] represented only a small part (about 15 million drachmas a year) of total taxes. The Roman army in Egypt cost at most 22 million drachmas a year,[14] government personnel even less. How did the government manage to return the remainder, still several hundreds of millions of drachmas a year, to Egyptian taxpayers so that these could continue to pay money taxes? I think the government managed this by exchanging the bulk of the tax money for foreign currency which was brought to Egypt from the rest of the Roman empire (first and foremost Italy) by traders. The government could freely spend this foreign currency abroad. The traders in their turn spent the Egyptian money they received from the government on goods they bought in Egypt.[15] Thus the money reentered the Egyptian 'whirlpool.'

Because Egyptians were not allowed to sell land to wealthy Italians, all they could do was to sell their agricultural surplus (not just wheat, but also, e.g., wine and vinegar) and other goods abroad. With the agricultural surplus[16] they could finance at most 40% of the money taxes. Some other, non-agricultural goods were imported from Africa, Arabia and India and re-exported with huge profits to the rest of the Roman empire, especially Italy. Pliny the Elder thought that because of the trade with the east a lot of gold 'leaked' out of the Roman empire. It did, but not as much as he thought.[17] Roman Egypt also sold goods to Africa, Arabia and India, especially Egyptian goods. At least well into the third century Egypt dominated trade with the east (whether it alone profited from the renewal of this trade in the fourth century is not clear). If we adopt the figures mentioned by Pliny we can calculate that Egypt could pay at most 20% of the money taxes with the profits made on goods imported from Africa, Arabia and India.

The rest, at least 40%, had to be paid for with the profits from trade in non-agricultural goods from Egypt itself. Roman Egypt could produce such goods very cheaply thanks to low wages and prices and sell them abroad with little or no competition from other providers. A comparison with modern Egypt is illuminating. In the nineteenth century Egyptian agriculture was turned into a producer of raw materials for western industry. A sophisticated system of government monopolies was created for the purpose of extracting as many raw materials as possible.[18] Because there was no western industry in antiquity it

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[13] The implantation of a new irrigation system on a private estate of 10,000 aruras (ca. 27,5 km^2) in the third century B.C. cost the equivalent of about 2,000 monthly wages (Pap. Lugd. Bat. XX Suppl. A). For the whole of Egypt this would work out as ca. 30 million drachmas in the first two centuries of Roman rule, but by that time all of Egypt already had an irrigation system which merely had to be kept in good order. This was mainly done through corvée which came free of charge. Major innovations such as deepening the Wadi Tumilat (Trajan's canal which linked the Red Sea with the Nile part of the year) were indeed financed with tax money, but such expenses did not often occur. Hadrian's foundation of Antinoopolis in 130 would be another example of state expenditure in Egypt.

[14] J.-M. Carrié, Le rôle économique de l'armée dans l'Égypte romaine, in *Armées et fiscalités dans le monde antique*, Paris 1977, 373–391.

[15] That is more or less what E. Christiansen, *The Roman Coins of Alexandria: Quantitative Studies*, Århus 1988, has argued. The exchange operation also allowed the government to extract silver from the tetradrachmas paid as taxes and to issue new coins with a lower silver content. Christiansen argues that this happened on a large scale during the latter part of Nero's reign.

[16] After deduction of the taxes raised in kind and of the food requirements of the Egyptian population itself. See for this and other details my forthcoming *The Economy of Roman Egypt.*

[17] Cf. P. Veyne, Rome devant la prétendue fuite de l'or: mercantilisme ou politique disciplinaire?, *Annales. Economies, Sociétés, Civilisations* 32 (1979), 211–244. From a comparative perspective a gold 'leak' to India is realistic. Especially trade with Southern India was imbalanced.

[18] On these monopolies see H. A. B. Rivlin, *The Agricultural Policy of Muḥammad ᶜAlî in Egypt*, Cambridge, Mass. 1961, and K. M. Cuno, *The Pasha's Peasants: Land, Society, and Economy in Lower Egypt, 1740–1858*, Cambridge 1992. Oddly enough, the monopoly system of modern Egypt provided the model for the one in Hellenistic Egypt, not the other way round. When the first substantial texts from the third century B.C. were published modern experience provided the backdrop for their interpretation. The ancient and modern monopolies were interpreted rather one-sidedly as a form of state intervention in the economy. Yet the reason behind the modern monopoly system was no doubt the same as that behind the Ptolemaic: to extract as much out of the economy as possible. An exhaustive study of the monopoly system of Ptolemaic and Roman Egypt is long overdue.

seems natural to assume (and anecdotal information in literary texts seems to confirm it) that ancient Egypt transformed its raw materials into finished products itself before exporting them.

