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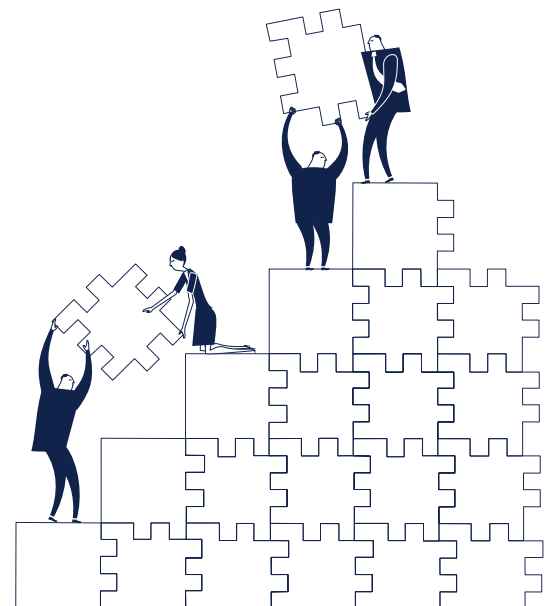
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# Two centuries of Farmland Prices in England?

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# Two Centuries of Farmland Prices in England

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## Abstract

*The dissemination of robust real estate data can help to improve market efficiency and investment analysis. To provide a perspective on property prices, a long series is vital. While long commercial and residential real estate data series are available, agricultural land is less well served. Comparable series describing long-term price and return histories for farmland in England are fragmented. We redress this data deficiency after considering the methodological complexities involved. The study employs a chain-linking approach to construct a long-term farmland price series for England. It then adjusts the series for inflation to examine real land prices. The resulting two-century series of English farmland prices establishes a basis for a more efficient farmland market analysis.*

*Notwithstanding issues around long-run chain component heterogeneity, the combined series illuminates English average farmland price dynamics and changing land market fortunes. For more than two centuries English land price real capital returns were positive. Farmland real price growth was 0.33 per cent annually from 1781 to 2013 and 0.71 per cent from 1801 to 2013 as measured by the geometric mean. The series provides prima facie support for land investment, even when ignoring spatial peri-urban opportunities, rental income or tax advantages.*

**Keywords:** Farmland, Prices, Returns, England.

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# Two Centuries of Farmland Prices in England

*'Sir, - In these times, when the rental and marketable value of land are in such an unsatisfactory and uncertain state that the savings of the community run riot on the Stock Exchange, it is interesting to those who are connected with the land to bring to light all facts bearing on the question'* (Norton et al., 1889, p.128)

## Introduction

The importance of good long-term data in real estate markets is well documented (Solomou, 1998; Hand et al., 2001; Wheaton et al., 2009; Wooldridge, 2009; Devaney, 2010; Mitchell et al., 2011). Its dissemination improves market efficiency and anchors expert advice (Makridakis et al., 1998). Long-term time-series analysis also helps us to understand important temporal changes (Solomou, 1998).

In addition to an appreciation of market changes, long time-series are necessary for most types of statistical analysis. Following Yaffee and McGee (2000), a properly estimated and parameterised model should contain enough observations. Although Yaffee and McGee did not suggest what constituted enough observations, the recommendation is that if a series is cyclical or seasonal, then it should be long enough to cover several waves.

In the UK, data on commercial and residential property markets is plentiful. London is the best documented property market in Europe (Ball and Tsolacos, 2002; McGough and Tsolacos, 2002; Lizieri, 2009; Devaney, 2010). As McGough and Tsolacos (2002, p.35) remark, 'in some senses, researchers seem spoilt for choice' since UK property data goes back for several decades, and is available at national and local levels, in various frequencies, regularities and length. This allows for detailed and robust property market analytics.

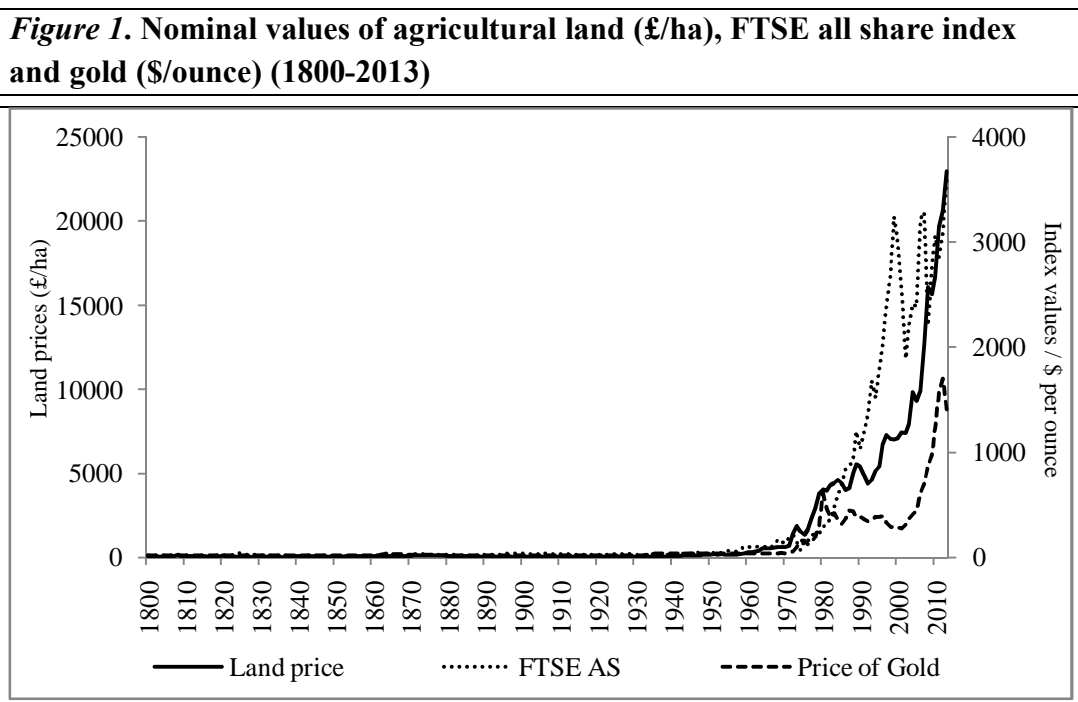
There is a growing interest from the property investment community in land market conditions and prospects (Jadevicius and Martin, 2014). Naturally, 'informed' as opposed to 'noisy' (Black, 1986) developers and investors would welcome well-established land price data series. Land values are the bedrock for urban economics. They are central in understanding property market price changes, the impact of land-use policies and taxes levied on property, costs of urban agglomeration, and even calibrating optimal settlement size (Albouy and Ehrlich, 2013). Aside from investors, farmers themselves need robust land price benchmarks (Walsh, 2011).

