Analysing Historical Data: A Justification of the Use of Quantitative Methods.

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Keywords: Domestacy Book, historical data, manorial efficiency, manorial and feudal systems.

Abstract:
Instead of answering point-by-point issues raised in the Comment, the response in this rejoinder is to the general thrust of the argument. It is maintained that it is possible to measure how haphazard Domestacy production was by measuring how close, on average, production was to best-practice production. This measure of closeness can then be compared with similar measures in other production situations. The wealth of carefully measured production data in Domestacy Book is contrasted with so called ‘contemporary’ documentary evidence referred to in the Comment. The interpretation made in the Comment that hides and fiscal acres were areal measures is rejected, and the issues of constant returns to scale in production, uniformity and comments about slave and conscript systems, which relate to absolute not best-practice efficiency, addressed.

Is it nonsense to compare balance sheets and profit and loss statements of enterprises that operate under different conditions or at different points in time? Are all comparisons of apples and oranges meaningless? Most people would argue that apples and oranges can be compared in terms of many characteristics, including size, weight and colour, and most are comfortable in comparing the speed of quite different things, hares and tortoises, spaceships and young boys walking to school. Comparing

* Acknowledgement: I would like to thank Eva Aker for her excellent research assistance, S. Snap and M. Muggles for their assistance, Garry Carnegie, a referee, Beverley Vickers, Peter Wagstaff, colleagues and seminar participants for their comments and The Australian Research Council and the Flinders University for financial support.
profit and loss accounts of different enterprises can be insightful and useful - although there are well-known limitations to the exercise.

The analysis in the paper (McDonald, 2005) is novel and, as such, it is potentially an easy target for criticism – just as initially the ideas of profit and loss accounts and national income accounting were questioned – but there is no need to apologise for what is a very careful and sensible study.

The study challenges the view of some Domesday scholars that in England in 1086 agricultural production was haphazardly organised with apparently no relationship between resources and net incomes of estates. This is done not by presenting selective anecdotal evidence or documentary evidence relating to the English economy some 300 years later, but by analysing, using appropriate statistical methods, carefully collected contemporary data relating to almost 600 lay estates in the county of Essex. Using our historical knowledge, economic theory and statistical methods to analyse historical data is an approach that is commonly adopted by economic historians.¹

In this rejoinder, instead of answering point-by-point issues raised in the Comment, the response is to the general thrust of the argument. It is maintained that it is possible to measure how haphazard Domesday production was by assessing how close, on average, production was to best-practice production. This measure of closeness can then be compared with similar measures in other production situations to assess whether Domesday production was more or less haphazardly organised. The exercise has little value unless the Domesday data are meaningful measures. It is argued that this is indeed the case.

The wealth of production data in Domesday Book is contrasted with so called ‘contemporary’ evidence referred to in the Comment. There is in fact little
contemporary documentary evidence on production efficiency. It is argued that
statements by Bede, who died in 735, 350 years before, and Chaucer, who wrote
about England some 300 years later, are of little relevance. They wrote about a
different England with different agricultural practice, economic and political
environments.

Other issues raised in the Comment are then addressed. The interpretation of
hides and fiscal acres as areal measures is a complete misunderstanding. Round
(1903), Loyn (1987) and other Domesday scholars interpret them as units of tax
assessment, not measures of land area. On constant returns to scale in production –
there is strong evidence in the Domesday data supporting the hypothesis of constant
returns to scale, but it is not necessary to impose constant returns to scale to derive the
key efficiency results. Similar results are obtained if constant returns to scale is not
assumed. Issues relating to uniformity are addressed. In particular, it is argued that
within a county, such as Essex, there was considerable uniformity in administration
and agricultural practice. Many of the quotes in the Comment appear to be out of
context and the broad ranging discussion of whether slave and conscript labour
systems were efficient appears to be about absolute not best-practice efficiency and so
is not relevant to the study. Finally, it is argued that it can be dangerous to generalize
from a few incidents and such evidence often adds little when other high quality
evidence is available.

The Analysis

One part of the production analysis was to show there was a strong statistical
relationship linking Domesday estate inputs or resources to estate net income. These
studies showed that 80 to 90 percent of the variation in estate net income is explained
by variations in estate resources, a result that would seem to be inconsistent with
haphazardly organised production. The current analysis involved constructing a production frontier for the Essex estate production data. The frontier describes best-practice transformation of inputs into output. Once it has been constructed, an efficiency index can be calculated for each estate that measures how far production on that estate was from the best-practice frontier. One can then calculate how far, on average, estate production was below the frontier and compare this average measure with measures calculated in other studies of agricultural production. On average, production on the Domesday estates was closer to the frontier than in the comparison studies, suggesting, again, that Domesday agriculture was not haphazardly organised.