What would happen if the money taxes were in fact a quarter less than I have assumed above? We cannot go much lower than that; we simply know too much. The surplus from agriculture would in that case account for at most 50% of the money Egypt needed to earn to pay taxes. What would happen if the yield of the land was in fact 10% lower than I have assumed? Again we cannot go much lower, because again we know too much. The surplus from agriculture would in that case account for at most 20% of the money Egypt needed to earn to pay taxes. There are thus margins on all sides of the model, but the margin of error does not increase because of them; it rather decreases because a lot of margins cannot be stretched indefinitely. If the yield of the land would be more than 10% lower than I have assumed, e.g. as low as at the beginning of the nineteenth century, there could not have been any agricultural surplus, and this would clash with what we know for certain, namely that not only Rome, but also other large cities in the Roman empire imported wheat and other agricultural goods (such as wine and vinegar) from Egypt.[19]

4. Agriculture in Roman Egypt: the big picture

Agriculture is decisive in a pre-industrial economy. If we cannot be firm about agriculture in antiquity we might as well give up. But if we can, as is the case for Roman Egypt, we still have to integrate the data by using a model. A one-sided but useful model is presented by the work of R. Sallares[20] on Attica in the classical period, especially in the fourth century B.C. According to Sallares, the population of Attica in that period rose far beyond the 'normal' level, with the implication that it could no longer be fed by what agriculture in Attica itself produced. To some degree that had been the case in the fifth century when wheat imports from abroad had given Attica some respite. After the fourth century B.C. the population of Attica dropped below the 'normal' level, because it (unconsciously) started to impose restrictive measures on itself, a kind of family planning.

In Roman Egypt the population peaked in the second century AD as is clear from the archaeology of ancient sites. In dealing with Egypt we cannot limit ourselves to the carrying capacity of the land,[21] as Sallares does in dealing with Attica from the fourth century B.C. onwards, because there were lots of others feeding on Egyptian wheat and other produce. Egypt provided the lion's share of the wheat consumed in Rome.[22] Through trade a lot of other wheat went to other cities abroad. The amount of wheat shipped to Rome was rather inelastic, because the bulk was collected as taxes in kind. The

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[19] See for the later period J.-M. Carrié, Les distributions alimentaires dans les cités de l'empire romain tardif, *Mélanges de l'École Française de Rome, Antiquités* 87 (1975), 995–1101, and H. Wiemer, *Libanius und Julian. Studien zum Verhältnis von Rhetorik und Politik im vierten Jahrhundert n. Chr.*, München 1995, 269–355.

[20] R. Sallares, *The Ecology of the Ancient Greek World*, London 1991. For Egypt see K. W. Butzer, *Early Hydraulic Civilization in Egypt: A Study in Cultural Ecology*, Chicago and London 1976. A lot of information about Egyptian agriculture can be found in M. Schnebel, *Die Landwirtschaft im hellenistischen Ägypten*, München 1925, and W. Willcocks and J. I. Craig, *Egyptian Irrigation*, London and New York [3]1913. Willcocks (1852–1932) invented the Aswan dam.

[21] Ancient historians are familiar with this concept since K. J. Beloch, *Die Bevölkerung der griechisch-römischen Welt*, Leipzig 1886.

[22] Following the traditional interpretation of Josephus, *BJ* 2, 383 en 386 (from the speech of Agrippa against the Jewish revolt), D. W. Rathbone, Graeco-Roman Egypt and the ancient economy, in L. Criscuolo and G. Geraci (eds.), *Egitto e storia antica dall'ellenismo all'età araba. Bilancio di un confronto*, Bologna 1989, 173, note 40, thinks it 'quite plausible' that more wheat arrived in Rome from North Africa than from Egypt. Now, when Josephus says that Egypt provided four months of the freely distributed wheat (386) I think he means that Egypt provided the *remaining* four months; he had mentioned previously (383) that North Africa provided up to eight months of the freely distributed wheat; there were only four months left for Egypt. The wheat for the rest of the population of Rome, which was not distributed free of charge, came mainly from Egypt, but Josephus is not concerned with that. See F. De Romanis, *Septem annorum canon.* Sul *canon populi Romani* lasciato da Settimio Severo, *Rendiconti della Accademia Nazionale dei Lincei* IX 7.1, Roma 1996, 133–159, for an unconvincing alternative interpretation (North Africa's eight months = free distributions of wheat only; Egypt's four months = wheat for the entire population of Rome, which was in fact an unknown and unknowable amount).

