The circulation of money and the behaviour of prices in medieval and early modern England.

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The surviving data on English money and prices is extremely rich, and so provides material for a comparative case study, which may be of interest to those studying the interaction of money and prices in other regions and periods.

English Currency and the Money Supply

The circulation of the English currency can be observed from plentiful surviving hoards and single finds. Looking at the distances between mints of origin and find spot, Metcalf found the late Anglo-Saxon currency thoroughly mixed, by commerce even more than by taxation.[1] When hoards are plentiful, above all in the fourteenth century, the London mint consistently contributed some 50% of the currency in both England and Scotland, while Canterbury normally accounted for about 25%, and the other provincial mints, continental imitations and Scots and Irish issues together usually made up the remaining 25%. The hoards do sometimes show a little minor variation favouring the issues of a more local mint, but this local bias only raises local representation by a few per cent and is only evident for a few years after the operation of the local mint. The medieval English currency was truly national. It is also worth noting that unlike

[1] D.M.Metcalf, *An Atlas of Anglo-Saxon and Norman Coin Finds, c.973-1086,* London 1998, for example at p.279: 'The regional pattern of minting and coin circulation strongly suggest that the predominant uses of coinage were commercial, and involved trade between the east-coast ports and their hinterlands, which overlapped, especially south of the Humber. If coin circulation had been essentially local, the single finds would have consisted mostly of coins of the local mint, which is far from being the case. If the predominant uses of coinage had been fiscal and administrative, one might have expected minting to be more nearly in proportion to the wealth of each shire, and single finds to reveal a tendency towards coin circulation confined within shire boundaries. There are no signs of such a pattern.'

medieval currencies on mainland Europe, the English circulation was not significantly penetrated by foreign issues. The Crown successfully forbade the circulation of foreign coins which are only rarely found.[2] The maritime coast and the concentration of international trade in the major ports allowed English kings to exclude foreign coin far more effectively than was possible for continental sovereigns. It is thus possible to regard the English money supply as a discrete entity, which can be estimated and compared with prices, and with estimated GDP.

English mint accounts survive from the early thirteenth century, providing accurate data on the annual mint production of the principal mints in London and Canterbury, together with some other data from provincial mints which were active from time to time.[3] In addition there is some other fragmentary documentary evidence which provides an indication of the general level of mint production from the late twelfth century, when the earliest price data begins, and this mint evidence is supported by die-studies which suggest there was a dramatic increase in the level of coin production in England in the 1170s and 1180s.[4] Coin production was

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[2] Exceptionally Scottish coins were tolerated so far as they were struck on the English sterling standard. Imitation sterling struck in the Low Countries were plentifully found in the 1290s, but successfully driven out thereafter. Venetian soldini occur in small numbers in the fifteenth century, when they supplied a want of English halfpennies. Florentine gold enjoyed a very limited circulation among merchants and bankers in the early fourteenth century, but this ceased to be the case once the Crown began to issue its own gold coinage in the 1340s. See especially B. J. Cook, 'Foreign coins in medieval England' in L. Travaini (ed.) *Local Coins, Foreign Coins: Italy and Europe 11th-15th Centuries: The Second Cambridge Numismatic Symposium,* Milan 1999, pp.231-84.

[3] C.E.Challis, ed., *A New History of the Royal Mint,* Cambridge 1992, Appendix 1. Mint Output, 1220-1985.

[4] The use of die-studies to estimate mint output in periods when documentary evidence is not available may be applicable to the ancient world, although some scholars have devoted much energy to the argument that this should not be done. See particularly the work of Ted Buttrey, especially 'Calculating ancient coin production: facts and fantasies', *Numismatic Chronicle* 1993, pp. 335-51. Suffice it to say on this occasion, that in the medieval period estimates based on die-studies have been confirmed by surviving mint documents and the continuing discovery of stray finds. My own view is that in the

maintained at these new, higher levels from the late twelfth century until the late 1320s. Output revived again in the mid fourteenth century, when coins were also struck in gold and the mint price for silver was increased, drawing more bullion to the mints to be struck into more plentiful, slightly lighter silver coins. This process of reducing the intrinsic content of the coins in order to strike more of them was repeated with weight reductions to both gold and silver coins in 1411, 1465, and 1526, on each occasion achieving an increase in mint output as a result. These moderate weight reductions reflected the rising international price of bullion which is apparent throughout the later middle ages.

However, from 1544 to 1551 a period of much more dramatic debasement of the currency ensued, in which both the weight and the purity of both the gold and the silver coinage was seriously reduced, and the volume of mint output in debased coin was sharply increased. The issue of new debased cons was halted in 1551, but the poor coin remained in circulation at reduced face value until it was entirely demonetised by Elizabeth I's recoinage of 1560. From that point until 1816 the intrinsic content of the coinage was broadly unchanged.

The study of mint output is thus key information for any estimate of the total money supply, but it does not tell the whole story, since it says nothing about the quantities of coin which may have been leaving the circulation whether carried abroad to pay for imports or war, or hoarded or lost in the ground, or even simply worn away on the finger tips of the population in daily use. In order to explore these questions, and to understand the size and character of the money supply actually in use, it is necessary to study the coins found as hoards and single finds. Once again England is fortunate to enjoy excellent evidence of coin finds made from all periods over the last two hundred years. It is the combination of all this evidence – the mint output, the die-studies, the hoards, and the single finds which underpins the estimates of the size of the currency which have been published over the last forty years. They are set out in Table 1.

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absence of such confirmation die-studies need to be interpreted with caution, but they are too important to be rejected altogether.

Table 1: Estimates of the size of the English Currency from the Twelfth to the Eighteenth Century in millions of £ sterling[5]

date	silver	total	
20011158	0.03-0.08		
1180	0.07-0.19		
1210	0.2-0.5		
1247	0.425-0.45		
1279	0.5-0.6		
1282	0.8-0.9		
1290	1.0		
1299	1.1		Plus foreign
1310	1.5		
1319	1.5		
1331	1.2		
1351	0.7-0.9	0.8-1.1	
1422	0.15-0.2	0.95-1.0	Gold biased
1470	0.35-0.45	0.75-0.95	Gold biased
1526		1.4	Gold biased
1546		1.45	March
1548		1.76	September
1549		1.92	Michaelmas
1551		2.66	July
1551		1.38	August
1560		1.71	September
1561		1.45	October
1600		3.5	

[5] See Martin Allen, 'The volume of the English currency, 1158-1470', *EcHR,* LIV, pp.595-611, which updates and corrects earlier estimates including my own. However, the figures in Table 1 for 1290 to 1331 are my own, since I am unpersuaded by Allen's estimates for this period. See Mayhew , in Diana Wood (ed.), *Medieval Money Matters,* .....1526-1600 estimates are based on Challis. See also Mayhew, *EcHR,* 1995 and R.Cameron.

1643	7.5	10	Inc 2.5 Eliz silver
1670		12	
1700		14.5	Plus banknotes, etc
1750		15m	Plus banknotes, etc

Even this evidence, for which there is a broad measure of agreement, does not completely represent the Money Supply, since it is also necessary to make allowance for the role of credit. The extent of medieval credit is increasingly recognised.[6] To a large degree, however, the volume of credit in the form of cash advances or credit sales is closely related to the size of the currency. When coin is relatively plentiful, so is credit; when coin is scarce, credit is much more difficult to find. Nevertheless the development of credit *instruments* – bills and bonds – does create an addition to the Money Supply to the extent that such instruments begin to circulate themselves effectively as money. Although this development did not achieve legally recognised status in England till the early eighteenth century, paper did effectively pass amongst merchants and bankers in gradually increasing quantities from the fifteenth century onwards.[7] Monetary historians have attempted to estimate the size of this additional

[6] Pamela Nightingale has written extensively on medieval credit, beginning with 'Monetary contraction and mercantile credit in later medieval England', *EcHR,* XLIII, 1990, but see also P.R.Schofield and N.J.Mayhew (eds.), *Credit and Debt in Medieval England c.1180-c.1350,* Oxford 2002.

[7] M.M.Postan, *Medieval Trade and Finance,* Cambridge 1973, pp.1-64. R.D.Richards, *The Early History of Banking in England*, New York 1965, pp. 44-48, where inland and outland bills and promissory notes achieved various stages of assignability and negotionability in the Law Merchant and the Common Law. All types of promissory notes were ultimately declared negotiable by Act of parliament in 1704: 3&$ Anne, c.8.

element in the currency from the late seventeenth century. Rondo Cameron estimated that in 1688-9 coin supplied 50% of the means of payment, while banknotes and deposits constituted 10% and bills, bonds and tallies 40%. By 1750 he estimated the corresponding shares as 37.5%, 12.5%, and 50%.[8] But the role of such alternative forms of money was also probably important in the sixteenth century. Eric Kerridge demonstrated the widespread use of credit of various kinds, including inland bills, between 1538 and 1660.[9] Nevertheless, if coin accounted for 50% of the means of payment in 1688, it is hard to think that it accounted for less than 75% a century earlier. Such an assessment would allow us to add some £1,166,666 (ie 25%) in 'other means of payment' to the estimate of £3.5m in coin c.1600.[10]

Year	Coin	Other	Total
1600	3,500,000	1,166,666	4,666,666
1643	10,000,000	3,333,333	13,333,333
1670	12,000,000	12,000,000	24,000,000
1700	14,500,000	14,500,000	29,000,000
1750	15,000,000	25,000,000	40,000,000

[8] Rondo Cameron, 'England 1750-1844', in Cameron (ed.) , *Banking in the early stages of industrialization: a studying comparative economic history,* Oxford 1967, pp. 15-67 at 42.

[9] Eric Kerridge, *Trade and Banking in Early Modern England,* Manchester 1988, p.99 where he observes, 'The volume of inland bills of exchange is unknown, except that it must have been great and increasing.' His attempt to estimate the ratio of money to credit on the basis of 351 inventories is difficult to evaluate.

[10] This approach necessarily involves broad estimates and gross simplifications and almost every figure could be discussed at length. Debating and refining these figures is the numismatist's and monetary historian's stock-in-trade. For our present purposes it is perhaps enough to treat them as working hypotheses adequate for methodological comparison with the Babylonian data.