Curiously, despite the importance of land values, UK long-term farmland series are fragmented compared to residential or commercial series. Typically, data on land is collected for a single area or certain time-period (Albouy and Ehrlich, 2013). The main contribution of this research is therefore to construct a long-term land price series for England to inform land management stakeholders, investors, farmers and developers.

## Main contribution

This research extends English farmland price series and finds that recent land price inflation is excessive compared to historical growth but is similar to price behaviour in equities or commodities (gold). We demonstrate that land provides investors a ‘safe haven’ or competitive hedge against inflation. In all likelihood, land provides investors with positive returns, additional to other qualitative or substantive consumption services.

Over the period 1801-2013, the geometric mean of annual real price changes was 0.71 per cent for land, 0.45 per cent for the FTSE index and 0 per cent for gold. Farmland real price growth was 0.33 per cent annually over extended 1781-2013 period. All three asset classes saw little appreciation over the nineteenth and mid-twentieth centuries. From the early 1970s inflation drove all three series significantly upwards, though with some periods of negative correction. The asset inflation tipping point was 1972. A year later, land prices were 103 higher and gold jumped 67 per cent in one year. The FTSE followed, and in 1975 the All Share price index grew by 136%. Positive real price growth slowed in the 1990s but resumed over the last decade.



*Source:* FTSE All Share series come from GFD (2015) and LSE (2015); Gold series are derived from Officer and Williamson (2015).  
 \*FTSE All Share series ó a closing index value for the last trading day of the year.  
 \*\* Gold series is New York Market Price (U.S. dollars per fine ounce)

<b>Table 1. Nominal and real growth for farmland and gold prices and stock market index</b>					
<b>Nominal price growth (1800-2013)</b>					
	<b>Mean(G)</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max</b>	<b>Count</b>
Farmland	2.76	25.72	-84.00	200.00	213
FTSE AS	2.50	17.70	-55.34	136.33	213
Price of Gold	2.03	13.33	-24.96	99.21	213
<b>Real price growth (1800-2013)</b>					
Farmland	0.71	26.17	-82.95	194.06	213
FTSE AS	0.45	16.71	-61.51	90.22	213
Price of Gold	0.00	12.99	-33.41%	68.84%	213
* Growth is a geometric mean returns over the sample period.					

## Literature review

Benjamin Franklin famously said, “You may delay, but time will not, and lost time is never found again” (Generation, 2012, p.1). The real estate academic literature also invokes a long-term view, whether for analytical (Makridakis et al., 1998; Solomou, 1998) or investment purposes (Generation, 2011; 2012; Ambachtsheer et al., 2013).

### *Stocks and bonds*

Beyond property, Smith (1928) examined the performance of stocks and bonds over the 1866-1922 period. Smith produced a series of scenarios comparing diversified common stock portfolios with bond portfolios. His empirical analysis suggested that stocks outperformed bonds in a long-term.

In his best-selling book, Siegel (2014) urged investors to take a long-term view of returns. Siegel demonstrated that stocks provided real annual returns of 5 per cent over the last 200 years. Stocks outperformed other traditional investment assets including bonds and gold.

Earlier, Mehra and Prescott (1985) noted the long-run outperformance of equity returns. Their study of ninety years of returns on the Standard and Poor 500 Index estimated real average annual yields for equities of 7 per cent. The authors originated “the equity premium puzzle” -the phenomenon for US stock returns to be considerably higher than can be rationally accounted by their relative volatility compared to returns for Treasury Bills (Mehra, 2003).

Dimson et al. (2002; 2003; 2014) took the 'the equity premium puzzle' anomaly further and investigated real returns on equities for sixteen different countries over the 100 year plus periods. Their studies suggested that equities generated the highest returns compared to alternative asset classes, including bonds, bills and currencies. However, these commentators urged investors and analysts to be cautious due to the higher risk attached to equities. Dimson et al. (ibid.) advocated a greater international diversification across various asset classes.

### ***Real estate returns and prices***

Real estate is a complex asset class (Ball et al., 1998; Baum and Hartzell, 2012; Bill, 2013). While global benchmarks exist to describe the universe of listed equity and bond securities (Bloomberg, 2015), the global real estate universe is less well defined (MSCI, 2015; S&P, 2015). Existing indices mostly cover trends in eligible real estate equities worldwide (FTSE/EPRA, 2015; S&P, 2015), while sector specific indices (covering e.g. residential, forestry and farmland sectors) are less developed.

In continental Europe, Eichholtz (1997) looked into Dutch housing markets. He constructed a price index for the Herengracht (a canal side street in downtown Amsterdam) which suggested that over the 345 year period from 1628 to 1973 house prices increased 2.2 times. House prices doubled between 1628 and 1929 and growth flattened thereafter. Considering this is more than a three century period, Eichholtz discovered little real growth in real estate values.

Across the Atlantic, Shiller's (2006) assessment of the US real estate market matched Eichholtz's observations. Shiller constructed a US home price index starting from 1890. As he found, real home prices were 66 per cent higher in 2004 than in 1890. The increase in real values averaged 0.4 per cent over the 114 year period.

Turning to commercial real estate, sources including *inter alia* Scott (1996), IPD (1999), Wheaton et al. (2009) and Devaney (2010) reach a similar conclusion of muted real growth over a long time-period.

Using Scott's findings, IPD (1999) examined UK commercial property returns starting from 1921. The report assessed cyclical characteristics of the sector, examined links between property and the wider economy, and compared returns from property against other asset classes. This historical analysis suggested that property yielded returns of 8.8 per cent p.a., which was above cash and gilts but below equities. However, this performance weakened after the 1980s compared to other asset classes. Annualised property returns over the 1970-1997 period stood at 12.3 per cent, while returns for gilts and equities were surprisingly both higher at 13.1 and 16.8 per cent respectively over the same period respectively. Within these returns, nominal income return varied between 4 per cent (in 1949) and 9.1

per cent (1993), producing two-thirds of the nominal total returns, with capital growth averaging less than 3 per cent per year.