amount of wheat shipped to other cities was more elastic. These bought Egyptian wheat primarily when there was not enough wheat to be had locally. When that happened these cities had less money to buy other agricultural and non-agricultural goods from Egypt. Otherwise Egypt exported rather more of those to raise the money to pay its taxes. In any case, constant pressure was exercised on Egyptian agriculture by the size of Egypt's own population and by taxation, both in kind (direct) and in money (direct and indirect).

Predictably (from a Malthusian perspective), when the population of Egypt peaked under Marcus Aurelius the plague hit. The effects of the plague in Egypt can be measured to some extent, because papyri from the Delta show that entire villages were (temporarily?) depopulated.[23] If Sallares is right in identifying the plague as smallpox, this must have become endemic and continued to affect, not the whole population of Egypt, but infants mainly. In their study of the demography of Roman Egypt R. S. Bagnall and B. W. Frier concluded that mortality increased in Egypt after the plague.[24] The population recouped to some extent, but may well have entered a protracted 'low' from the third century onwards, just as the population of Attica did from the fourth century B.C. onwards. The sites in Roman Egypt we know best did decrease in size from the third century onwards. Various kinds of family planning such as extended lactation, deferred remarriage of widows and the killing and exposure of infants, all of which Sallares found in Attica from the fourth century B.C. onwards, are found in Egypt well before the plague under Marcus Aurelius. Unfortunately it is impossible to know whether the effect of any of these constraints increased over time. It does not seem likely on the surface that the age at first marriage for Egyptian girls was higher from the third century A.D. onwards. The only constraint whose effect did at least increase over time is celibacy, which removed more and more women (and men) from the reproductive circuit in Egypt, but only from the fourth century onwards.

Can we follow the development of the size of the population of Egypt with the help of more reliable statistical material? The study of Bagnall and Frier about the census documents has provided major insights into the demography of Roman Egypt, but not into the changing size of the population over time. I think we need to bring into play here what we know about agricultural production. In pre-transitional economies agriculture is so essential, and the intensity of agriculture in Egypt is so much dependent on the size of the population, that we are allowed to ascribe a significant decrease in the production without further ado to a decrease in the size of the population. The total amount of land in Egypt is rather inelastic. The Greeks had increased the amount of land somewhat, but these gains disappeared again from the third century onwards.[25] The urbanisation level is also rather inelastic. Both cities and villages peaked about the middle of the second century. It is conceivable that a decrease in the size of the population in the villages did not *immediately* result in a decrease in the size of the population in the cities (such a decrease was inevitable in the long run, because in pre-transitional societies cities always depended on the influx of immigrants from villages). In late antiquity there may have been a larger percentage of the (now decreased) total population living in cities, but not for very long. If agricultural production in Egypt was significantly lower in late antiquity, we can safely say that there was an extensification of agriculture and a decrease in the size of the population *ceteris paribus*.

Hundreds of leases of land from Roman Egypt provide insights into the size of the agricultural production.[26] If we limit ourselves to the couple of hundreds of leases which specify a fixed amount of

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[23] Not just because of the plague. We have to add raids by bandits and by Roman soldiers (see P. Thmuis I). For further indications of the plague under Marcus Aurelius in papyri see the analyses of R. P. Duncan-Jones, The impact of the Antonine plague, *Journal of Roman Archaeology* 9 (1996), 120–125.

[24] R. S. Bagnall and B. W. Frier, *The Demography of Roman Egypt*, Cambridge 1994, 173–178.

[25] See P. van Minnen, Pelousion, an Arsinoite village in distress, *Zeitschrift für Papyrologie und Epigraphik* 77 (1989), 199–200, and Deserted villages: two late antique town sites in Egypt, *Bulletin of the American Society of Papyrologists* 32 (1995), 41–56.