English Prices

English medieval price data is no less rich, and although the material available for the early modern period is not so plentiful, there is more than enough to occupy the most exacting price historians. In the nineteenth century J.E.Thorold Rogers provided the first rigorously scientific collection of price evidence,[11] which was refined and developed by William Beveridge between the wars.[12] In the 1950s Henry Phelps Brown and Sheila Hopkins constructed a cost of living and a wages index,[13] and since then improved price series for individual commodities have been published by David Farmer for the middle ages[14] and by Peter Bowden for the early modern period.[15] Most recently Bob Allen and Greg Clark have constructed indexes of their own.[16] This material is capable of much sophisticated manipulation and analysis, and can be presented in various ways. While annual and often almost monthly quotations are available, decennial or rolling averages less susceptible to the extremes of harvest variation can also be instructive. Prices can also be presented either in nominal or in constant silver form, or nominal prices deflated by the consumer price index.[17]

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[11] J. E. Thorold Rogers, *A History of Agriculture and Prices in England, 1259-1793,* 7 vols, Oxford 1866-1902.

[12] William Beveridge - Prices and wages in England from the twelfth to the nineteenth century**.** London, New York, Longmans, Green [1939].

[13] E. H. Phelps Brown and S. Hopkins, 'Seven Centuries of the prices of consumables compared with builders' wage-rates', *Economica,* NS XXIII, 1956.

[14] D. L. Farmer, *Agrarian History of England and Wales,* II, pp.716-817, and III, pp. 431-525.

[15] Peter Bowden, *Agrarian History of England and Wales,* IV, pp.593-695 and 814-70, and V, pp.1-118.

[16] R. C. Allen, 'The Great Divergence in European Wages and Prices from the Middle Ages to the First World War', *Explorations in Economic History,* 38, 2001, pp.411-447, esp. 419-24. His consumer price indices are available at www.nuffield.ox.ac.uk/users/allen. Gregory Clark, 'The Macroeconomic Aggregates for England, 1209-2008' UC Davis , Economics WP 09-19, revised October 2009.

[17] R. C. Allen, 'English and Welsh Agriculture, 1300-1850: Output, Inputs, and Income' (January 2005) available at http://www.nuffield.ox.ac.uk/users/allen/unpublished/AllenE&W.pdf , seen on 18 March 2011. See p.20 and Table 13.

Personally I tend to favour nominal prices which more closely reflect the experience of the people of the time, who generally were required to accept the king's money at its proclaimed face value. Prices expressed in weight of silver fail to recognise that the value of silver itself fluctuates, and this was certainly the case in later medieval England, when modest weight reductions in the coinage did not raise prices. Nevertheless there is certainly a role for silver and nominal prices at the time of the Tudor debasement when buyers and sellers did try to reflect the reduced quality of the coin in the prices agreed. To simplify comparison with the behaviour of Babylonian prices, I offer here English decennial index prices for barley from 1200 to 1750 drawn from the work of Farmer and Bowden.[18]

Table 3:
Barley prices in shillings per quarter by decades, from Farmer AHEW II, p.734, and III, p.444

Decade	Barley price	Decade	Barley Price
1190-1200	1.00	1350-1360	5.18
1200-1210	3.95	1360-1370	5.82
1210-1220	2.30	1370-1380	4.73
1220-1230	3.02	1380-1390	3.52
1230-1240	2.57	1390-1400	4.08
1240-1250	2.81	1400-1410	4.24
1250-1260	3.28	1410-1420	3.89
1260-1270	3.11	1420-1430	3.51
1270-1280	4.39	1430-1440	3.84
1280-1290	3.50	1440-1450	2.73
1290-1300	4.68	1450-1460	2.97
1300-1310	3.94	1460-1470	3.39
1310-1320	5.67	1470-1480	3.01

[18] The Farmer and Bowden series are not completely compatible, as they reach different prices for the period 1450-1500. See Farmer, AHEW, III, p.501. Nevertheless Farmer judged there to be 'a high degree of consistency between the calculations of Thorold Rogers, Lord Beveridge, and P.J.Bowden,' and his own. (p.497).

1320-1330	4.68	1480-1490	3.60
1330-1340	3.92	1490-1500	3.33
1340-1347	3.57		

Table 4:
Price of Barley and malt in shillings per quarter by decades, from Bowden AHEW, IV , p.857, and V, p.865. (Bowden's prices in Volume IV are given only as an Index, but these are converted to shillings per quarter in line with Volume V).

Decade	Index	Shillings/quarter	Decade	(index) Shillings/quarter
1500-9	108	2.69	1630-9	(876) -21.81
1510-9	112	2.79	1640-9	(796)-19.82
1520-9	136	3.39	1650-9	17.85
1530-9	158	3.93	1660-9	17.50
1540-9	197	4.91	1670-9	16.91
1550-9	450	11.20	1680-9	16.36
1560-9	338	8.42	1690-9	18.73
1570-9	360	8.96	1700-9	17.06
1580-9	482	12.00	1710-9	18.66
1590-9	600	14.94	1720-9	19.84
1600-9	583	14.52	1730-9	17.30
1610-9	665	16.56	1740-9	16.84
1620-9	648	16.13	1750-9	17.90

One needs, however, to retain an awareness of the limitations of studying single commodities. English barley was influenced by the price of wheat and of meat, as purchasers substituted products balancing needs, preferences and price. In the later middle ages, when wages were historically high and prices low, more meat could be afforded and cereals were correspondingly less in demand, though the situation reversed in the

later sixteenth and seventeenth centuries.[19] Similarly, on an annual basis we know that the Babylonian barley price was affected when the date harvest came in. The movement of the price of different commodities relative to one another thus becomes a consideration.

In addition to the decennial indexes given above, Figures A to D illustrate the movement of English annual barley prices, and Figures E to H wool prices, from 1209 to 1914, as presented by Gregory Clark.[20]

Figure A presents the price of Barley expressed in grams of silver, while Figure B presents the same price in shillings per bushel. The two graphs reveal a clear difference in the later middle ages, when a series of weight reductions reduced the silver content of the coinage, and this contrast is illustrated more clearly in Figures C (silver weight) and D (shillings face value), which focus on the period 1209 to 1600.Expressing these prices in silver weight shows the reduction in the silver content of the coinage between 1351 and 1526 clearly. However, for the people of the time who actually experienced prices in sterling face value the late fourteenth- and fifteenth- century recession was eased somewhat. Reducing the silver content of the coinage acknowledged the rising European price of silver, and stretched the available bullion further. These modest currency devaluations clearly did not generate inflation, but helped to moderate a difficult economic climate by increasing the money supply.

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[19] Christopher Dyer, *Standards of Living in the Later Middle Ages: Social change in Englnad c.1200-1520*, Cambridge 1994, p.159- 'By the early fifteenth century, harvest workers were allowed a pound of meat for every two pounds of bread, compared with an ounce or two of meat for every two pounds of bread 150 years earlier.' P. Bowden. AHEW, IV, pp.625-9 gives various examples of how the fortunes of the grain harvest could also affect meat and wool sales.

[20] Gregory Clark, (www.iisg.nl.hpw where his work may be found under Global Price and Income Group), presents annual prices for an extensive series of commodities, essentially based on the work of earlier price historians, but the range of Clark's prices from the thirteenth to the twentieth centuries in both sterling face value and silver weight prices makes this compilation invaluable. It is this series which has principally been used by Bruce Campbell, website. I am most grateful to Bas van Leeuwen, of Professor Campbell's team, who kindly and swiftly provided me with additional data lying behind Campbell's *Three Centuries of English Crop Yields, 1211-1491*, see below note

However, the graphs do not reveal a contrast as one would expect in the mid sixteenth century, when England experienced the worst debasement of its history. This puzzled me until I realized that Clark's silver weight prices do not properly reflect the debasement period. Clark's series needs to be amended at this point.[21] Wool prices are presented in Figures E, F, G, and H in the same way. Again there is close correspondence between silver and shilling prices for wool after 1600, but a marked divergence in the fourteenth and fifteenth centuries (See especially the graphs concentrating on the period 1209 to 1600, Figures G and H). The same flaws in the Clark silver series again obscure the effects of the mid sixteenth-century debasement.

Although calculating barley and wool prices in grams of silver can provide insights they also distance us from the experience of the people of the time, and they fail to acknowledge the truth that the value of silver was itself liable to fluctuate. It also creates a fertile source of potential error as Clark's mistakes illustrate.

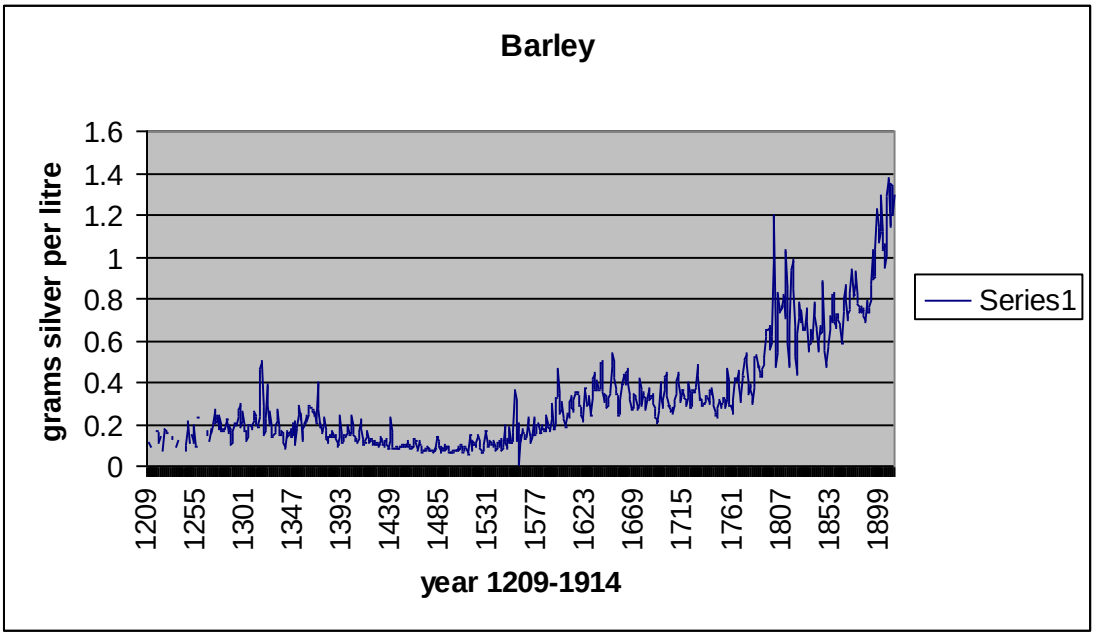


Figure B

[21] My corrections to Clark's series are available in Appendix 1.