Efficiency is used here in a technical sense and the comparisons are of best-practice not absolute efficiency. Best-practice efficiency is rigorously defined and its interpretation requires careful consideration. Notions of best-practice will reflect the technology and institutional framework of the time. If agricultural technology improves the expectation would be that the best-practice frontier would move outwards. If security issues inhibit agricultural operations (by restricting the use of labour and land) and security became of less concern, again, the expectation would be that the frontier would move outwards. An individual estate will appear efficient if it has production advantages, for example, fertile soils, proximity to good communications and markets, or if the landholder employs good agricultural practice or displays entrepreneurial flair. In *Production Efficiency* (1998, ch. 4), using regression methods, the link between estate efficiency measures and these characteristics is investigated and it is shown how estate efficiency measures can be used as a tool to gain understanding about production on individual estates.

Although it is valid to compare how close average production was to best-practice production at different points in time (for example, for Domesday, post-
bellum Southern agriculture and modern Californian farms), such comparisons have their limitations. For example, best-practice may not be good-practice. It is possible that all producers in the sample operated well below what was technically and institutionally possible. Then the best-practice frontier would not be a good-practice frontier. However, it only requires there be a few good operators for the frontier to measure good-practice. And the larger the sample, the more likely it is that some operators did adopt good practice.

The Data

Of course, any technique can only be as good as the underlying data. How good were the Domesday data? The Domesday Survey of 1086 was a carefully organised survey. The counties of England were grouped into circuits, each supervised by a team of commissioners, who were major lay and ecclesiastical lords. The commissioners sent out a list of questions to landholders about their landholdings. The answers were reviewed in the county court by the hundred juries of the county, who testified to their accuracy under oath. The county returns were then assembled and the circuit return compiled. Finally, the Exchequer in Winchester checked and edited these returns.

This process contained a number of procedures to ensure accuracy. For example, to protect against corruption, the commissioners of a circuit were chosen so they possessed only minor holdings in the counties of the circuit. Further, a landholder’s answers were not confidential, but were reviewed in public by his neighbours. Evidence was presented under oath and some answers were challenged. It is known that William sent out agents to check that his orders were being carried out. Returns were checked and edited.
In McDonald and Snooks (1985c), the Domesday Survey is compared with modern surveys. Perhaps the most striking contrast is that the idea of confidentiality of responses was entirely absent from the Survey process. If the Survey procedures were applied to our contemporary tax system, then your tax statement would be public knowledge, and you would be required to justify it in a public arena in the presence of neighbours and co-workers.5

The estate entries consist of lists of estate resources and the estate’s tax assessment and annual value or net income (the paper, contains a comprehensive example). Most seem to be complete and, with a basic knowledge of the structure and terminology of entries, are easily interpreted. Nevertheless, a few appear incomplete or implausible. For all estates, the Victoria County History (VCH) of Essex entries were checked against the entries in the Phillimore edition (Morris, 1975), going back to the original Latin where necessary. In the study only entries for which (1) annual value is recorded, (2) either ploughteams or livestock entries (or both) are recorded, and (3) at least one of the four labour inputs are recorded, were retained for analysis (see footnote 7 of the paper). The rationale for this was that to undertake arable or livestock husbandry, labour and either ploughteams or livestock were required.6

Analysing agricultural production is a relatively straightforward – certainly much more straightforward than describing the operations of modern global corporations such BHP Billiton or Microsoft – but it is important to distinguish (as was done in the paper) the various capital forms used (demesne and peasants’ ploughteams) and labour (freemen and sokemen, bordars, villans and slaves), as separate inputs because they performed different functions in estate production. Further, as there were institutional and organisational differences between kings,
ecclesiastical and lay estates, the study focused on the largest class of estate, lay estates, only.

‘Contemporary’ Accounts

In many historical situations there is a dearth of hard data and it is necessary to rely on, sometimes questionable, contemporary documents. Late eleventh century England is unusual, Domesday Book provides a wealth of information on economic production in 1086 – information about agricultural production on thousands of estates. Why not use it? It does not make sense to instead rely on snippets of information contained within a contemporary account such as *The Anglo-Saxon Chronicle*.