For the US, Wheaton et al. (2009) suggested that real commercial office values in Manhattan were 30 per cent lower in 1999 compared to 1899. The authors compiled a series using 86 repeat-sales transactions for office buildings in the area. The researchers restricted themselves only to institutional grade properties. They considered buildings of 10 or more stories, with elevators and of no less than 250,000 square feet in area. The transaction values were then adjusted for inflation. The results were in line with previous studies on the subject suggesting modest value appreciation - and real declines - for commercial property.

Devaney's (2010) assessment of office rents in the City of London over the 1867-1959 period enabled him to measure the long-term performance of this property segment. The series exhibited distinct periods of rise and decline, which was similar to the Wheaton et al. (ibid.) observations for the US, and real rental growth over the 92 year period was close to zero (0.1 per cent p.a.).

### ***Land prices***

The roots of land market performance analysis can be traced back to Ricardo (1821). A century later, Thompson (1907) investigated the rental values of agricultural land in England and Wales. Thompson's study covered the nineteenth century period (1801-1900). Thompson's (ibid., p.602) analysis suggested that the average rent of agricultural land in England and Wales in 1900 was 30 per cent below the figure of 1872, 34 per cent below the maximum of 1877, and 13 per cent below the figure of 1846, although he drew attention to the difficulty in settling on finite descriptive statistics within heterogeneous markets. The other challenge for Thompson was to separate agricultural land from its residential, woodland or other auxiliary components, as improved farmland, including residential property built thereon for the farm operator, has a value distorted by that improvement. Thompson also struggled to render episodic price fluctuations in the series.

Farmland itself creates other challenges. Given population growth and urban migration, peri-urban agricultural land (the landscape interface between town and country) can transition into development land which has a completely different market dynamic.

Much of the published work on land prices has an urban dimension. In the US, Hoyt (1933) examined land values in Chicago over the period 1830-1933. Generally, Hoyt suggested that business conditions, commodity price levels, value of money and especially a rapid increase in population within a relatively short period drove urban land price inflation. The overall findings, however, again suggested modest gains for this asset class.

Also in the United States, Edel and Sclar (1973) examined the performance of land prices and house values in the Boston metropolitan area over a one-hundred year period. Their estimates suggested that over the century economic gains in real estate did not incur a significant capital gain when adjusted for inflation. An explanation could involve the relative decline in traditional industries and a structural shift towards the 'sunbelt' states.

Atack and Margo (1996) assessed price changes for vacant land in New York City between 1835 and 1900. The authors used sales figures for individual lots obtained from four New York City daily newspapers. Their estimates suggested 'an extraordinary increase in the price of land in New York City' (ibid., p.16). In 1845 average prices were \$0.48 per square foot while by 1900 the average stood at \$5.85 (a 1,200 per cent increase).

Similarly, Case (1997, in Glaeser and Quigley, 2009) examination of land values in the Boston area over the 1900 to 1997 period suggested superior returns. According to this research, real growth in the price of land in the area was 3.9 per cent per annum.

Allen (1988) assessed prices of freehold land in seventeenth and eighteenth century England. During the early period of Allen's study, land was considered the only long-term investment asset available (see also Neild, 2008). By the advent of the eighteenth century, however, the impact of overseas trade altered the situation. New long-term financial assets, for example government bonds, East India company shares and mortgages, came into the market. As a result, land lost its appeal and no longer commanded a premium. The net return from land fell in line with other interest rates. For example, in the period 1600-1624 net returns were 4.63 per cent and 10 per cent on land and mortgages respectively, but the gap contracted in early eighteenth century. Between the years 1704 and 1713, land generated 4.81 per cent net returns while mortgages offered 5.50 per cent. For the period 1805-1814, net returns were 2.82 per cent and 5.0 per cent on land and mortgages respectively.

Offer (1991) examined tenure and landownership in England. His research covered the period from the 1750s to 1950s. He asserted that land, due to its finite supply, is a 'positional asset' and can confer social, political and economic authority in addition to its monetary returns. Nevertheless, status notwithstanding, Offer was puzzled by the economic rationale behind farmland investment. In England, as he commented, land was sold at a higher multiple (years of purchase, or YP) than government securities. Even allowing for its ancillary consumptive advantages, the premium exceeded rational explanation. Offer therefore criticised Allen's (1988) comments that a large YP was not sufficient to conclude that land was overpriced and suggested just the opposite. According to Offer, agriculture is volatile. It is a subject to unpredictable external and internal factors. Yet its output



was rated as being more secure (driving a higher YP) than income guaranteed by the crown (ibid., p.1), though investment in land was not comparable with the advantages which the money of a successful business man can command (ibid., p.15).

Lloyd (1992) used time series (error-correction, co-integration and ARIMA) modelling techniques to model land prices in England and Wales. The author employed the Oxford Institute Series for the period 1859-1990. Lloyd's estimates suggested that returns on farmland are adequate. The real rate of return on farmland (with changes in rents) stood at 3.6 per cent per annum over the 132 year period. Lloyd hypothesised that short run dynamic behaviour of land prices was influenced by changes in rents while being less responsive to inflation. These values were in line with Burt's (1986) findings. In his study of the land market in the United States, Burt estimates that the capitalization rate for farmland prices had averaged 4 per cent.

However, as with Eicholtz (1997), Wheaton et al. (2009) and Devaney(2010),Lloyd (1992)detected bouts of land market exuberance. To document his point, Lloyd (ibid., p.13) quoted Sturmeys(1955) remarks: "*the history of English Farming over the lifetime of those living in 1900-39 suggested that, even if it was the Cinderella among industries in peace, in war-time pumpkins turned into carriages of gold and glass slippers were made to fit its feet, so that any farming venture commenced in the early war years was likely to show substantial returns before the prince Charming tired of his bride and sent her back to the hearth. For the investor this meant largely the chance of capital profits on the realisation of properties when the war might end*".

Despite these efforts, it appears from our literature search that compared to other asset classes the evolution of land prices is currently an under-researched area. Re-examination of this topic is therefore called for.

The new research described in this paper generates a long-term farmland price series for England. The motivation is an interest in producing a longitudinal land price series and examining the performance of this asset class over two centuries, enabling a comparison with other traditional (speculative) assets.

## **Data**

In the UK, land price/value related series are provided (as is the case for other real estate sectors) by both public and private organisations. One of the best UK land prices series is produced by Savills. Savills reports two series. The first is farmland values for England, Scotland and Wales. This data-set is based on the quarterly valuation of a static portfolio of 9 types of bare land with vacant possession in 25 regions across Great Britain by a panel of Savills agricultural

valuers. The most recent data covers both arable and livestock land across eight different areas of Britain and is available from 1992 (Savills, 2015).