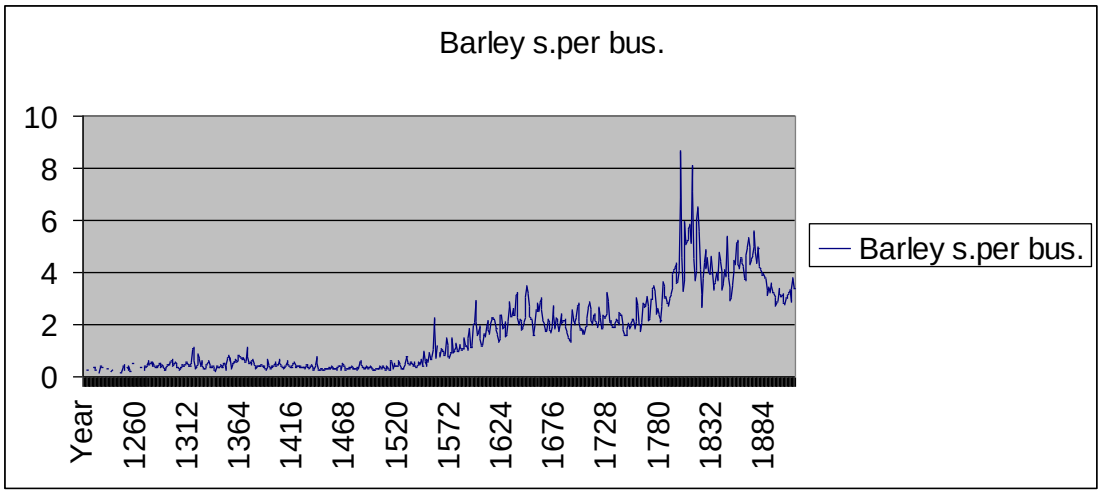


Figure C

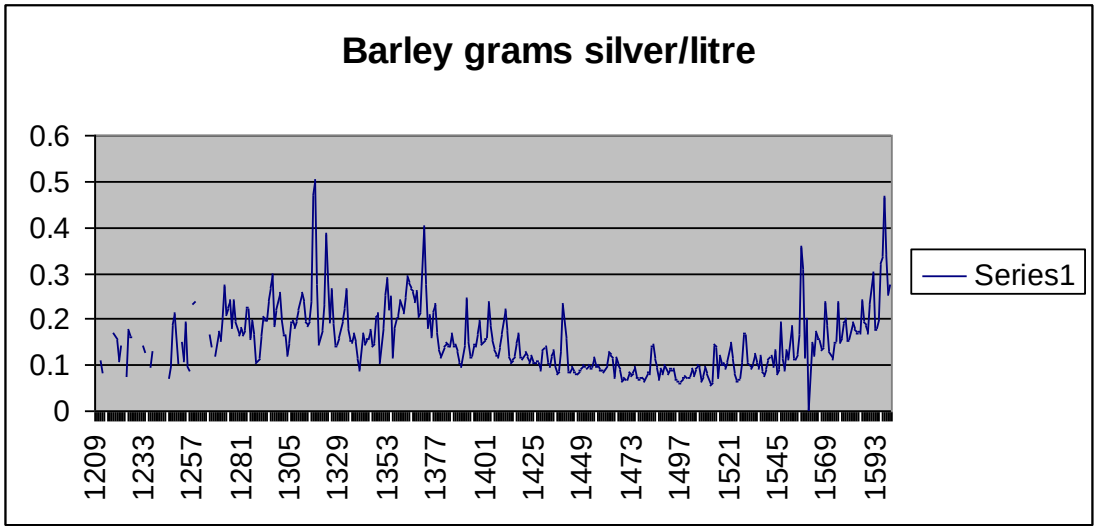
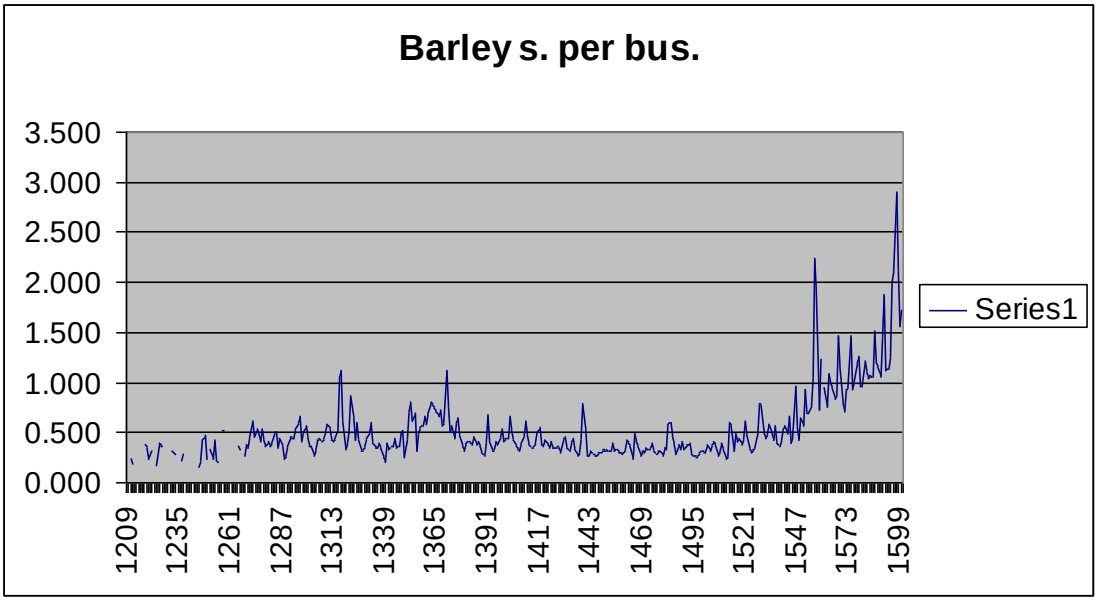


Figure D


Barley s. per bus.
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
1209
1235
1261
1287
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1365
1391
1417
1443
1469
1495
1521
1547
1573
1599
Series1

Figure E

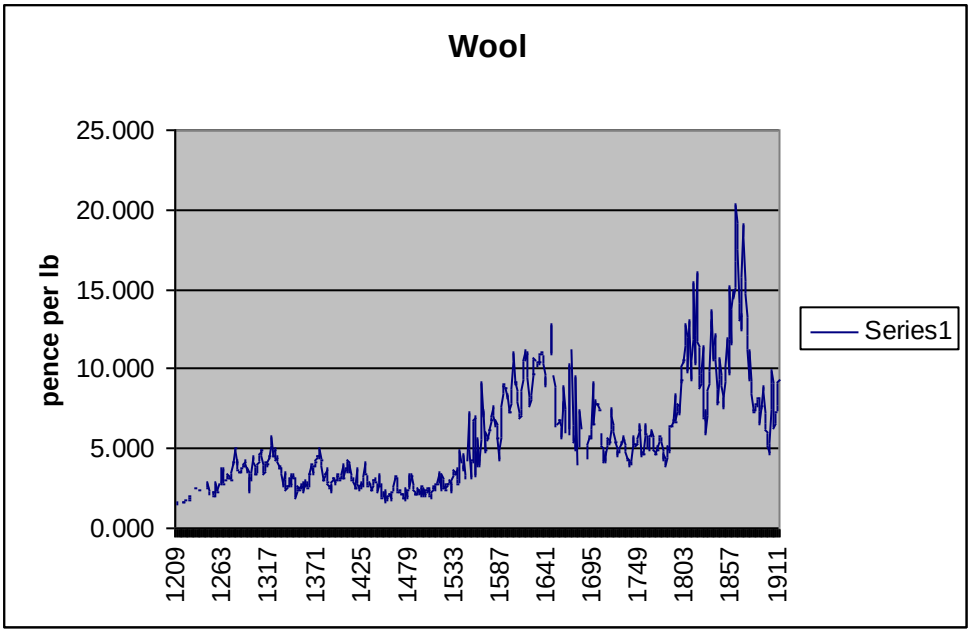
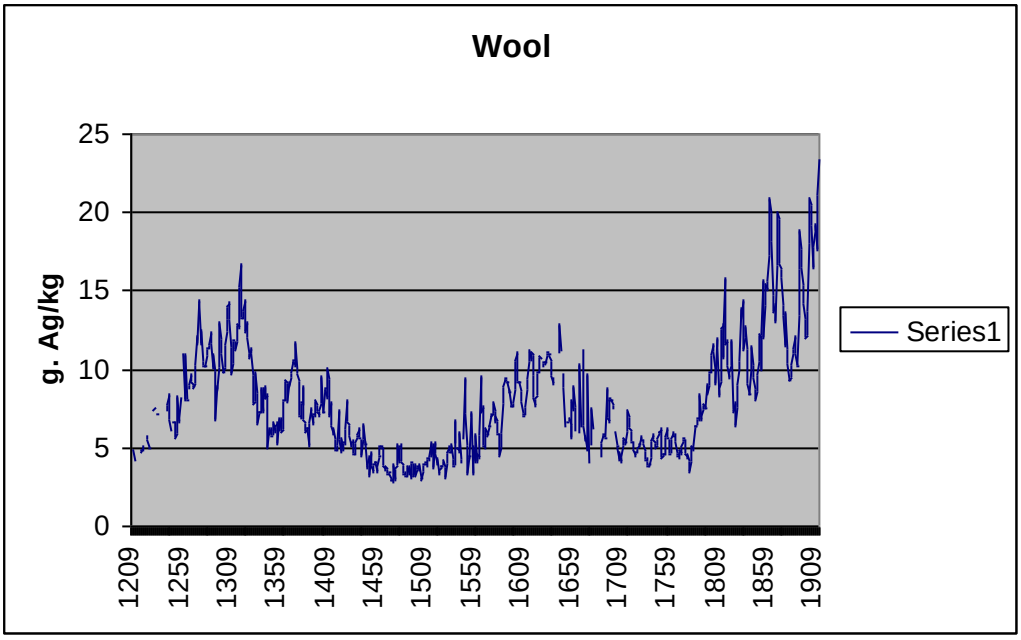

Wool
pence per lb
25.000
20.000
15.000
10.000
5.000
0.000
1209
1263
1317
1371
1425
1479
1533
1587
1641
1695
1749
1803
1857
1911
Series1

Figure F


Wool
g. Ag/kg
25
20
15
10
5
0
1209
1259
1309
1359
1409
1459
1509
1559
1609
1659
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1859
1909
Series1