[26] For the first three centuries see also R. F. Muth, Real land rentals in early Roman Egypt, *Explorations in Economic History* 31 (1994), 210–224, who uses A. C. Johnson, *Roman Egypt to the Reign of Diocletian*, Baltimore 1936, instead of

wheat as rent, we can estimate the yield of land used to grow wheat, because the rent oscillates around 50% of the yield. Outright share-cropping (where the yield is proportionally split between landowner and tenant) occurs remarkably seldom in such leases, mainly in the fourth century. If we include in our calculations the effect of other, more and less productive crops and of the cropping rate,[27] we arrive at a realistic picture of the development of agricultural yield over time (figure 1).

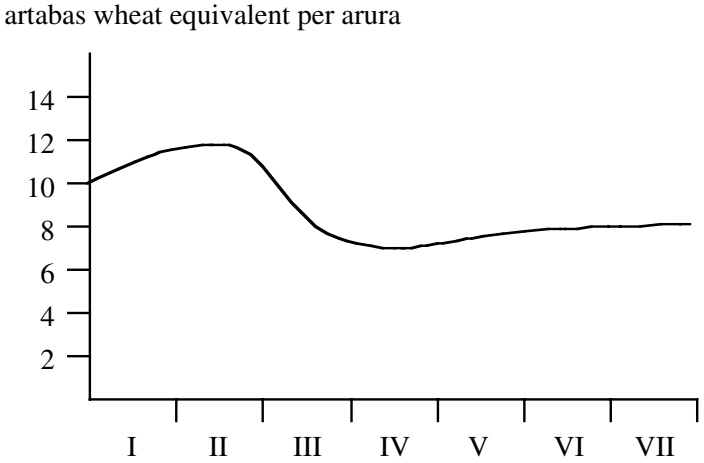

Figure 1: Agricultural yield in Roman Egypt from the first to the seventh century

The curve expresses the yield in artabas (of somewhat less than 40 litres or 30 kilograms) wheat equivalent per arura (ca. 0.275 hectare). The movement of the curve corresponds to what we would expect if the population indeed entered a protracted 'low' after the plague under Marcus Aurelius. The nadir in the fourth century can be explained in part by the sharp increase in the pressure on Egyptian agriculture from Diocletian onwards. Taxes consumed a larger part of the much smaller surplus in the fourth century, and the army 'consumed' relatively more men, because the size of the army did not decrease – and more soldiers died in real wars than before. The consequence of all this was a sharp drop in the size of the population. The very poor performance of Egyptian agriculture in the fourth century fits in rather well with the relatively high frequency of share-cropping in that century. Did Pliny the Younger not advocate share-cropping as a last resort at a time of agricultural contraction (in Roman Italy much earlier than in Roman Egypt)? In the fourth century beer disappears from the Egyptian menu, which suggests that barley had become so scarce that it was mainly used as animal fodder. Relatively more land had to be grown with wheat for human consumption than before.

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more recent works such as H.-J. Drexhage, *Preise, Mieten/Pachten, Kosten und Löhne im römischen Ägypten bis zum Regierungsantritt Diokletians. Vorarbeiten zu einer Wirtschaftsgeschichte des römischen Ägypten* 1, St. Katharinen 1991. In what follows I have left out leases of land from the Arsinoite nome from the third century onwards, because the best documented part of that nome is in deep trouble then (see the references in the preceding note) and the rent sometimes seems extraordinarily low. A more intelligent use of Egyptian leases of land as a source for economic history is called for. The study of P. T. Hoffman, *Growth in a Traditional Society: The French Countryside, 1450–1815*, Princeton 1996, provides a useful model. The remark of D. P. Kehoe, *Investment, Profit, and Tenancy: The Roman Jurists and the Roman Agrarian Economy*, Ann Arbor 1997, 15–16, note 23, that the decrease in the level of rent in the third century (which Muth explains with reference to an increase in tax pressure) points to an increase in bargaining power of tenants, has to be put in a larger perspective (wages were higher in the third century, *pace* Muth, which also points to a decrease in the manpower available). See also D. P. Kehoe, Legal institutions and the bargaining power of the tenant in Roman Egypt, *Archiv für Papyrusforschung* 41 (1995), 232–262.