Second is a long term farmland values series, which is one of the longest indicators available. This series is available from 1900 annually in current and at 2017 (forecast) prices (Savills, 2013). Its predecessor is the Oxford Institute Series, which recorded annual average prices for vacant possession and tenanted land sold at auction. This was a pioneering work carried out by D.K. Britton and J.T. Ward and continued by G.H. Peters and A.H. Maunder who initiated the study on land prices (Farmland Market, 2006). The Oxford Institute Series are available in the public domain with data going back to 1945. The series was taken over by Savills research department in 1989 and extended to 1900 (Walsh, 2001).

Knight Frank (KF) (2015) produces its own English Farmland Index. It is an opinion-based index, compiled quarterly by Knight Frank's Farms & Estates and Valuations staff in the UK. According to the Knight Frank report, the index tracks the price performance of bare agricultural land without dwellings or buildings. The index is available from 2003. Knight Frank also reports farmland prices in pounds (£) per acre, with the series going back to 1963.

The IPD (2014) UK Annual Rural Property Index is another farmland series. It measures ungeared total returns to direct investment in a sample of tenanted farmland. The index is available from year 1981. At December 2013 the index contained 4,208 assets/estates covering 338,340 acres of land, with a total capital value of £3.1bn. The index covers eight regions including the South East, South West, Eastern, East Midlands, West Midlands, Yorks & Humberside, North West & North East, and what IPD calls 'Other' regions, as well as 'all UK'.

The RICS/RAU (2014) Farmland Price Index for England and Wales (CALP/RICS series) offers an alternative to commercial data-sets. This is a transaction-based series which contains any transactions reported to the RAU which are of 5 hectares and above, and includes all types of farms, with or without buildings and residential property, as long as the residential element of the sale price is less than 50%. These rules are those adopted by the Ministry of Agriculture, Fisheries and Food (MAFF), forerunner to Department for Environment, Food and Rural Affairs (DEFRA), when it set up a land price series in 1973, to which the RICS index is a successor (from 1995). The price information is supplemented by an opinion survey on prices for arable and pasture land, by region and nationally, together with opinion on supply and demand. The RICS/RAU (RICS, 2014) index is considered as being the only independent indicator of market movements in the UK.

In addition to current land prices series, there is a number of historical land price indices available, including Thompson's (1907) series on the average rent per acre of agricultural land from 1800 to 1900; Oxford Institute (available from Lloyd,

1992) dataset on prices (per hectare) of agricultural land in England and Wales for the 1850-1990 period; and DEFRA (2006) agricultural land sales and price series for England from 1944 to 2004.

<b>Series</b>	<b>Basis</b>	<b>Time-period</b>	<b>Measurement unit</b>
Savills	Valuation based	1900-2015	£/acre
Knight Frank	Opinion based	1965-2015	£/acre
IPD	Valuation based	1981-2015	£/acre
RICS/RAU	Transaction based	1994-2015	£/hectare
Norton et al. (1889)	Sales prices	1781-1880	£/acre
Oxford Institute	Sales prices	1859 - 1990	£/hectare
DEFRA(2006)	Sales prices	1944 - 2004	£/hectare

## **Methodology**

Clearly, existing land market series present some disparities. Some can be questioned as they are produced by commercial organisations with an interest in promoting the asset class. The series vary in duration; they cover different periods; their composition methodology also differs. To alleviate UK farmland market data variation and gain a greater appreciation of the UK farmland performance over long period of time, the current study produces a combined series.

Savills offers a land price benchmark which stretches over more than a century. As noted, it is one of the best series available in the UK. The current study, however produces an alternative and currently maintained independent land price indicator which covers a longer period of time. The research uses this new dataset to investigate the long-term performance of land prices in England, and compares land price returns with alternative investment assets, including equities and gold.

### ***Annual chain-linking***

To produce an alternative land price series, the study combines existing series into one using an 'annual chain-linking' approach. Chain-linking is not the only methodology available to link series and different authors used different methods to achieve this aim. Liesner (1989) for example used the simplest series combination solution. She (ibid., p.271) 'used simple average estimates as the central point to construct national accounts'. In other words, Liesner simply averaged overlapping series which, as Savage et al. (2012) point out, is statistically insufficient.

Gruneberg and Hughes (2005) and Vivian (2007) employed more robust series blending techniques, involving correlation analysis to detect which of the series

had a greater statistical relationship. Vivian used correlation analysis to check data validity and identify the appropriate time series to link.

For theoretical and empirical reasons, however, Chain-Linking is considered as a better series combination approach (OECD, 2005). According to the OECD (ibid., p.97), an advantage of chain linking is that it is joining together two indices that overlap in one period by rescaling one of them to make its value equal to that of the other in the same period, thus combining them into a single time-series. Chain linking has been used by major organisations, including the Scottish Government (2007), ONS (Tuke and Reed, 2001) and the World Bank (2012), to construct long-term economic series. McKenzie (2006) indicated that in the year 2006, 14 out of 29 OECD countries used some sort of linking methodology for index combination.

Tuke (2002) and Robjohns (2006) underscore the two major principles underpinning the chain-linking methodology: these are fixed base year chain-linking and annual chain-linking. Fixed base year chain-linking uses a set of weights which are applied to each component to produce an aggregate measure. This method revises weights every 5 years. However, in a changing economy, it may not be adequate, as this approach does not reflect the current state of the market. Therefore, annual chain-linking is recommended to measure aggregate figures more frequently. As the name suggests, rebasing is performed every year.

Stutely (2010) suggests a four-step algorithm for chain-linking index numbers: (i) identify a time period/point at which series overlap; (ii) divide the rebased series by the base value; (iii) multiply the rebased series by the result; (iv) apply the rebasing principle on the rest of the series. Mathematically, this algorithm can be expressed as follows:

$$I_t = \frac{I_t}{1 + \frac{I_t - I_t}{I_t}} \quad (1)$$

where  $I_t$  is new chain-linked series,  $I_t$  is the base series,  $I_t$  is the series which is re-based, and  $t$  is time period.

Equation 1 is used when the current series is a base and an older data-set is being re-based. In other words, chain-linking moves into the past.