Figure G

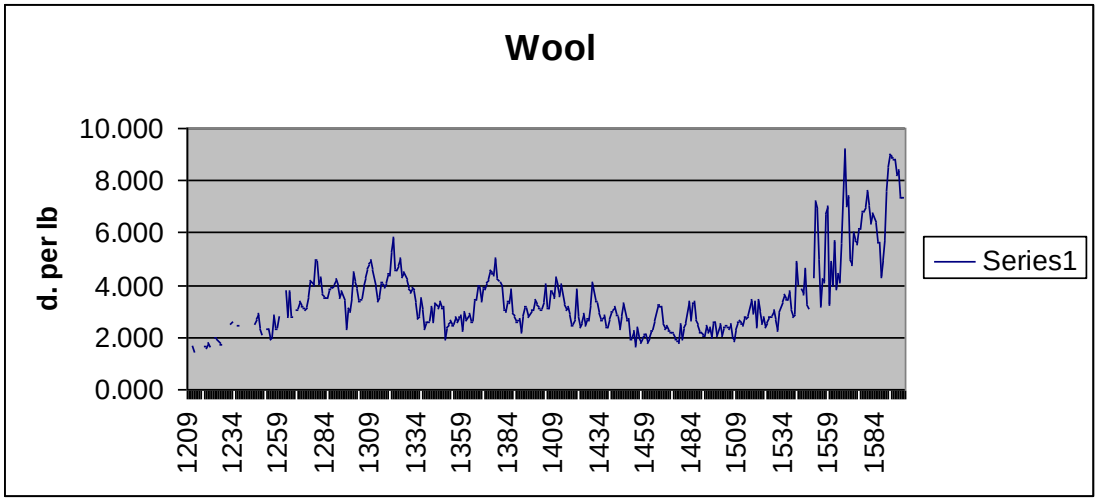
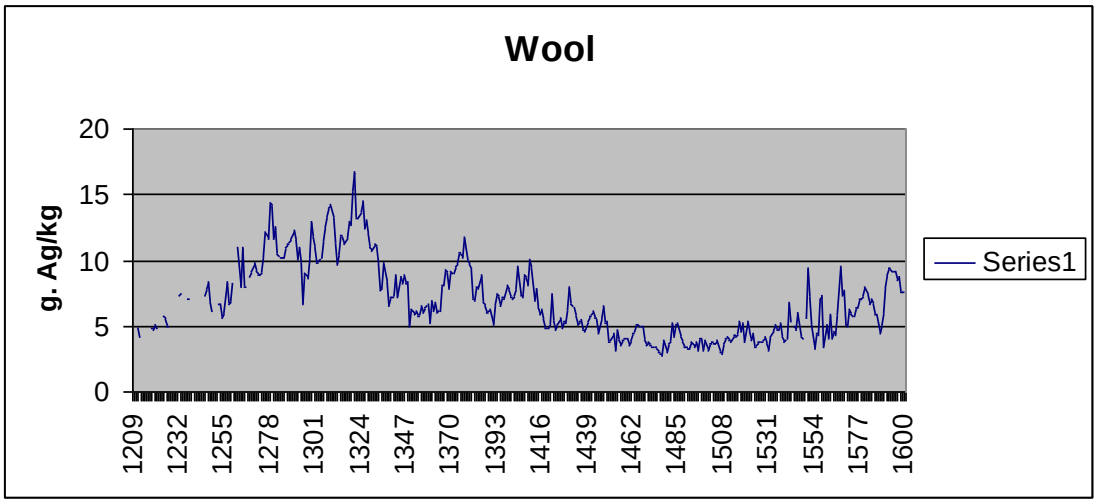


Figure H



English and Babylonian Prices for Wool and Barley

Although drawn from centuries and thousands of miles apart, comparison between the English and Babylonian barley and wool series prompts a number of observations.

The Babylonian prices were quoted as the quantity of barley and wool available for one shekel, and van der Spek has explained the implications

of this form of price quotation, and also derived an alternative series expressed as the price in shekels of 1000 litres.[22] We may note for example that the Babylonian shekel, like the English pound, was both a unit of weight and a unit of account. In both cases a weight of silver gave its name to a sum of money which was expressed in reality by a number of coins. Two drachma coins made a shekel, weighing about 8.33grams of silver, but there was no shekel coin. Similarly the pound had no existence as a coin until the time of Henry VII, and coins with the value of a pound were exceedingly rare before the seventeenth century.[23] The correspondence between unit of weight and unit of account prompts the question of how far coins were taken by weight or by number. The presumption among Babylonian scholars is that coins were weighed,[24] though I would welcome a discussion of the evidence, since we can be clear that in medieval England coin payments were sometimes weighed and sometimes taken by number at face value. Domesday Book and the twelfth-century Dialogue of the Exchequer both record payments which are sometimes weighed and sometimes taken by number. On some occasions there was even a requirement that coin be tested for the purity of the metal, though tests for metal fineness and weighing were mostly means by which the Royal Exchequer extracted additional payments from its officials and subjects. For the most part, in ordinary business the crown required its people to accept coin at the face value it decreed, though very occasionally government did encourage the weighing of coins[25] and often the public weighed coin, especially gold, without any official encouragement.

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[22] R.J. van der Spek, http://www.iisg.nl/hpw/babylon.php

[23] Actually although the guinea was initially envisaged as pound coin, the value of its gold content rose above 20s. It was not till the nineteenth century that the sovereign gave effective expression to the pound of 20s.

[24] M.A.Powell, 'Money in Mesopotamia', *Journal of Economic and Social History of the Orient,* 39, 1996, pp.224-242. P.Vargyas, 'Silver and Money in Achaemenid and Hellenistic Babylonia', in J.Marzahn and H.Neumann (eds.), *Assyriologica et Semitica: Festschrift für Joachim Ölsner,* Münster, 2000, pp. 513-522. Cited by Temin.

[25] At the time of John's recoinage in 1205.

As we have seen, behind this rather ambivalent attitude to weighing coin in payments or taking them by number lay a fundamental uncertainty about how far the pound was a unit of weight, and how far a unit of account. In the case of medieval England the monetary pound of account, consisting of 240 actual coins (pennies), diverged from the pound weight quite early. It stabilized in the twelfth century at 5400 grain (349.9grams) for a monetary pound, compared with 5760 grains (373.24grams) for the Troy pound weight, but from the fourteenth century onward the weight of the penny was successively reduced every fifty years or so, so that by 1526 the pound of 5760 grains was struck into 540 pennies.

Table 5

Date	Pence struck per pound wt	Weight of penny in grains
1247	242	22.3
1279	243	22.2
1331	Halfpence at 488	No pence struck
1335	Halfpence at 504	83% silver. No pence
1343	243	22.2
1344	266	20.3
1345	268	20.1
1346	270	20
1351	300	18
1413	360	15
1464	450	12
1526	540 (Troy pound)	10.6

What is more, on each occasion that the weight of the penny was reduced and more coins accordingly struck from the same weight of silver, there was no apparent impact on commodity prices. This illustrates an important point, which is that the value of silver itself was rising. The idea that

payments needed to be weighed or that economic historians should monitor the behaviour of prices in terms of grams of silver rather than in nominal prices are both based on the underlying assumption that metal prices are constant, whereas in truth they fluctuate in accordance with the laws of supply and demand. Nevertheless, if the precious metal content of the coinage were reduced beyond the rising value of the metal, prices certainly would respond as the English experience during the debasement of Henry VIII and Edward VI makes clear. There seems to be a parallel in the reduction of the silver content of the coinage in the Parthian period which also corresponds with a period of rising prices.

Returning to the Babylonian drachma and shekel, we would ask whether it might be possible that payments in coin could on occasion have been made by number rather than always by weight. Much of the point of coin is that it removes the requirement to weigh or even assay payments. If weighing is always required anyway, the distinction between payment in coin and payment in bullion begins to fade away, and the advantages of coin disappear. Yet we need not doubt that those advantages were real, since merchants paid a premium to have bullion minted into coin. Of course the weight of coin was often checked, but it may be that ancient coin was more often paid by number than has generally been suggested. Nor should the expression of prices in a unit of weight – the shekel – necessarily imply that money payments were all weighed. The English pound shows how a unit of weight could evolve as a money of account without needing to be represented as a single coin. There seems to be some evidence that the shekel sometimes served as a money of account consisting of 2 drachma. We may also note that both in England and in Babylonia coins were often used as weight standards for measuring other commodities, but this practice does not mean that they might not also pass unweighed as money.

The custom of presenting prices as the amount of a commodity available for the shekel of two drachma has some similarities with the practice of English towns which recorded the amount of bread and ale available for a penny, thus fixing the unit of money rather than the unit of weight or

volume. In England it is clear that this approach allowed for a much finer gradation of price change than the coinage itself permitted, and this was especially important for retail trade in towns when purchases were made with the smallest coins available. Whole books have been written about *The Big Problem of Small Change* in medieval Europe.[26] In England even the smallest available silver coins had significant purchasing power, and they were constantly in short supply. I do not know what fractional coinage if any may have been available in Babylon, though I am aware that in classical Greece fractions have been found to have been less exceptional than was once thought.[27] Perhaps it is enough here to note that the English evidence suggests that a pure silver coinage had difficulty providing convenient units for small purchases which were probably an inseparable feature of town life. Rather surprisingly little has been written about the necessary association of monetisation and urbanisation, but Jan Luccassen has promoted a comparative study of how far denominational structure may have been geared to the requirements of wage payments.[28] Another entirely different aspect of the comparison of English and Babylonian money and prices concerns the impact of war. It has been observed that the opening of the Persian treasuries by Alexander in 321 BC made silver abundant and prices high, while after his death the wars of succession had similar effects. Although there are some occasions when ransom payments to or from England may have increased or reduced bullion supplies in medieval England, it is noteworthy that trade fluctuations affecting the flow of bullion connected with the wool and cloth trades seem to have been more powerful factors. The outbreak of the Hundred Years War in 1337 saw the effects of war and trade combined, as

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[26] Thomas J. Sargent and Francois R.Velde, *The Big Problem of Small Change,* 2003.

[27] Henry Kim, 'Small change and the moneyed economy' in P. Cartledge, E. E. Cohen and L. Foxhall (eds.), *Money, Labour and Land in Ancient Greece*, London, 1999, and 'Archaic coinage as evidence for the use of money' in A. Meadows and K. Shipton (eds.), *Money and its Uses in the Ancient Greek World*, Oxford: OUP, 2001, pp. 7-21.

[28] Jan Lucassen, ed., *Wages and Currency: Global Comparisons from Antiquity to teh Twentieth Centuries,* Bern 2007.

Edward III diverted the profits of the wool trade directly to funding the war in France, leading to coin shortage in England and a dip in prices.