[27] Two harvests a year were always possible in Egypt. For data from modern Egypt before the great innovations in irrigation see T. Ruf, The history of agricultural development, in G. M. Craig (ed.), *The Agriculture of Egypt*, Oxford 1993, 188–208.

The size of the object leased can also be plotted over time and yields about the same graph as that of the agricultural yield. The size of the object leased is fairly high in the first two centuries of Roman rule and then drops significantly. Under normal circumstances the size of the object leased should be the inverse of the height of the rent: the more one leases, the lower the rent will be (the premium effect for large 'consumers'). *Ceteris paribus* the two curves should have mirrored one another. If the size of the object leased decreased significantly in late antiquity, the amount of the rent should rather have increased. If the opposite happened, the movement of the curves becomes extra significant. After the second century there did not occur a gradual, hardly noticeable decrease of agricultural yields in Egypt, but a major and unmistakable landslide. History took a turn here, to use a favourite phrase of Mommsen's.

We can also plot the duration of the contract of lease against the size of the object leased (figure 2).[28] It makes a huge difference whether one leases for an even or an uneven number of years.

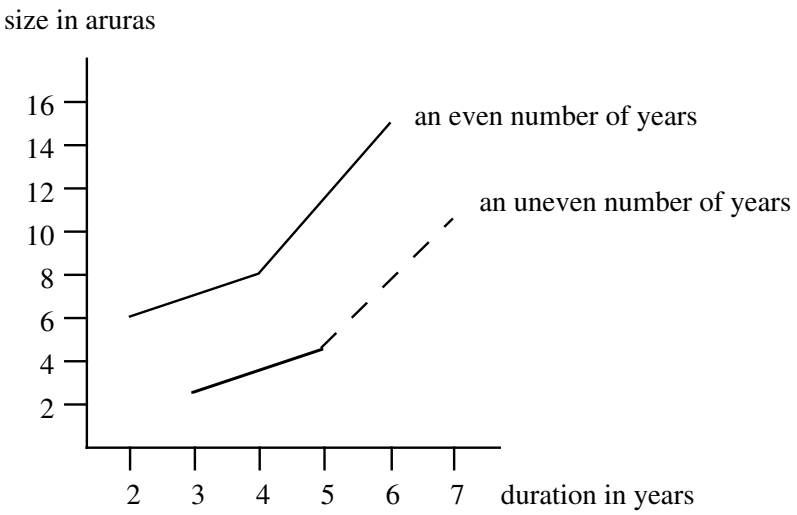

Figure 2: The duration of the lease of land plotted against the size of the object leased

From the graph it appears that an uneven number of years corresponds to smaller-scale and therefore relatively more intensive agriculture, an even number of years to larger-scale and therefore relatively more extensive agriculture. In contrast to the Fayum and the Hermopolite nome the Oxyrhynchite nome has so far produced almost exclusively leases for an even number of years – or for a single year. It seems as if agriculture in the Oxyrhynchite nome was quite different from agriculture elsewhere in Egypt. We should therefore be wary of extrapolating data from the Oxyrhynchite nome to the rest of Egypt without further ado.[29]

[28] I have excluded the many leases for the duration of a single year. Because there are in fact only a few leases for seven years the line connecting 5 and 7 is broken.

[29] J. L. Rowlandson, *Landowners and Tenants in Roman Egypt: The Social Relations of Agriculture in the Oxyrhynchite Nome*, Oxford 1996, rather invites one to do so. B. E. Nielsen, Early fourth century tax bases in the Oxyrhynchite nome, in B. Kramer, W. Luppe, H. Maehler and G. Poethke (eds.), *Akten des 21. internationalen Papyrologenkongresses* 2, Stuttgart and Leipzig 1997, 756–764, notices another difference between the Oxyrhynchite and other nomes. From about 300 onwards the number of *epoikia* (originally settlements on the estate of big landowners) increases dramatically in the Oxyrhynchite nome, but hardly so elsewhere. There are also many smaller settlements in the Oxyrhynchite nome, which follows from the very uneven statistical spread of tax quota.