Alfred the Great initiated the Chronicle in 890 and a succession of scribes continued reporting till the death of Stephen in 1154. The Chronicle was mainly concerned with political events, often used exaggerated language (it has been described as the first British tabloid) and during William’s reign took the part of the ‘oppressed’ Anglo-Saxons, reviling William as cruel and grasping. In the paper (McDonald, 2005) a translation of most of what it said about the Survey is reproduced. It is extremely unlikely that the scribe had access to the data of the Survey, and even less likely he analysed the Survey information as an economist might. The scribe was scathing about the oppression of the English but it is unclear how his comments help us to assess whether manorial production was close to the best-practice frontier.

The Chronicle is a contemporary source but what relevance is a quote from Chaucer? Chaucer wrote about England some 300 years after the Domesday Survey. Relying on his account is somewhat akin to relying on Dickens books to throw light on industrial England today (this time gap is less than 200 years, Dickens wrote 1836-
64) – unless, of course, it can be argued that Chaucer’s England was Domesday England.

It is popular to think of the Middle Ages as a stagnant period when nothing much happened, but did William and Chaucer really inhabit a common environment? The Domesday Survey was carried out 20 years after William had invaded England. The invasion force was small – less than 10,000 men and this small group then had the task of controlling an English population of about one and a half million souls and securing the kingdom from external threats. They did this by virtually eliminating the Anglo-Saxon aristocracy taking over their lands, building a series of defensive castles and using the existing administrative system modifying it to their own purpose. Nevertheless, there were many revolts which William put down ruthlessly.

In this situation, security of the kingdom was of prime concern and the organization of the economy reflected this. The feudal and manorial systems ensured that land holdings were tightly controlled and the peasant classes were effectively locked-up on estates. While this enhanced local security it hampered agricultural production. Estates were, in effect, run with their endowed land and labour resources – there were no effective land or labour markets. Since estates were run with widely different mixes, one would expect that land and labour productivities would vary greatly across estates. The study (McDonald, 2005) confirms this. An attempt is also made to measure the cost of operating this security system by estimating by how much the Essex county total net income could have been increased had land and labour been mobile between estates.

During the twelfth and thirteenth centuries, as security issues became less critical, the economy became commercialised – land and labour markets developed,
increasingly labour was hired to work estates, land was bought and sold, and towns prospered (see Britnell and Campbell, 1995). Political events, such as Magna Carta in 1215, modified the relationship between the king and his barons. By the fourteenth century the English were invading France. On August 26th 1346, Edward III defeated the French king, Phillip VI, at Crecy, thus starting the 100 Years War. Interestingly, this battle signalled the end of an era, the dominance of mounted, heavily armoured knights – they were slaughtered by English longbow men. In contrast, the Battle of Hastings in 1066 marked the introduction of armoured, mounted knights to England.

Chaucer’s *Canterbury Tales* were written 1387-1400. By then an agricultural revolution had occurred in England. A three-field rotation system (with a summer crop, eg. wheat, and a winter crop, usually rye, and one third fallow) had largely replaced the two-field rotation system (with a summer crop and one half fallow). In the 1270s, Walter of Henley wrote the first modern handbook on agronomy, giving guidance on animal husbandry, ploughing, sowing, manuring and fertilising land and estate management. During the thirteenth and fourteenth centuries, with the development of the horse collar and the improved wheeled plough, horses replaced oxen in ploughing, and with the development of the overshot water wheel, water-power became more effective, and was used to grind flour and in hammer mills. By Chaucer’s time, agricultural technology and economic organization had undergone radical change (see Britnell and Campbell, 1995, Hallam, 1981 and 1988, Langdon, 1982, Lennard, 1959, Miller and Hatcher, 1978, and Oschinsky 1971, for details).7

**Other Issues**

In the Comment, hides and fiscal acres are interpreted as areal measures. This is a total misunderstanding. They were units used to measure tax assessments.
The tax, the Geld, originated from Danegeld, and was first levied by Ethelred in 991. Initially, it was a land tax – hence the units of hides and acres. By 1086, it was more broadly based and hides and acres did not correspond to areal measures but were units of account used to measure the tax. It is not surprising, therefore that the fiscal acres of the Isle of Wight exceeded the areal acreage – they were different measures. Moreover, in Essex in 1086, it is widely acknowledged that there were 120 fiscal acres to the hide. This is clearly stated by the Victorian scholar, Round (1903), and no one else has contradicted Round’s judgement (Round, 1895 and 1903) that references to hides and acres in the entries are tax and not areal measures.8