The wealth of English price and monetary data allows one to explore the relationship between money and prices in some depth. The idea that a rise in the money supply is likely to generate a rise in the level of prices is enshrined in contemporary economic policy of most central banks. In Britain the Monetary Policy Committee of the Bank of England is expected to target an annual inflation rate of 2% by adjusting the rate of interest as the simplest way to influence money supply. Although the accuracy with which the 2% target is achieved may be questioned, the efficacy of the interest rate instrument is widely accepted: raising the interest rate tightens the money supply and tends to lower prices, while cutting the interest rate increases money supply and raises prices. The adoption of these economic principles into an explicitly acknowledged policy is only a feature of the last twenty years, but the core idea that an increasing money supply raises prices and a contracting money supply lowers them can be traced to at least the sixteenth century.[29] In modern times it was codified in Irving Fisher's Quantity Theory, expressed as MV=PT, where M stands for the Money Supply, V for Velocity of circulation, P for the Price level, and T for the level of Transactions. Cambridge economists, most famously Maynard Keynes, operated with an alternative version of the same theory, expressed as M=kY, in which Y stands for estimated GDP at current prices. This is used as a measure of the size of the economy in place of Transactions which are otherwise difficult to quantify, and k stands for the demand for money to hold, the inverse of k (k=1/V).[30] After World War II Keynes' General Theory tended to eclipse his two works on Money,[31] and the

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[29] Early writings by Jean Bodin (1568), Sir Thomas Smith (1581), and Gerard de Malynes (1601) are conveniently summarized by R.B.Outhwaite, *Inflation in Tudor and Early Stuart England,* Studies in Economic History, 1969, pp.21-23.

[30] N.J.Mayhew, ' Population, Money Supply, and the Velocity of Circulation in England, 1300-1700' *Economic History Review*, New Series, Vol. 48, No. 2 (May, 1995), pp. 238-257.

[31] *A Tract on Monetary Reform,* 1923, and *A Treatise on Money,* 1930.

monetarist argument was propounded above all by Milton Friedman and the Chicago school. Nevertheless it is important to recognise that monetary history need not necessarily be 'monetarist' in the Chicago sense, and an essentially Keynesian monetary history is perfectly feasible.

This point is worth making since for some reason monetary history has encountered vigorous opposition among medieval and early modern historians, who prefer to explain the behaviour prices – especially the price rises of the thirteenth and the sixteenth-seventeenth centuries – above all in demographic terms. The argument is that rising population increased demand for goods – above all food – faster than could be met by increased supply, and that this shift in the balance of supply and demand caused prices to rise. In fairness it should be admitted that most proponents of the demographic explanation nowadays think of it as the principal determining factor in the movement of prices, but not as the only one. Along with possible environmental factors, monetary influence on the behaviour of prices is accepted, though in a secondary role. Thus Hatcher and Bailey for the middle ages, and Wordie[32] and Bowden[33] for the early modern period, together with Fisher[34] for both periods do accept some monetary influence on prices, while nevertheless reserving the role of 'prime mover' for population change. This school of thought accepts some monetary influence at certain points in the story: for example when prices rise immediately after the Black Death when demand for food fell by one half to one third, it is generally accepted that the corresponding rise in

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[32] J.R.Wordie, 'Deflationary Factors in the Tudor Price Rise', *Past & Present*, No. 154 (Feb., 1997), pp. 32-70

[33] Peter Bowden, 'Agricultural Prices, Farm Profits and Rents', in Joan Thirsk, (ed), *The Agrarian History of England and Wales,* IV 1500-1640, Cambridge 1967, pp.595-6.

[34] David Hackett Fischer, *The Great Wave: Price Revolutions and the Rhythm of History,* Oxford 1996, pbk 1999, p.19. Fisher p.85 also quotes George Hakewill 'The plenty of coin and multitude of men…either of which asunder, but much more together, must needs be a means of raising prices of all things.' *An Apologie or Declaration of the Power and Providence of God in the Government of the World,* 2nd ed Oxford 1630, quoted by F.J.Fisher, 'Influenza and Inflation in Tudor England' *EcHR*, 18, 1965, 120-1

coin per capita explains the burst of enhanced prices. The argument that monetary factors influenced prices sometimes but not consistently seems to me difficult to sustain. My own view would be that the monetary effect on prices was constant, though it becomes more or less apparent from time to time.

Nevertheless, several erroneous arguments are still repeatedly proposed to deny money a more permanent role. For example it is often suggested that a price rise occurring for monetary reasons should impact all prices equally.[35] This falsehood has been refuted many times,[36] but it is still being put forward. In fact although money does impact on the general level of prices, there is no reason to expect it to affect all prices equally. Different commodities have varying levels of elasticity of demand. In difficult times of course people economise on luxuries or inessentials which accordingly rise in price less than necessities.

Money's influence on the behaviour of historic prices has also been questioned on the grounds that the development of credit will have liberated the economy from the constraints of a limited coin supply. It must be readily conceded that the evidence for the role of credit in medieval and early modern England is extensive and powerful. Anglo-Saxon charters show that loans were secured against property, and the evidence of Jewish money-lending is well known.[37] The Jews were excluded

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[35] Hatcher and Bailey, *op.cit.* p.61 describe Postan's use of this mistaken argument. It is repeated by D.H. Fisher, *op.cit.* p.75.

[36] For example by Outhwaite, as long ago as 1969. *op.cit.,* pp45-6. Outhwaite concluded, 'That all prices should have risen, or have risen equally, are the last things we should expect.' Temin , p.57, goes even further: 'Only administered [as opposed to market prices] maintain their relative prices over long stretches of time.'

[37] On Jewish lending see Robert C.Stacey, 'Jewish lending and the medieval English economy', in Richard H. Britnell and Bruce M. S. Campbell (eds.) , *A commercialising economy: England 1086 to c. 1300,* Manchester1995, pp.78-101, and Robin R. Mundill, 'Christian and Jewish lending patterns and financial dealing during the twelfth and thirteenth centuries', in P.R.Schofield and N.J.Mayhew (eds.), *Credit and Debt in Medieval England c.1180-c.1350,* Oxford 2002, pp.42-67. On Anglo-Saxon lending see the paragraphs contributed by Susie Mayhew to Nick Mayhew, 'Wealth in Medieval England and its relation to the Money Supply', , edited by Laurent Feller, forthcoming.

from other means of earning a living but found a role where Christians were constrained, lending money. However, much medieval lending did in fact also take place between Christians, for it was usury which was prohibited, while lending at reasonable rates of interest which did no more than compensate for the lender's opportunity cost or for any delayed repayment, was accepted.[38] The twelfth-century lending of William Cade is well known,[39] while in the late thirteenth century Italian bankers assumed an important role financing sovereign debts, and lending to the Church itself. In the 1280s Edward I put in place improved legal machinery for the recovery of debts even before the expulsion of the Jews. This legal machinery has left behind an extensive series of records of credit and debt from all over England which extends into the sixteenth century,[40] and by the fifteenth century the records of bankers involved in international credit reveal the extensive use of international bills.[41] In the sixteenth century such bills were also employed widely in inland trade,[42] even though these merchant obligations were not enforcible in the courts before the eighteenth century.[43] There can be no doubt that lending was extremely widespread throughout English society as Kowaleski has shown for medieval Exeter and Muldrew for early modern King's Lynn.[44]It is no

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[38] The Christian order of the Knights Templar, who financed the ransom of Louis IX, were prominent lenders . See Jean de Joinville, *Histoire de St Louis,* ed. N.de Wailly, 1874, cited by Michael Metcalf in P.W.Edbury and D.M.Metcalf (eds.) *Coinage in the Latin East,* Oxford BAR 1980, p.1.

[39] *Oxford Dictionary of National Biography,* 2004, under William Cade.

[40] Pamela Nightingale, above note 6.

[41]J. Bolton 'The Borromei Bank Research Project' in *Money, Markets and Trade in Late Medieval Europe. Essays in Honour of John H.A.Munro* ed. L.Armstrong, I.Elbl and M.M.Elbl (Leiden: Brill, 2007).

[42] Kerridge, above note 9.

[43] Postan, see above, note 7.

[44] Mariane Kowaleski, *Local Markets and regional trade in medieval Exeter,* Cambridge 1995, esp chapter 5, and Craig Muldrew, 'Credit and the courts: debt litigation in a seventeenth-century urban community', *EcHR,* XLVI, 1993, and *The economy of obligation*, Basingstoke 1998, present a picture in which whole towns seem to be involved in borrowing and/or lending to one another.

exaggeration to say that credit was an essential feature of the English economy.[45]

There remains, however, a fundamental dispute between those who believe that these credit networks and legal structures solved the problem of illiquidity on the one hand, and those on the other hand who argue that universal dependence on credit merely illustrates the size of the problem. Impressive though the legal systems for the prosecution of debt may have been, they were also expensive, and added very significantly to transaction costs. Moreover, it has to be recognised that credit itself was dependent on the extent of the money supply. Historians seem sometimes to have failed to grasp the fundamental point well known to both medieval and modern bankers: when money is tight, so too is credit; when money is plentiful, credit may easily be had. Thus credit grows or contracts with the money supply; it does not compensate for any short fall. This point can perhaps be most powerfully illustrated by the evidence for the reduction in Velocity which is a feature of English economic development from the Norman Conquest to modern times.

The behaviour of Velocity has been widely misunderstood, so it is worth taking a little time to explain it. Velocity, the V of Fisher's Quantity Theory (or the inverse of Keynes' k, the demand for money to hold) falls over time from medieval to modern times.[46] Velocity does not measure the frequency of money payments in the economy, which does indeed increase over time. Instead Velocity indicates the number of times the Money Supply (M) needs to turn over in order to accomplish the total amount of required business in the economy (Transactions). V is thus a function of M,P and T. That it can be shown to have risen historically over time demonstrates that it is the rise in M, not V, which is characteristic of growing or modernising economies. Indeed the historical evidence shows that there are real limits to how large V can become, without impacting seriously on the economy. The eleventh-century V of over 10 in fact

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[45] England was not exceptional. See Daniel Smail, 'Goods and Debts in Mediterranean Europe'. Paper presented at a research seminar at Harvard, May 2010.

[46] Mayhew, Rondo Cameron, above notes 30 and 8.

required a large amount of business to be carried out by non-monetary expedients, such as labour services or payments in kind instead of money rents and wages.[47] More thorough monetisation required a reduction in V and a growth in M.

It is this point which confirms the observation above that credit cannot grow without an increase in the available money supply. [48] If credit itself is dependent on the money supply, the argument that the growth of credit liberated the economy from monetary constraints falls.