5. Agriculture in Egypt: the nitty-gritty

Papyri tell us first and foremost something about a local situation somewhere in Middle Egypt. But they tell us a lot. By studying agriculture in a single village or even a single crop grown in a particular village we can also find out more about agriculture in general thanks to the wealth of detail provided. For Theadelphia in the Fayum[30] we have substantial sets of data for the first, second, third and fourth centuries. Thanks to these data we know virtually everything about viticulture there. One set of data has been subjected to a thorough economic analysis by D. W. Rathbone.[31] Appianus, a prominent member of the elite of Roman Egypt, owned several clusters of land in the Fayum about the middle of the third century. Each cluster was run by a manager. One of these managers, one Heroninus, was responsible for Theadelphia. He kept up a busy correspondence with the central administration in the capital of the Fayum. We know quite a bit about the other clusters as well and about what happened to the wine produced on the estate, because the central administration used old records from elsewhere for its correspondence with Heroninus. At Theadelphia Appianus owned about 250 aruras of arable land on which mainly wheat was grown for local consumption, as well as about 100 aruras of vineyards, all in small parcels. Records of income and expenditure allow us to calculate net profits from the estate.

Most striking is the importance attached to viticulture on the estate at Theadelphia. The high percentage of land used as vineyards is remarkable, and the records of Heroninus also show that this part of the estate focussed on the production of wine for export; about 90% of the wine was sold. In Theadelphia the 'least bad' wine of the whole area was produced. Only a small part of the wine was consumed locally. The bad wine from elsewhere on the estate was used to pay labourers employed on the estate throughout the year or on an ad hoc basis. Wage labour was frequent on the estate, even if wages had risen relatively more than prices after the population decreased at the end of the second century. Leasing is also attested. Big landowners had a lot of options in the third century, not so much with regard to crops (there had been vineyards at Theadelphia long before Appianus arrived on the scene), but mainly with regard to the organisation of production.

Let us take a look at Theadelphia about a hundred years earlier. For the middle of the second century we do not have many private documents, such as those of Heroninus, but rather more official documents, especially tax lists (mainly BGU IX), many of them still unpublished. A couple of documents list the vineyards and gardens at Theadelphia and specify the taxes due or paid. There is also an early and complete list of about a hundred small owners of vineyards more than half of which are women. The number of aruras per owner is not given in that text, but from other texts we know that the total area occupied by vineyards was between 250 and 300 aruras. The average number of aruras per vineyard owner was therefore small (less than 3 aruras or 0.75 hectare). There do not seem to have been owners with a lot of vineyards, in other words no proto-Appianuses. Among the owners appear a number of people with Roman or Alexandrian citizenship, but they do not own substantially more vineyards than other owners.

In later documents only a few of these owners reappear. That seems natural, because owners die. But it rather looks as if the majority of new owners were not the heirs of the previous owners as one might have expected. It therefore appears that the owners of vineyards at Theadelphia often sold their

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[30] See M. Sharp, The village of Theadelphia in the Fayyum: land and population in the second century, in A. K. Bowman and E. Rogan (eds.), *Agriculture in Egypt from Pharaonic to Modern Times* Oxford 1999, 159–172, and the unpublished dissertation of J. France, *Theadelpheia and Euhemereia: Village History in Graeco-Roman Egypt*, Leuven 1999. For another village in the Arsinoite nome (Tebtynis) in the first two centuries of Roman rule, see J. Rowlandson, Agricultural tenancy and village society in Roman Egypt, in Bowman and Rogan (eds.), *Agriculture in Egypt*, 139–158.

[31] D. W. Rathbone, *Economic Rationalism and Rural Society in Third-Century A.D. Egypt: The Heroninos Archive and the Estate of Appianus*, Cambridge 1991. Compare D. P. Kehoe, *Management and Investment on Estates in Roman Egypt during the Early Empire*, Bonn 1992, also for other sets of documents. Kehoe limits himself to applying a number of 'fundamental' concepts, which he had previously applied to the imperial estates in North Africa and the estate of Pliny the Younger.

property to others. Viticulture in Egypt demanded more expertise than continuity. Vines were exhausted faster there than elsewhere (because of the high volume), as is shown by the accounts of the Appianus estate; a high percentage of the vines there was permanently in the process of being renewed. Smaller owners will have tried to sell their exhausted vineyards if they did not have the means to invest in new vines.