Further issues raised in the Comment include constant returns to scale and uniformity. Some results in the paper rely on Domesday production exhibiting close to constant returns to scale (CRS). There is no problem with this. CRS is a plausible assumption because on large and small estates essentially the same production processes were used (the same process being used on larger estates but in larger multiples). Many studies of agricultural production have found returns were either constant or close to CRS.9 In Production Efficiency it is showed that Essex Domesday estate production functions exhibited close to CRS (see chapter 5). Further, frontier studies using much weaker assumptions than CRS (both non-increasing and variable returns to scale) produced very similar results (see chapter 4).10 Evidence from the data, then, support the hypothesis of CRS. Moreover, it is not necessary to impose CRS to derive the key efficiency results.

On uniformity, in England even today, there are regional variations between London and the Yorkshire moors, the North and South of England, Cornwall and East Anglia, but within a county a certain uniformity. By 1086, the English counties had
been established for some time and the Normans worked through the existing county administrations. Within Domesday Essex, almost without exception, taxes were measured in hides and fiscal acres, the various labour categories were similarly described and the Domesday data collected in a common way. Agricultural practice varied with the terrain, according to the outputs produced and whether arable or animal husbandry was practiced, the proximity of town centres and ease of transport. It is precisely factors such as these that determined the efficiency with which inputs were transformed into output.

Much of the Comment is not about efficiency as defined in the paper (that is, in terms of closeness to best-practice production), but a broad ranging discussion of whether slave or conscripted labour systems were efficient. The discussion involves quotes from Adam Smith and references to Stalin and Pol Pot. Nowhere is efficiency defined, but it seems to be some general notion of absolute efficiency. This discussion is not relevant to the paper.

Many of the quotes in the Comment appear to be out of context. The Comment also contains a number of misunderstandings in addition to interpreting fiscal acres as areal measures, such as, confusing the production possibility frontier with a best-practice frontier, absolute efficiency with best-practice efficiency, and complaining that the Survey was not designed by researchers to measure efficiency yet ignoring the fact that almost all data analysed by economists are secondary data produced initially for some other purpose. Some questions asked are quite baffling. There is not the space to address all the issues raised, point-by-point, but there is a need to comment on the general methods advocated for assessing hypotheses. These
can be summarised as generalising anecdotal comments of contemporary reporters and blindly accepting the opinions of authorities.

Consider, for example, the quote of Mitchell and Leys about William Bright being killed by his lord with a dung fork because he idled at some time in the Middle Ages. Does this colourful story indicate a general slackness and lax management? The Comment suggests Mitchell and Leys think so (although they seem to be quoted out of context), and they have read of other examples. But how general were they? Can we rely on Mitchell and Leys opinions? Other than the few examples in documents they read, on what were the opinions based? This fundamentally non-scientific method of assessment contrasts with the data-based approach of the paper. Documentary evidence of this kind should not be ignored – often it is all there is – but it should be weighed appropriately.

To summarise, it is argued that it is sensible to use the Domesday Survey, a carefully constructed data source, to assess whether manorial production was haphazardly organised. It makes sense to do this by measuring how close production was, on average, to best-practice and then comparing this measure with measures calculated in other studies of agricultural production. The study is limited in that it is an analysis of production on lay estates in one Domesday county. It would certainly be interesting to see if similar results are found for kings and ecclesiastical estates and for other counties.
References


McDonald, J., 2005, Using William the Conqueror’s Accounting Record to Assess Manorial Efficiency, *Accounting History*, 10, 2, 125-145.


*Victoria County History*, 1900-, London, Oxford University Press.
See almost any issue of *Journal of Economic History* or *Economic History Review*. Papers describing our Domesday research have been published in key statistics, management science and economic history journals.

2 See McDonald and Snooks (1985b) and (1986) and McDonald (1996), (1997) and (1998). Round Maitland and Darby made huge contributions to our knowledge of the politics, social organization and geography of Domesday England, but they had little training in economics and, indeed, said very little about the Domesday economy. Nor did they use statistical methods to assess evidence. Their approach was to generalise from a few cases (see McDonald and Snooks 1985b and 1986, ch. 3). It was by applying economic principles and assessing evidence using modern statistical methods that different conclusions about the organization of the economy were reached.

3 That efficiency is used in a technical sense, which needs careful interpretation, is stated on the opening page of the paper.