<b>Year</b>	<b>RICS Series</b>	<b>Defra series</b>	<b>Defra series (%)*</b>	<b>Old index rebased</b>	<b>Chained index</b>
1992		3617.00	4.81	3791.06/(1+4.81%)	4397.41
1993		3791.06	11.55	5141.50/(1+11.55%)	4609.03
1994	5141.50	4229.04			5141.50
1995	5437.75				5437.75
1996	6704.75				6704.75
1997	7301.25				7301.25
1998	7065.50				7065.50
1999	7025.75				7025.75
2000	7103.50				7103.50

\* the percentage series are growth numbers estimated using the following equation:  
 $\Delta_{t,t-1} = \frac{Q_t}{Q_{t-1}} - 1$ , where  $Q_{t,t}$  is the current value of the series and  $Q_t$  is the value of the series in a following period

**Performance measurement**

When observing efficient markets (Fama, 1965; Fama et al., 1969; Fama, 1970), the asset price should incorporate all available information and expected future earnings from that asset (Malkiel, 2003). This premise of the efficient market hypothesis (EMH) has been well documented (Shiller, 2003; Malkiel, 2003) suggesting that economic agents make rational decisions (Thaler and Sunstein, 2009; Kahneman, 2012).

While, theoretically, English farmland buyers should consider only the economic aspects of their investments, i.e. the expected and required income returns and capital growth from farmland, it is well known that property markets are not entirely efficient (Case and Shiller, 1989; Shiller, 2014). Presumably, the land market is also afflicted by information asymmetry, lemons and the agency problem (Anglin and Arnott, 1991; Case et al., 1993; Wong et al., 2012). What is more, as noted above, although land values are at the core of urban economics, land values series have been inadequate and fragmented (Albouy and Ehrlich, 2013).

The present research produces a price series with a focus on capital returns to characterise the past. It examines price changes during the research period disregarding the income received from the farmland. For this longitudinal analysis, a standard formula was adopted to estimate percentage changes of the English farmland prices over time. The formula adopted is as follows (Baum and Hartzell 2012):

$$Q_t = Q_{t-1} - \Delta_{t,t-1} Q_{t-1} \tag{2}$$

where  $R_t$  is asset returns over the time period  $t$ ,  $P_t$  is the current value of the asset at the time period  $t$ , and  $P_{t-1}$  is the value of an asset at the previous time period.

However, as commented by Baum and Hartzell (ibid.), a total return should incorporate income received from that asset:

$$TR_t = R_t + I_t - \frac{P_t - P_{t-1}}{P_{t-1}} \quad (3)$$

where  $TR_t$  is the total return of an asset and  $I_t$  is the income received from time  $0$  to  $t$ .

As noted,  $I_t$  is not included in the current study.

Following on from this, the mean capital (price) returns on farmland are determined. There are two traditional methods of calculating average return, i.e. the arithmetic mean and geometric mean (Anson et al., 2011). The arithmetic mean is the sum of all returns divided by the number of observations:

$$\bar{R}_t = \frac{1}{T} \sum_{t=1}^T R_t \quad (4)$$

where  $\bar{R}_t$  is the average return on an asset over the period  $t$ .

The geometric mean uses compounding to estimate return which is estimated as follows:

$$\bar{R}_t = \sqrt[T]{(1 + R_1) * (1 + R_2) * ... * (1 + R_T)} \quad (4)$$

where  $\bar{R}_t$  is a return for the geometric mean.

This is the single average rate of return required to allow an investment made at the start of the period to accumulate to the same end value as the individual year returns would produce. This study uses the geometric mean to reflect the compounding nature of this measure and its likely application to forecasting.

### ***Series construction***

The study uses four independent series which are chain-linked, the process starting with the most recent series. First is a RICS/RAU farmland price series (£ per hectare) for the 1994-2013 period (RICS, 2014). This series is accepted as the basis for the future chain-linked data-set. Second is DEFRA's (2006) average price of agricultural land in England which is available for the 1944-2004 period. The third series is the Oxford Institute's series of land prices which is available for the 1859-1990 period from Lloyd (1992). The last data-set is Norton, Trist and Gilbert's (1889) average price (£ per acre) of agricultural land from 1781 to 1880.

Linking various available series allows the construction of a land price dataset which goes back to end of the eighteenth century. However, this approach has some limitations. A long-term series combination is imperfect unless the data sources and method employed are identical, which is not the case. Annual chain-linking is a mechanical procedure and combines series disregarding their heterogeneity. Nonetheless, correlation analysis was employed to dissect the comparability of the series.

First, the CALP/RICS farmland price series was extended by chain-linking it with DEFRA's (2006) farmland series. The correlation coefficient over the period 1994-2004, when the two series overlap, is 0.88 which indicates very strong positive correlation. It is therefore suggested that these series can be successfully linked together. The combined series was then extended by chain-linking it with the Oxford Institute series. The correlation analysis over the 1944-1990 period when both series overlap indicates almost perfect positive correlation with a correlation coefficient of 0.99. Figure 2 shows that these datasets appear to be almost identical. Accordingly, by chain-linking both series, the farmland series was extended to 1859. Finally, the Oxford Institute's land price series was chain-linked with Norton's et al. (1889) average price of agricultural land, extending the series to 1781. (A limitation, however, is that the Oxford Institute and Norton et al. series are less correlated, which a correlation coefficient of 0.43.)

Figure 2 graphs all four series.