How these owners managed to make their small vineyards profitable is illustrated by a set of documents from the end of the first century (P. Soter.). An entrepreneur from Theadelphia, one Soterichos, leased vineyards, each time for a couple of years. He was allowed to keep only a small part of the yield; the bulk went to the owners. The yield was more than either the owners or Soterichos could consume privately in one year, so they must have sold the surplus. The owners themselves did not always have the expertise to make their small vineyards profitable. They therefore teamed up with someone who had the expertise such as Soterichos. Both the owners and Soterichos somehow had access to markets for wine, otherwise they would not have been able to dispose of their surplus.

The ca. hundred owners of small vineyards near Theadelphia in the middle of the second century were just such people. The many female owners must have employed the services of other wine-growers to make their small vineyards profitable. Some owners must have worked in their own vineyards. Combinations of small wine-growers who tended their own vines as well as those of others also occurred (Soterichos is the prime example). In other words, in Theadelphia in the first and second century there were literally *hundreds* of people who were either owners of small vineyards without the necessary expertise or owners of small vineyards with the necessary expertise who tended their own vines and sometimes also those of others. In addition there were wine growers who did not own a vineyard of their own.

The population of Theadelphia decreased sharply at the end of the second and the beginning of the third century. The land surrounding the village contracted from a peak of 6,750 aruras in the second century to about 5,000 aruras in the third. A number of wine growers will have taken to growing other, more essential crops such as wheat. Viticulture needs a supply of water throughout the year, and this was difficult in Theadelphia. The village was situtated at the end of a major canal, and only an influential person such as Appianus could enforce the supply of water in case of problems higher up the canal.[32] In Egypt the irrigation system depended on high labour input, and the system could therefore easily break down in case the population decreased. Appianus was apparently the only one capable of making the vineyards at Theadelphia profitable in the third century and he therefore ended up being their exclusive owner, even if only for a relatively short time. According to the set of documents relating to Sakaon (P. Sakaon) the population of Theadelphia in the first half of the fourth century consisted of a mere fraction of what it used to be. The remaining inhabitants had great difficulty in making even what was left of the arable land (only about 500 aruras) profitable, because the water supply had broken down completely. Eventually they too took to their heels, and with them Theadelphia disappeared forever.

To approach the ancient economy macro-economically we have to resort to models with figures. Only for Egypt can we create such models with the help of data which are not completely arbitrary. The conclusion imposes itself that only the economy of Egypt can be studied realistically. The work of Bagnall and Frier about the demography of Roman Egypt has demonstrated that demographical studies

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[32] For the present-day situation see H. C. J. van Zon and K. W. Jeanes, *Environmental Profile: Fayoum Governorate, Egypt*, Cairo 1992, 19: 'The main problem is the difficulty of balancing water supply with crop demand. Distribution is clearly biased in favour of the upper basin and the eastern Gharaq area, while tail end areas suffer water shortages. The string of factors causing this includes illegal pumped extractions, official modifications to the original equitable design, dimensional changes in canals because of maintenance excavation and aquatic weed growth. The result is "management by complaint", with upper basin rice growers – a high value crop – having the strongest lobby.'

for other regions of the ancient world are hopelessly inadequate.[33] Ordinary historical demographers will turn to Bagnall and Frier's work and forget about the rest. To approach the ancient economy micro-economically we need sets of data such as those for Theadelphia, and such sets exist almost exclusively for Egypt. If we get more and more of such sets and if they are studied in depth from an economic perspective, we will be able to correct our macro-economic models for Egypt accordingly. For this one region of the ancient world we are in a position to write an ordinary economic history without much *Schöngeisterei*.

Ancient historians with an interest in economic history therefore *have to become documentary papyrologists*, because the source material for the only region for which we can write an ordinary economic history consists of papyri. The work of Bagnall and Frier about the demography of Roman Egypt has also demonstrated that we need a critical mass of data to conduct a statistically reliable demographical study. For a number of issues I have addressed in this article there is not yet such a critical mass of data. But the number of unpublished papyri is a multiple of those currently published. The statistical basis for what I have said can therefore only improve with time. More papyri will have to be published, which means that we need more documentary papyrologists in any case. Who will take up the challenge?

Bibliographical appendix

NB: the letters to the left allow one to construct sub-bibliographies on various topics. The letters are abbreviations for the following topics: A(griculture), B(udget), C(urrency and prices), D(emography), F(ood), I(ndustry), L(oans), M(edieval and modern Egypt), P(haraonic Egypt), T(rade), and gen(eral).

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