4 The latter has encouraged individuals and historical societies in England to investigate Domesday estates in their locality. The book also contains much more detail about Essex production and frontier methods than is in the paper.

5 It is misleading to assert that evidence was provided by a hostile population. By 1086, almost all the major landholders were William’s Norman followers. The Anglo-Saxon aristocracy had been virtually eliminated. The central players in the Survey were Norman, not English.

6 This rule of thumb may overstate the situation because on some smallholdings the landholder could have provided the labour, but it is better to err on the side of caution when including data in the analysis. If smallholdings without labour are included in the sample, the results are virtually unchanged.

7 Other ‘contemporary’ sources referred to in the comment include Bede, who died in 735 (350 years before the Survey), Walter of Henley who wrote *Husbandry* in the 1270s and statements by Keen referring to England after 1348 and Nokes on the thirteenth and fourteenth centuries.

8 Thus, Round (1903, p. 426), in the note to Essex VCH, states,

“The Domesday ‘hide’ was a unit of assessment divided into four quarters called ‘virgates’, each of which was reckoned to contain 30 acres; but these are merely fiscal, not areal measures. In Essex the word ‘virgate’ is of somewhat rare occurrence, ‘30 acres’ being used instead’.

In Hampshire VCH, page 402, Round says,

“We know now that the ‘hide’ of Domesday was not, as used to be generally believed, a fixed area of land, but a unit of assessment bearing no fixed relation either to area or to value.”

and in (1987), H. R. Loyn, then with Darby the leading Domesday scholar, interprets hides in Domesday entries as units of tax assessment, as do other Domesday authorities. (For further information on the Geld see McDonald and Snooks, 1985a, 1986, 1987a, 1987b, McDonald, 1998 and 2002, and the references therein)

Although the Domesday Survey estate entries are usually easily interpreted, some knowledge of terms and the format is required. To clarify the issues raised in the Comment about the two estates Hallingbury and Laindon, the following interpretations of the entries may be helpful. The entry for Hallingbury may be interpreted as follows:

Hallingbury was located in the Half Hundred of Harlow. Before the Conquest (1066), it was held by Edeva (Edith). In 1066 and 1086, the tax assessment was 30 fiscal acres. (This was not the areal size of the holding.) In 1066 and 1086, it had access to a ploughteam for half of the week, it had 2 acres of meadow and its annual value (net income) was 5 shillings.

The second, Laindon, was located in the Hundred of Barstable (see Essex VCH, p. 441). It was held by Wulflmer in 1066 and by Ralph in 1086. In 1066 and 1086, the tax assessment was half a hide or 60 fiscal acres. In 1066, there was one slave on the estate, but none in 1086. In both years, the annual value was 6 shillings. The reference to a manor is of little significance. The terms ‘manor’, ‘hall’ and ‘land’ were used interchangeably as general terms for an estate (see Yorkshire, VCH, 1907, p. 144).
Both estates are listed under the lands of ‘The Fee of the Bishop of London’, and the bishop was the tenant-in-chief in 1086. Neither of these very small holdings were included in my study because they were ecclesiastical not lay estates. They also appear to be incomplete in that no labour is listed for 1086.

9 See McDonald (1998, chs. 5 and 6), and the references cited there.

10 These studies are referred to in footnote 6 of the paper.

11 For example, the statements of Mitchell and Leys, which seem to be used in the Comment as evidence of lax management. The first “It is not surprising that the peasants grudged their services and were sullen and unwilling to perform them” in fact continues “in districts where they could see their fellows working under better conditions.”, while the second, “We read of the lord who wickedly slew William Bright with a dung fork because he found him idling in his service, and of peasants neglecting their services, assaulting the lord’s officials and destroying his property” actually begins “There are many instances of friction; we read of the lord. . . property.” And then continues “On the whole, however, there seems to have been a willingness to compromise; . . .”. The completed sentences would seem to convey a different meaning.

12 For example, “And, in any case, is the mean annual value of 108.5 shillings adequate to the task of representing a group with such a wide distribution from 3 to 1200 shillings with one quarter being below 30 shillings and one quarter above 140 shillings?” As the group was not represented by the mean but detailed information about the annual value distribution given, the question is perplexing. (What was said in the paper was “The estate annual value, measuring net output, varied from three to 1,200 shillings (20 shillings to the pound). Three quarters of estates had an annual value of 30 shillings or more and one quarter a value of 140 shillings or more. The mean estate annual value was 108.5 shillings.”)