A third objection to the monetary explanation for the behaviour of medieval prices is that if the economy suffered from a chronic shortage of currency, bullion would have been diverted from luxury and display functions and made available as coin. In fact there are occasional instances where silver and gold plate was sent to the mints for conversion into coin, but these are exceptional. That it did not happen more often indicates that those who held the plate were not the classes most inconvenienced by the lack of coin. Moreover, the key factor determining the flow of bullion to the mints can be seen to be the price for that bullion offered by the mints. If, as was characteristic of England in the eighteenth century, the mints offered a lower price for silver than the goldsmiths making plate, or the East India Company for export to the East, then bullion would not feed the mints. Thus a shortage of currency might be caused by scarcity of bullion,

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[47] Nicholas Mayhew, 'Modelling medieval monetisation' in Britnell and Campbell (eds.), *A Commercialising Economy,* p.72 for the suggestion of Velocity over 10 in 1086.

[48] Credit of course contributes to V, so far as it concerns cash loans, credit sales or deferred payments, but once credit instruments begin to circulate themselves they become Money. The exception to the observation that V falls over time is in the sixteenth century, when the calcualted figures for V rise before falling again in the seveteenth century and thereafter. The explanation for this may lie in the absence of any allowance in the Money Supply for the role of Bills, which Kerridge believes was extensive and growing in the sixteenth century. An alternative view, famously propounded by Wordie, is that Elizabethan England actually suffered monetary deflation, ie that the price rise would have been even greater if the money supply had grown more. Wordie, see note 32; Kerridge, see note 9.

but plentiful bullion did not guarantee a ready supply of coin if the mint price for metal was uncompetitive.

Of course mints most easily raised the price they offered for bullion by reducing the precious metal content of the coins. Much has been written about the evils of debasement, and there is no shortage of examples of its pernicious effects, but it has perhaps been less widely recognised that maintaining a currency which is too strong could also create difficulties. Strong money keeps prices down, but it can make exports uncompetitive and domestic money scarce, inhibiting growth.[49] Those charged with the control of English monetary policy in the middle ages and early modern era generally erred on the side of keeping sterling too strong; or to put it another way, they failed to recognise that other countries were setting a higher price on bullion. Underlying this whole issue, are the conflicting functions of money. Traditionally these are defined as 1) a means of exchange, 2) a store of value and 3) a measure of value, but these functions actually pull in opposite directions. Providing an adequate means of exchange for a growing economy, which often involves an element of inflation, conflicts with the interests of those most concerned to preserve the value of the money they hold. In short, the complexities involved in the valuation of the currency mean that any simplistic assertion that bullion can be found from other sources to supply a monetary shortage is mistaken.

Equally the idea that New World bullion cannot be shown to have reached England can be set aside. Challis has shown that in fact New World bullion can be traced to England, and the mint accounts leave no doubt that money supply was growing.[50] Wordie has argued that most of the newly

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[49] The effects of debasement are those of a modern devaluation, or of a reduction in the interest level.

[50] C.E.Challis, 'Spanish bullion and monetary inflation in England in the later sixteenth century', *Jn of European Economic History,* 4, 1975, pp.392 reads: 'On the basis of manuscripts hitherto neglected [theis brief analysis] has concluded that where documentation does survive [in the Mint ledgers and melting books] there is clear evidence of Spanish bullion not only influencing but actually dominating mint supply, and that this inflow of bullion was certainly connected with the seizures of treasure made by

minted Elizabethan coin may have been swiftly exported, suggesting that only some £1.5 to 2M remained in circulation at the end of Elizabeth's reign,[51] but in fact we know that at least £2.7M must have been present in England in 1603, since that much Elizabethan coin was still in circulation in the 1640s.[52] Thus we may safely discount the suggestion that the money supply was not affected by fluctuations in bullion supply.

Finally, monetary explanations for the movement of prices have also been challenged on the grounds that any change in price should be proportionate to the change in money supply, and demonstrating such proportionality has proved very difficult. In fact the expectation of proportionality originates in Irving Fisher's Quantity Theory, but was effectively dismissed by Keynes and others who have observed that such theoretical proportionality could take a very long time to work through the system. In reality prices and wages do not adjust easily but are often 'sticky', and some adjustments occur faster than others. Generally prices tend to rise faster than wages, but both tend to fall only slowly as sellers and workers are reluctant to accept less than they have come to expect.[53] The Quantity Theory is just that – a theory - which is not borne out precisely by events at any one moment, since the effects unroll at varying speeds. The Fisher *Identity*, however, is constructed as a truism: any disproportionality between money supply and prices is explained by

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English seamen, and possibly also with both a favourable balance of trade and a bi-metallic flow.' For France and Spain, metallic analyses confirm the arrival of New World silver in quantity from the 1570s. See E. Le Roy Ladurie et al, 'Sur les trace de 'argent de Potosi'', *Annales E.S.C.,* 1990, pp.483-305;

[51] Wordie, *op.cit.* p. 60, note 32 above.

[52] Edward Besly, *English Civil War Coin Hoards,* British Museum Occasional paper No 51, 1987, p.56, estimated that the silver currency in 1643 stood at £7.5m made up of £3.5m of Charles I, £1.2m of James I, and £2.7m of Elizabeth I, based on an analysis of 1640s hoards. If so much Elizabethan silver was still in circulation in 1643, at least as much, and probably significantly more, was present in 1603.

[53] 'A change in prices and wages as measured by money is capable of transferring wealth from one class to another, and redistributing fortune in a way which baffles anticipation and upsets design.' J.M.Keynes, 1920.

adjustments to velocity (or k in the Cambridge version) or to the level of transactions (or the size of the economy.)
Thus all four of the objections commonly advanced to deny a monetary role in the behaviour of prices can be effectively met. A monetary effect would not impact on all prices equally. Credit follows the money supply, it does not counter-balance it. Both shortages of coin and monetary booms can be related to known mint output, and the estimates of money supply based on them. And finally, there is no need to demonstrate *proportionate* changes to money supply and prices; it is enough to show a broad correspondence, and this can be demonstrated.

Nevertheless, even those convinced of an important monetary role in the economy have recognised the fundamental agency of land and labour. Peter Spufford, who has done more for the cause of monetary factors than any other historian, regarded demographic factors as the motor of the medieval European economy, while monetary growth simply released the brake which allowed the vehicle to move forward. Historians have generally found it easier to accept this elegantly formulated compromise than to swallow the more fully committed monetary theories of scholars like John Day, John Munro, and Pamela Nightingale. I have myself argued for a major but not exclusively monetary role in the determination of prices, and this still seems the most balanced approach, though it should be recognised that monetary and demographic explanations may not always be compatible. Wordie, who places himself in the demographic camp while accepting some role for money, has accepted that a rising population would enjoy a smaller amount of coin per head of the population, and might therefore very well have a *deflationary* effect on prices. Similarly, other things being equal, a rising population would be expected to lower wage costs. Thus demographic growth would only be inflationary if it could be shown both that money supply grew more than the population, and that population grew faster than the supply of goods.
As we have seen, modern economic policy is founded on the role of money supply as a cause of inflation, while it is also recognised that price

rises originating in a shift in the balance of supply and demand can only be reflected in prices if the money supply 'validates' the change. However, there seems to be a fundamental though surprising dislocation between the thinking of twenty-first century economists on the one hand and economic historians of the medieval and early modern period on the other. While the former generally accept money's influence on prices as a given, the latter resist it doggedly, while neither party even seems to be aware of the existence of the other.[54] However, if as seems to be the case, money supply is nowadays thought to have a major influence on the behaviour of contemporary prices, it seems reasonable to ask why it should not have been equally influential in the past.

Could it be that this distinction between contemporary and medievalist thinking is explained by the much greater role played by money in the modern world? Alfred Marshall, another great Cambridge economist, was always cautious about applying contemporary economic theory to history on the grounds that in many respects the past was different.[55] Such an approach would have obvious implications for the study of Babylonian prices. However, all recent work in medieval economic history has tended to emphasise the importance of commercial factors and the use of money and credit much earlier than previous generations (including Marshall's) may have thought. The work of historians such as Dyer, Britnell, Campbell

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[54] For recent economic historians of modern times who assume monetary explanations of sixteenth and seventeenth century inflation, see for example James MacDonald, *A Free Nation Deep in Debt: The Financial Roots of Democracy,* Princeton and Oxford, 2006, pp.119-20, and Carmen M. Reinhart and Kenneth S. Rogoff, *This Time is Different: Eight Centuries of Financial Folly,* Princeton 2009, p.71. Reinhart and Rogoff also apply monetary theory to ancient history, p.174.

[55] Nicholas Poynder, 'Grain storage in theory and history', paper presented at the 3rd Conference of the European Historical Economics Society, Lisbon, 1999., quotes Marshall thus: '"if we are dealing with the facts of remote times we must allow for the changes that have meanwhile come over the whole character of economic life: however closely a problem of today may resemble in its outward
incidents another of recorded history, it is probable that a closer examination will detect a fundamental difference between their real characters." Marshall *Principles of economics*, p. 774.

and Kowaleski is vivid testimony to the importance of commercial and monetised transactions in thirteenth-century England. Moreover, Dyer has also argued for much commercial activity as early as the eleventh century, and serious students have long been impressed by the ubiquity of coin in Domesday Book.[56] The evidence of coin finds also contributes to the impression of widespread use of coin in England in the eleventh century and before.[57] This is not to suggest that there were no differences between ancient, medieval and modern money: self-evidently money has been expressed variously in precious metal, paper, and electronic accounts. The proportion of wage-earners and primary producers has varied. The economy has evolved through all the phases of capital and industrial development.

Nevertheless to the extent that money prices operated in ancient, medieval and modern economies, it would seem to be difficult to argue that monetary factors influenced prices in the twentieth and twenty-first centuries but not in the sixteenth or the thirteenth. Though earlier generations struggled with more or less chronic illiquidity, money has been shown to be central to the conduct of both economic and political business from at least the thirteenth century, and recent interpretations of the Anglo-Saxon, Byzantine, Roman, Iron Age and Babylonian economy are all envisaging an increasing roll for money and the market.

Indeed Peter Temin has argued that the behaviour of Babylonian prices can be shown to be driven by the market in much the same way as medieval, early modern and modern prices.[58] The plentiful English evidence allows us to review the movement of money prices, to establish how far they can be shown to be consistent with the operation of markets and the laws of supply and demand. Of course the efficient operation of

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[56] D.C.Douglas, *Medieval East Anglia,* Oxford, 1929, and Reginald Lennard, *Rural England, 1086-1135,* Oxford 1966, pp. 115, 120, 176-80 saw this long ago, but it also informs the current thinking of Sally Harvey.