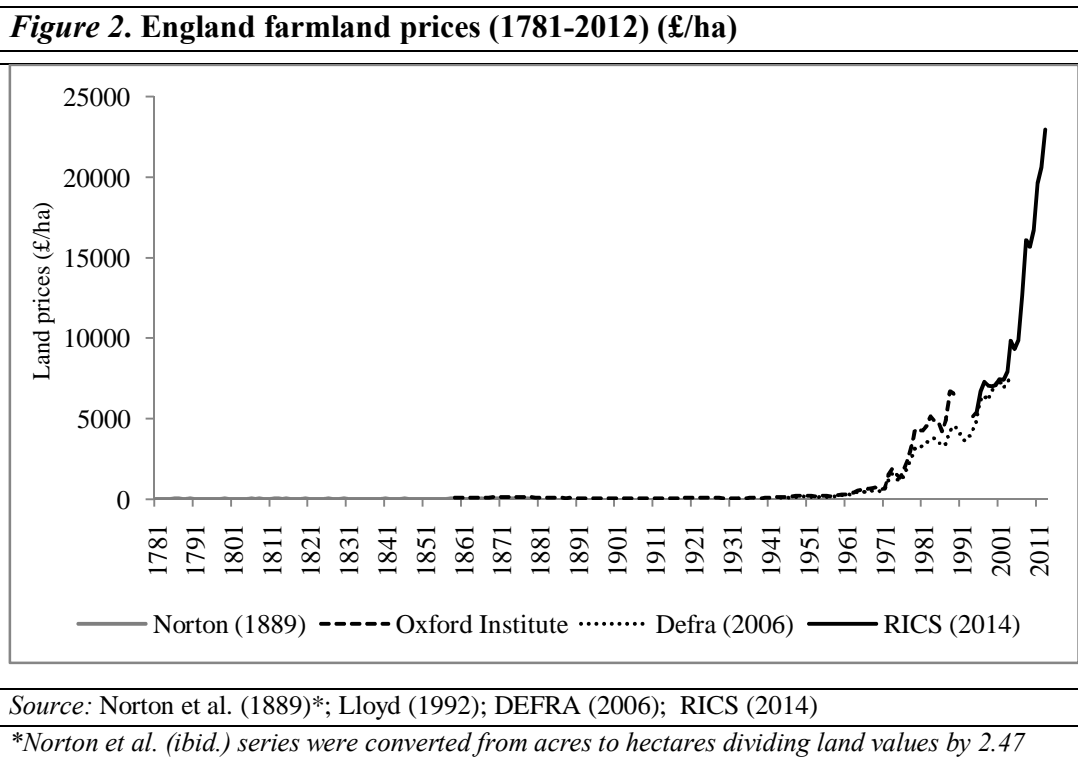


Table 4 presents the key statistical properties of selected series and their correlation estimates.

<b>Table4. Series summary statistics and correlation estimates</b>				
<b>Summary statistics</b>	<b>Series</b>			
	Norton et al. (1889)	Oxford Institute	DEFRA (2006)	RICS (2014)
Mean	37	686	2365	11092
Median	35	96	12723	8619
Std. Deviation	11	1494	2421	5510
Kurtosis	1	6	-1	0
Skewness	1	3	1	1
Range	65	6670	7561	17816
Minimum	8	47	93	5142
Maximum	73	6717	7654	22957
Count	100	132	61	20
<b>Correlation coefficients</b>	Norton et al. (1889)	Oxford Institute	DEFRA (2006)	RICS (2014)
Norton et al. (1889)	1	N/A	N/A	N/A
Oxford Institute	0.43	1	N/A	N/A
DEFRA(2006)	N/A	0.99	1	N/A
RICS (2014)	N/A	N/A	0.88	1

## Results

### *UK farmland price growth*

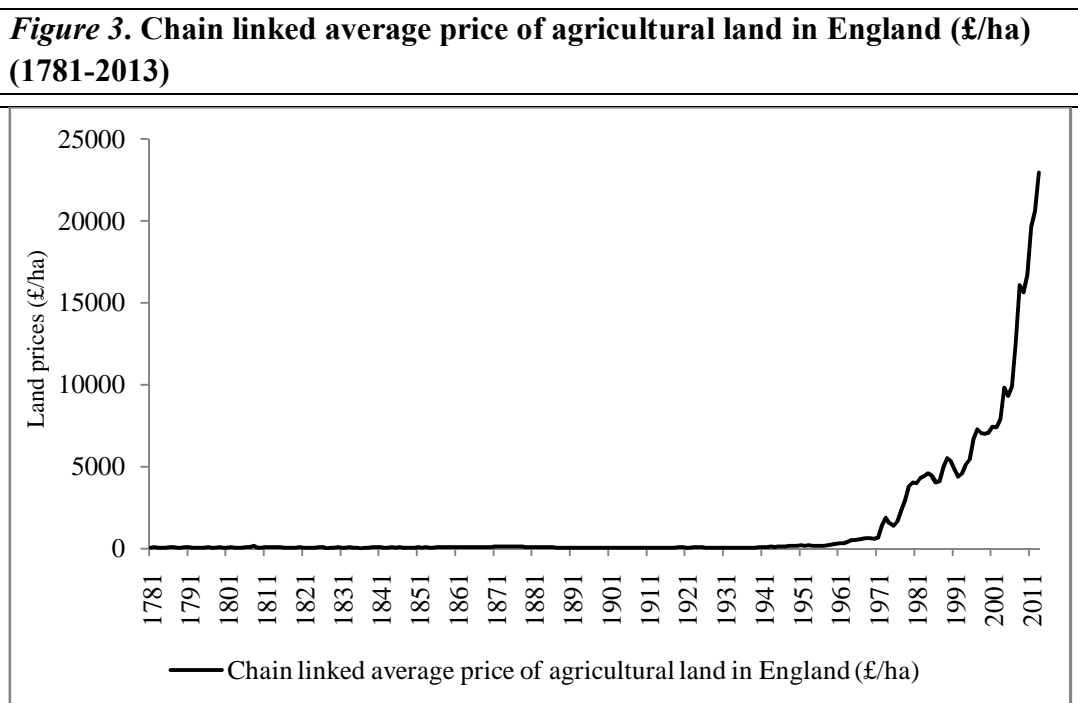
The Figure 3 below presents a 233-year nominal series of the average price of agricultural land in England. It is evident that farmland hardly appreciated until the 1970s. For Lloyd (1992) and Francis (2000) the key historical influences on land prices in England after the WWII were British government policy and inflation. Interventions to encourage domestic production and state protectionism attracted institutional investors and high net wealth individuals (HNWI) to farmland and stimulated demand, and inflation clearly drives land prices.

In this policy and inflationary milieu, the UK's accession to the European Community ushered in a new era of volatility (Lloyd, 1992; Francis, 2000). Demand, fuelled by the extension of trade links (Francis, *ibid.*) was compounded by two oil crises during 1973-74 and 1978-81 (Lee and Ni, 2002) which stoked food and commodity prices (Cooper and Lawrence, 1975) and pushed land prices higher. Following Lloyd (*ibid.*, p22.), the combined effect of soaring inflation, economic recession and CAP support mechanisms had dramatic ramifications on the land market and led to the most turbulent period in the market's history since the frenetic activity in the 1920s. On the supply side, seeing land price inflation



farmers were reluctant to sell their land, which further elevated land prices. Ironically, rather than heralding in a new era of agricultural stability and prosperity, disequilibrium and turbulence characterised UK land markets in the 1970s (Francis, *ibid.*). Land prices inflated by 145 per cent between 1970 and 1973, and 66 per cent between 1975 and 1979.