[57] Databases of English coin finds may be found at http://finds.org.uk/ and at http://www.fitzmuseum.cam.ac.uk/dept/coins/emc/ .

[58] Peter Temin, 'Price Behavior in Ancient Babylon', *Explorations in Economic History*, 39, 2002, p53. 'The ancient prices behave like Medieval and early modern prices, which in turn share the time-series properties of prices today.'

markets is always subject to the provision of information and the availability of transport. Moreover those in a position to manipulate markets and exploit inefficiencies have always done so. Mutatis mutandis, ancient and medieval markets were no more perfect than modern ones. Yet we can examine the behaviour of prices to see how far they moved in ways capable of rational explanation. I intend to look first at price movements over the course of the harvest, and then to compare prices and yields from year to year to see how far high yields lead to low prices as we would expect, and vice versa. This will be done first as a simple correlation, and then on the basis of a regression analysis. Finally I will examine how far markets appear to be integrated, allowing poor yields to be off-set by the movement of grain from higher yielding areas.

Over the course of a single year medieval prices generally did reflect the ebb and flow of supply and demand, typically falling after the harvest when goods were plentiful but rising towards the end of the growing year as the previous year's harvest became exhausted. Temin notes this pattern for barley and date prices in Babylon, [59] and the same trend is clear in thirteenth-century England.[60] However, occasionally the simplicity of this pattern was complicated as farmers and merchants estimated the likely success of the coming harvest. Moreover, some attempts at corn storage or the importing or exporting of corn could have an impact on the 'normal' pattern.[61] Galloway's study of the Exeter data showed that the

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[59] Temin, *loc.cit*. p.57.

[60] Farmer in AHEW, II, p.739. Campbell, Galloway, Keene and Murphy describe the seasonal movement of wheat prices in southern England thus: 'The general pattern was for prices to rise gradually from November to a peak in March, April, May, or June, which was often followed by a slight fall.' *A Medieval Capital and its Grain Supply: Agrarian Production and Distribution in the London Region c.1300,* Historical Geography Research Series No.30, 1993, p.97.

[61] Poynter's paper summarizes the attempts of various historians to calculate the cost of grain storage in accordance with modern theory. However, the difficulty of reconciling the historical evidence with the theory may tell us as much about the quality of our evidence as about the soundness of the theory. Bowden AHEW IV, 619 notes that in 1619 Robert Loder stored wheat after a good harvest for three years to sell it at 3 times its original value, but storage was not generally well organised.

degree of price variation within the year altered markedly between the 1320s and the 1360s without identifying any clear explanation.[62] In short, the main outlines of the surviving evidence are broadly compatible with modern theoretical expectations but at the detailed level the correspondence is often less than perfect. Yet despite such irregularities, the fundamental underlying features of the growing year are for the most part reflected in the pattern of money prices.

Another approach allows us to observe the consequences of harvest success or failure as they are revealed by the annual price. Medieval English manorial accounts provide a wealth of information which enables us to calculate the harvest yield for most years from the early thirteenth century to the end of the fifteenth. This information on yields of wheat, barley and oat harvests from a host of manors in southern England has been wonderfully made available on the web, as the fruit of Bruce Campbell's ground-breaking research project.[63] Naturally yields in any one year varied a good deal from place to place, reflecting the character of the soil, the vagaries of the weather, and the efficiency and diligence of the cultivators. These variables resulted in much yield and price variation over the country as a whole. However, Campbell has been able to construct an indication of the national yield for each year to set alongside the notional national price suggested by Farmer and Bowden, and these price series have been adapted by Clark and Allen to permit their continuation into the early modern period. Of course all such abstractions are constructs which can be criticised by other scholars minded to make their calculations and assumptions slightly differently, but although each competing price series

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[62] James Galloway, 'One market of many? London and the grain trade of England' in Galloway, ed., *Trade, Urban Hinterlands and Market Integration c.1300-1600,* London 2000, p.32, and p.27 note 17 for details on the Exeter sources. Bowden also noted unusual price movement within the year at Exeter, AHEW, IV, p.620.

[63] Bruce M. S. Campbell (2007), *Three centuries of English crops yields, 1211-1491* [WWW document]. URL **http://www.cropyields.ac.uk** **[accessed on 31/01/2011].**

differs somewhat from the others, the broad outline pattern they reveal is largely similar.

This data permits us to explore the hypothesis that prices and yields should be inversely correlated, high yields leading to low prices and vice versa. There are many reasons why this correlation might be less than perfect. The national figures for price and yield may imperfectly reflect reality. The medieval markets will have lacked perfect information about yields either locally, regionally, nationally or internationally. Transport networks will have imperfectly connected markets, and if they had worked perfectly the costs of transport would have affected prices as well as the harvest yield. It should also be borne in mind that our yield data comes to us entirely from seignorial accounts, while we know that peasant production contributed very significantly to the market and may have achieved different yields.[64] Nevertheless, despite these distorting factors, Campbell's correlation of these national series of yields and prices is interesting, and is presented in figures I to K.

Figure I

Correlation of Wheat yields and prices

http://www.cropyields.ac.uk/images/chronologies_graph_05.png

Figure J

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[64] While it used to be assumed that seigniorial yields exceeded peasant yields as a result of monopolising manure supplies and maximising capital inputs, recent work has argued that peasant labour on smaller acreages may have done better than hired or exploited labour. Demesne estates may also have suffered from pilfering or fraud by accounting officials. David Stone, 'The productivity of hired and customary labour: evidence from Wisbech Barton in the fourteenth century', *EcHR,* L, 1997, pp.640-656, reveals the lower productivity of forced labour, and p.655 suggests peasants worked harder for themselves. B.M.S. Campbell, 'Agricultural progress in medieval England: some evidence from eastern Norfolk', EcHR, XXXVI, 1983, pp. 26-46, esp. at pp.30-41, suggests that contrary to Postan's view, peasants might have rung better yields from their own land. It has long been recognised that peasant flocks contributed more to the national wool clip than the demesnes. See Eileen Power, *The Wool Trade in Medieval English History,* Oxford 1941, pp.29-31; A.R.Bridbury, 'Before the Black Death', *EcHR*, XXX, 1977, p.398.

Correlation of Barley yields and prices
http://www.cropyields.ac.uk/images/chronologies_graph_20.png

Figure K
Correlation of Oat yields and prices
http://www.cropyields.ac.uk/images/chronologies_graph_25.png

These figures indicate how far prices and yields correlate, so that the higher the value of r, the stronger the relationship between the two variables.[65] They suggest that the degree of correlation varied over time and from grain to grain. Wheat appears to correlate better than the other grains, perhaps because wheat was more widely bought and sold, while a higher proportion of the barley and oat crop was liable to be consumed by producers rather than sold. The variation in the extent of correlation over time may suggest that prices and yields correlated better in periods of higher prices, and/or times of greater liquidity, though I would welcome other suggestions for the interpretation of these graphs. Although the evidence taken as a whole confirms the existence of a relationship between prices and yields, it is less clear cut than we would have expected if markets and money prices were operating perfectly.

An alternative approach also based on the assumption that yields are an important determining factor for prices is a regression analysis of yields and prices. I first attempted this method in 1988, based solely on yields and prices from the estates of the bishop of Winchester.[66] It is now possible to apply the same methods to the additional price and yield data collected by the Campbell project.[67] Taking yield as the independent

[65] Campbell inverts the yield so that the correlation should be positive. The closer the result is to 1, the more perfect the correlation. 0 indicates the absence of any linear correlation.

[66] N. J. Mayhew, 'Money and Prices in England from Henry II to Edward III', *Agricultural History Review*, 35, 1987, pp.121-32.

[67] Adding data from, for example, the Westminster Abbey estates.

variable and price as the dependent variable, it is possible to suggest the likely price for any given yield. I have analysed the data in a series of separate periods, since the long term trend of rising prices through the thirteenth and early fourteenth century followed by a falling or flat trend from the late fourteenth underlies the annual variation.

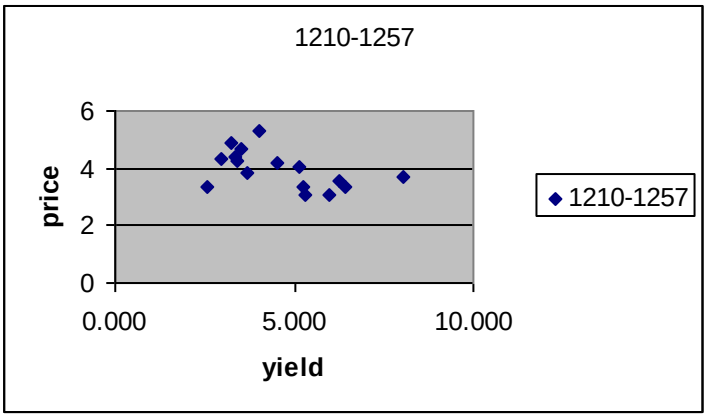
The thirteenth century data appears in Figures L, M and N. The R squared figure indicates that between 27% and 36% of the price variation observed can be explained by the variations in yield. The R squared for the century as a whole suggests that figure is 32%. The slope of the best fit line is negative in all cases, as we would expect, since prices rise as yields fall. The average price in shillings per quarter rises from the 4.3 shillings a quarter in the first half of the century, to 5.7 shillings a quarter in the second half of the century. Only 16 and 26 pairs of data were available for Figures L and M, which is why the century as a whole was treated in Figure N, which had 42 pairs.

Figure O shows that prices peaked in the first half of the fourteenth century, when the average price reached 6.34 shillings. The slope of the line was also steepest then, though that and the high intercept point are perhaps unduly squewed by the exceptional famine prices of 1315 and 1316. However, the high R square number indicates that 44% of the price variation in this period may be explained by the yield variations.

The explanatory power of these regressions falls sharply after the Black Death, as indicated by the R square numbers for Figure P (0.15) and Figure Q (0.0820), but the average price remains high, at 6.5 shillings in the second half of the fourteenth century and 6 shillings between 1401 and 1450. In the fifteenth century the slope, at -0.65, though still negative, is alarmingly flat, confirming that in this period prices were much less responsive to changes in yield than previously.