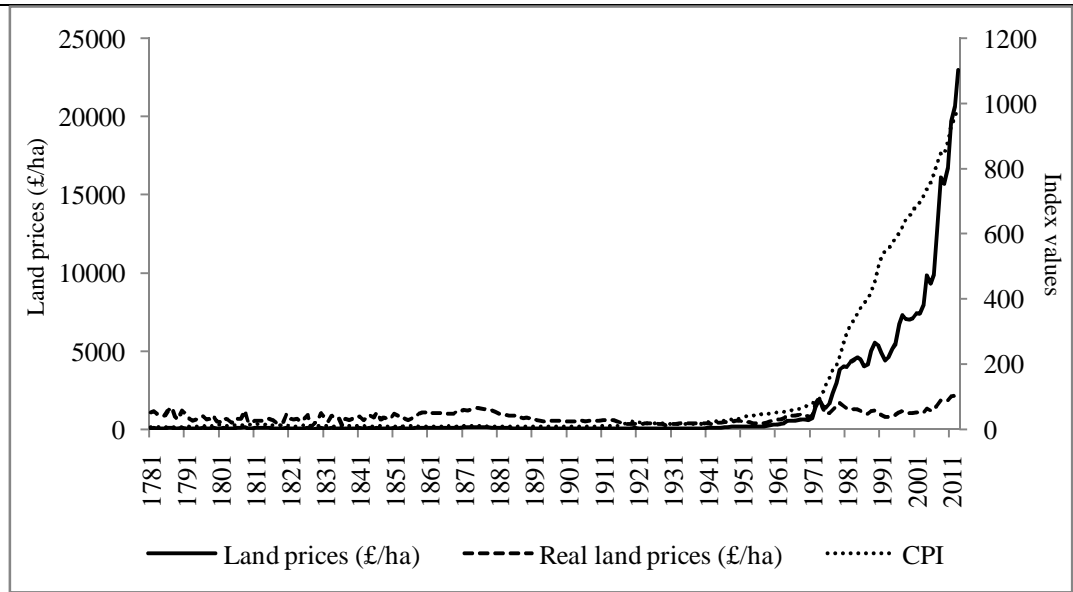
Following a hiatus in the 1980s and 1990s, more recently the cost of farmland in the UK has risen (Jadevicius and Martin, 2014). Figures from the RICS/RAU (2014) Rural Land Market Survey suggest that average land values increased by 3 per cent to £9,594 per acre (£23,217 per hectare) in the first half of 2014. Land prices were 12 per cent higher compared to the same period in 2013. Compared to 1994, when RICS/RAU began recording rural land prices, land values have increased 400 per cent from £2,028 per acre (£4,908 per hectare).



### ***UK farmland real price growth***

The impressive growth in farmland prices depicted in Figure 3 is further strengthened by looking at real price performance over the research period shown in Figure 4 and Table 5. Certainly, English farmland prices have experienced interchanging eras of growth and decline. The 1801-1945 period saw negative real price growth of -0.09 per cent. Growth however accelerated between 1946 and 1970 when real values advanced by around 2.45 per cent per annum. Over the 1971-2013 period land values remained almost unchanged. During the overall 1781-2013 period, average real land price growth was 0.33 per cent.

**Figure 4. Actual and real agricultural land prices in England (£/ha) (1781-2013)**



\*The historical inflation data comes from O'Donoghue et al. (2004) and the ONS (2014)

\*\* The series were transformed into real by deflating nominal values by CPI index using the following equation:  $\bar{P}_t = \frac{P_t}{I_t} * 100$ , where  $\bar{P}_t$  is real value,  $P_t$  is nominal value and  $I_t$  is price index at the time period  $t$  (O'Donoghue et al., 2004; Dallas Fed, 2014)

**Table 5. Nominal and real land price growth**

<b>Nominal land price growth</b>					
	<b>Mean(G)</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max</b>	<b>Count</b>
1781 - 2013	2.52	26.24	-84.00	200.00	232
1801 -2013	2.76	25.72	-84.00	200.00	213
1801-1945	0.37	28.93	-84.00	200.00	145
1946 - 1970	6.74	8.94	-12.20	32.83	25
1971 -2013	8.81	19.44	-18.25	103.33	43
<b>Real land price growth</b>					
1781 - 2013	0.33	26.56	-82.95	194.06	232
1801 -2013	0.71	26.17	-82.95	194.06	213
1801-1945	-0.09	29.87	-82.95	194.06	145
1946 - 1970	2.45	9.65	-14.12	28.54	25
1971 -2013	2.42	18.20	-29.56	89.80	43

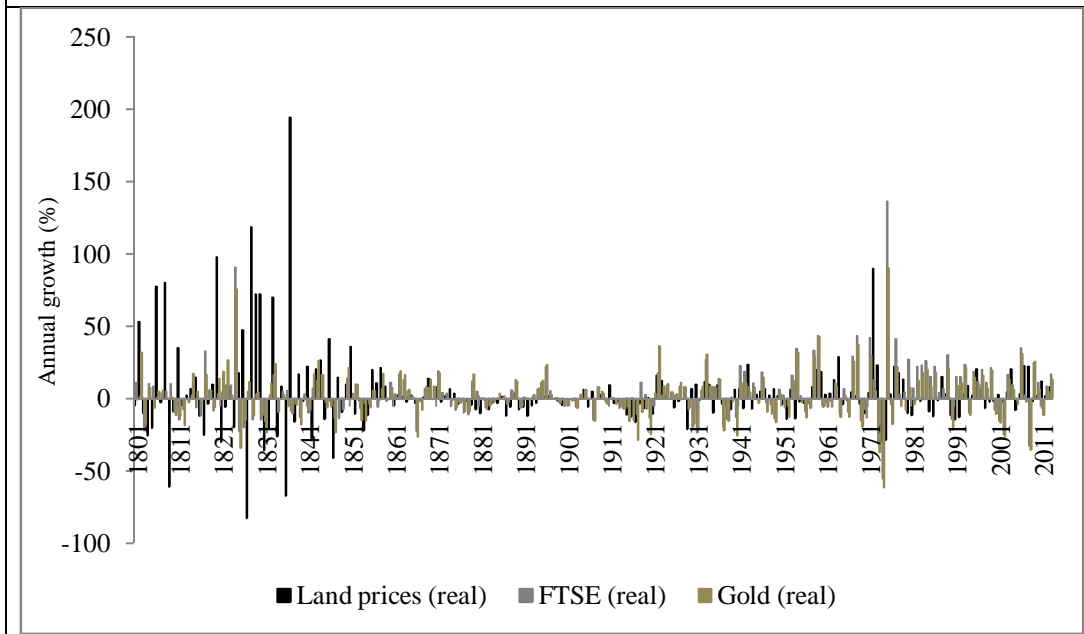
\* Growth is a geometric mean returns over the sample period.