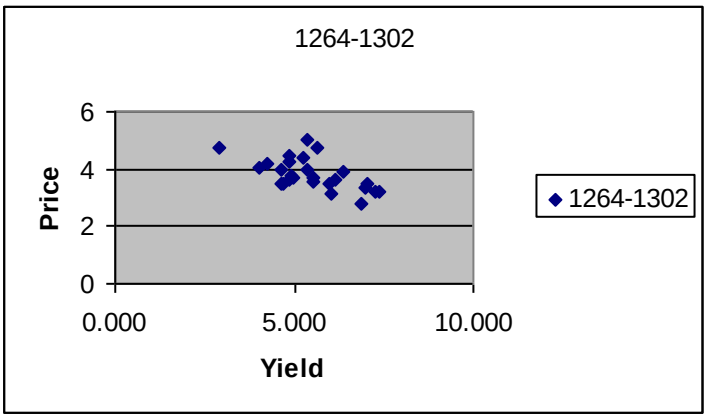
Farmer wheat prices and yields

Figure L



Slope -1.20178
Intercept 9.368324
R Square 0.269245
Average price 4.298
16 pairs

Figure M



Slope -1.26552

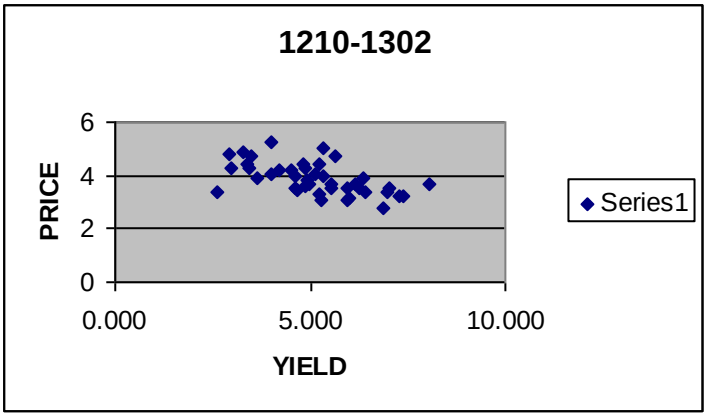
Intercept 10.05173

R Square 0.360538

Average price 5.670

26 pairs

Figure N



Slope -1.19317

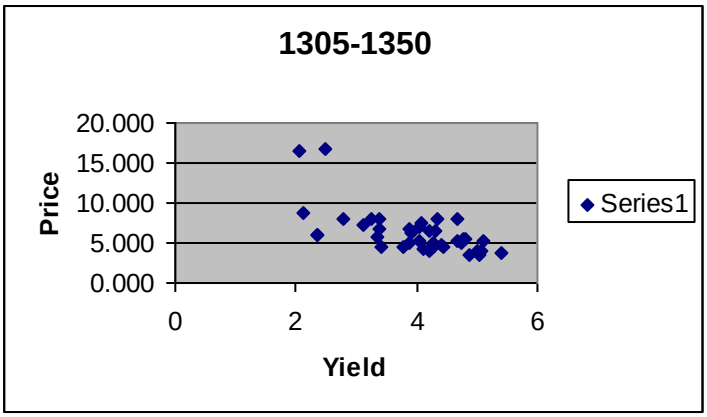
Intercept10.03987

R square 0.315358

Average price 5.084

42 pairs

Figure O



Slope-2.05885

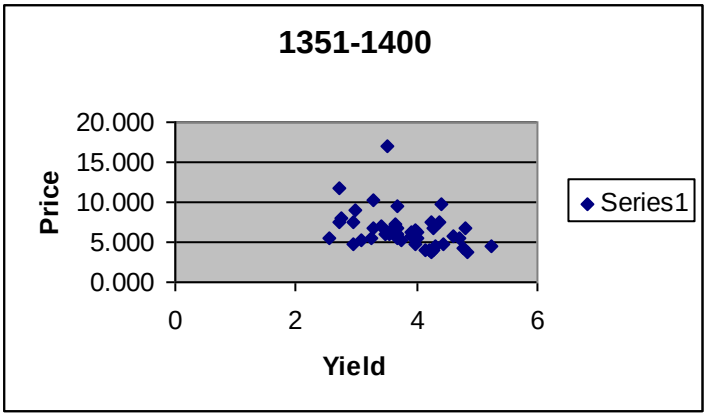
Intercept 14.42203

R square 0.447274

Average price 6.336

40 pairs

Figure P



Slope -1.42445

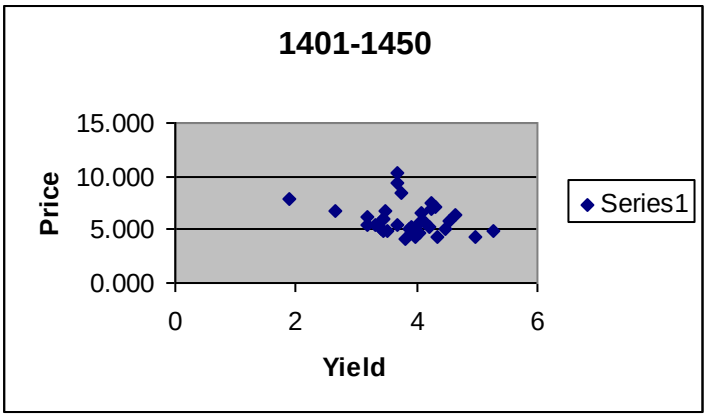
Intercept 11.95135

R square 0.146413

Average price 6.485

45 pairs

Figure Q



Slope -0.65458

Intercept 8.458523

R square 0.082048605

Average price 6.050

Generally the results confirm the suggestion that the movement of prices is compatible with rational market expectations. The market is, however, far from perfect. In addition to the reasons offered above for such imperfections, one may note here that prices may come from any point in the year, and we know that they normally varied over the course of the

year. A price from the summer of 1251 might reflect either the residue of the previous harvest or be influenced by an awareness of the prospects for the coming harvest or both. In short associating any harvest with its subsequent price is not exact. Given all these possible sources of error, the regression of prices and yields is necessarily a somewhat approximate exercise. It does generally confirm their relationship, and demonstrate that market prices were responsive to harvest yields, though more so in the thirteenth and fourteenth centuries than in the fifteenth. However, in a perfect market we might expect prices to be much more closely related to supply, as indicated here by the recorded yields. Transport costs need also to be accounted for if productive areas were to supply areas of shortage, and the possibility of speculative storage could also distort prices. Above all one must recognise that the information at the disposal of medieval price setters can only have been imperfect, while the data available to the historian, though exceptionally rich for historical data, is nevertheless partial.

The plentiful English medieval data also allows us to approach the question of market integration. It has been convincingly demonstrated that London drew its corn supply from its agricultural hinterland to which it was connected by water transport, prices in the capital approximating to those in the hinterland plus the costs of transport.[68] Thus prices to the west of London along the Thames valley fall gradually as the distance from the capital increases. It can also be shown that farming practice and the prices paid varied from region to region reflecting the nature of the land and climate. Long ago N.S.B.Gras attempted to map the different regions of medieval England and to demonstrate their different price regimes.[69] This

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[68] Bruce M.S.Campbell, James A Galloway, Derek Keene and Margaret Murphy, *A Medieval Capital and its Grain Supply: Agrarian production and distribution in the London region c.1300,* Historical Geography Research Series, Number 30,1993. Also James A. Galloway (ed.), *Trade, Urban Hinterlands and Market Integration c.1300-1600,* Institute of Historical Research 2000.

[69] N.S.B.Gras, *The Evolution of the English Corn Market from the Twelfth to the Eighteenth Century,* Cambridge Mass. 1915, London 1926.

work has been criticised on the grounds that the regions were defined somewhat arbitrarily, that prices were grouped together over long periods, and that the creation of regional price averages lacked statistical sophistication. Importantly it has been pointed out that 'Rather than regions of price-equality, we should expect to find, if the market were integrated, that prices varies across the country in a logical manner, with differentials reflecting the cost of transport between locations.'[70] Nevertheless the fundamental observation that different regions were farmed in different ways and experienced different price regimes is sound.[71] Thus for example, Norfolk specialised in barley, which it grew cheaply enough to allow it to bear the transport costs of sending large quantities to London. Generally speaking northern England paid more for corn but less for meat, reflecting the rough grazing which supported cattle and the poorer climate and shorter growing season which discouraged arable. This contrast can be very clearly illustrated by the comparison of prices in England and Scotland.[72] As one goes further north cattle prices fall and grain prices rise, and this difference led to different patterns of consumption and established the basis of longer distance trade. Thus Scots, unable to successfully grow wheat, ate more oats or imported wheat, which they paid for with the profits of the cattle trade. This was an enduring relationship based on unchanging fundamentals. The drovers' roads which brought cattle south were permanent features of the landscape for centuries. Merchants and farmers knew with certainty that corn was cheaper in the south and meat cheaper further north, and that London would pay good prices for both.

Regional towns had similar relationships with their own hinterlands, but at the very local level the case for market integration may have been less

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[70] James A. Galloway, 'One market or many? London and the grain trade of England' in *Trade, Urban Hinterlands etc.,* p.24 for this quotation and the other criticisms.

[71] P.J.Bowden, AHEW, V, pp.857-875 provides a regional analysis of the 1640 to 1749 prices.

[72] Elizabeth Gemmill and Nicholas Mayhew, *Changing Values in Medieval Scotland,* Cambridge 1995.

certain. Although corn yields might vary markedly over quite short distances in one year reflecting better farming practice, unless performance was consistently superior the transport and information networks required were unlikely to develop. In other words the evidence for market integration is confused, and different scholars have reached different conclusions. Gregory Clark found the evidence suggestive of reasonably efficient markets,[73] while James Galloway thought 'it may be that annual prices constitute too coarse-grained a measure to fully reflect changes in integration levels' and 'Clearly, there is as yet no certainty about the long-term course of change in price volatility and integrated levels within the English grain market.'[74]

It is difficult to determine objectively how perfect the correlation of prices and yields or the degree of market integration might reasonably be expected to be. The data from medieval England does provide evidence that prices rose or fell in line with harvest success or failure, and that trade networks were established to allow centres of cheaper production to market their goods where demand was sufficient to justify the transport costs. The market was very far from perfect, but money prices moved broadly in line with expectations, confirming both the commercial nature of medieval society and that monetised transactions were widespread. This is not to deny the existence of labour rents and payments in kind, or of auto-consumption by producers, or uneconomic practice by those wealthy enough to prioritise other religious or social considerations. But it is to assert that the prices and trade patterns we observe are capable of rational explanation consistent with a somewhat imperfect market economy. We concur with Temin's judgement that Babylonian, ancient, medieval and modern prices behave like market-driven prices. In other words, we can see money behaving like money from ancient to modern times.

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[73] Gregory Clark, 'Markets and Economic Growth: The Grain Market of Medieval England', http://www.econ.ucdavis.edu/faculty/gclark/210a/readings/market99.pdf accessed on 18 March 2011.

[74] Galloway, *Trade, Urban Hinterlands etc,* p.41-2.