Interestingly, these estimates are not far removed from other traditional asset classes including other forms of real estate. Real returns from UK farmland were close to returns on US Stocks and US (short term) Bonds respectively if compared to Siegel's (2014) estimates. According to Siegel, real capital appreciation of the US stock market was 1.6 per cent p.a. over the 1802-1997 period. As noted above, office rents in the City of London did not appreciate above inflation (Devaney,

2010), while Dutch house prices grew by 0.5 per cent p.a. in real terms over the three centuries (Eicholtz, 1997). Taking a long-term view, the escalation of UK farmland prices was significant, aligning with Dutch housing (Eicholtz, *ibid.*), and beating inflation, US commercial office values (Wheaton et al., 2009) and office rents in the City of London (Devaney, *ibid.*).

This farmland performance is further strengthened by comparing it with the performance of the FTSE index and the price of gold. The geometric mean of annual real price changes over the period 1801-2013 was 0.71 per cent for farmland, 0.45 per cent for the FTSE index and 0 per cent for gold.

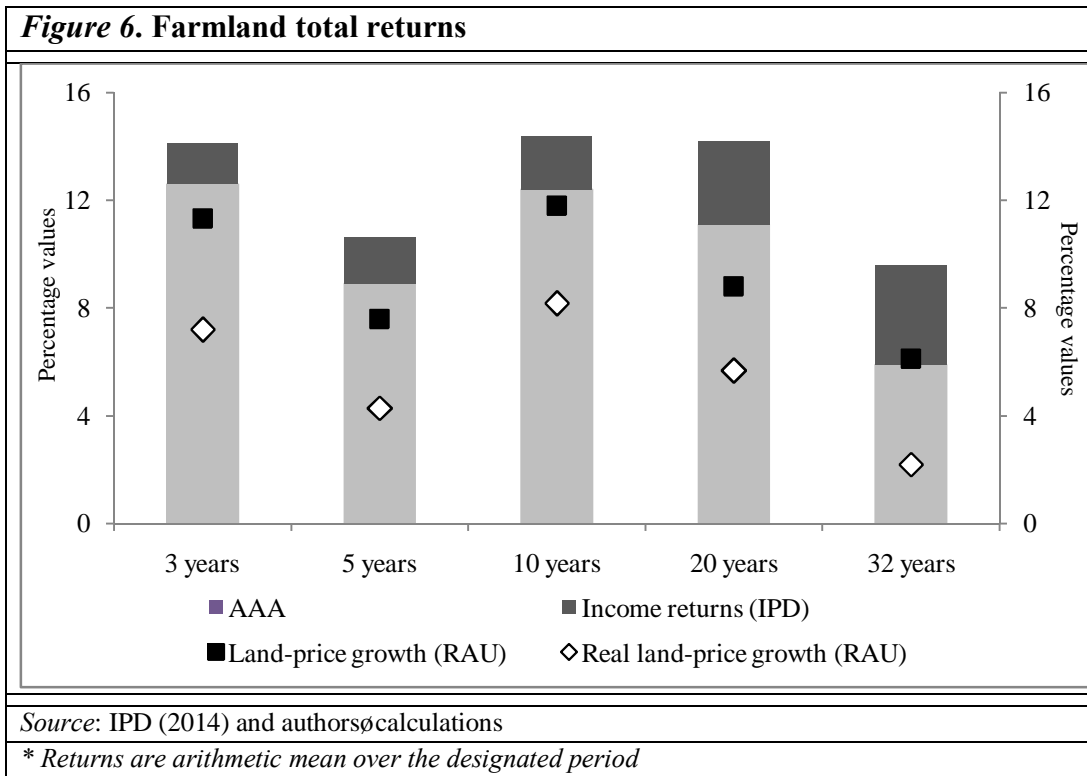
**Figure 5. Real values of agricultural land (£/ha), FTSE all share index and gold (\$/ounce) (1800-2013)**



### ***What about farming income?***

The incorporation of farm income returns would certainly enrich the current study. IPD (2014) addresses this issue by including income return and capital growth into its UK Annual Rural Property Index. This adds around 2 per cent to the total annual returns from a farmland (Figure 6). Unfortunately, IPD's data goes back to 1988 only. By addressing this so called 'performance measurement' issue (Baum and Hartzell, *ibid.*, p.475) and adding income returns into the total return formula, the results suggest that farmland can generate total returns ahead of inflation if actively managed/rented. If not farmed, farmland is more like gold, due to its low correlation with other financial asset returns (Painter, 2010; Kuethe et al., 2013).

Correlation coefficients were -0.061 and 0.126 between land price growth and the FTSE index and the price of gold respectively; low correlations were also observed between real land price growth and other assets, i.e. -0.004 and 0.185 with equities and gold.



## Conclusions

This research extended the English farmland price series to cover the past two centuries of data. It cuts information asymmetry for investment analysts, farmers, developers, planners and other stakeholders. Notwithstanding issues around long-run chain component heterogeneity, the combined series illuminates English average farmland price dynamics and changing land market fortunes. The work shows that farmland real price growth was 0.33 per cent annually from 1781 to 2013 and 0.71 per cent from 1801 to 2013 as measured by the geometric mean. Second, land offers comparative returns to other (speculative) assets.

For the series construction, we adopted a chain-linking approach. The constituents for the longitudinal data-set were Norton's et al. (1889) average price per acre of agricultural land, the Oxford Institute/Savills land prices series (Lloyd, 1992), DEFRA's (2006) average price of agricultural land in England, and RICS/RAU's farmland price series.

Though the analysis presented here ignores rental income and the various tax advantages of holding land, we found that land provides investors a safe haven or competitive hedge against inflation.

Beyond the scope of this paper, it also appears that in addition to its investment benefits, land offers investor landholders status and other substantive consumption services which may further explain the recent surge in interest in the asset class by global investors and wealthy individuals. Future work will consider these missing softer variables, plus rents and tax benefits, in order to examine long term total returns to farmland in England.

## References

- Albouy, D. and Ehrlich, G. (2013) *The Distribution of Urban Land Values: Evidence from Market Transactions*. Working paper, University of Illinois, pp.34.
- Allen, R.C. (1988) The Price of Freehold Land and the Interest Rate in the Seventeenth and Eighteenth. *The Economic History Review, New Series*, Vol.41, No.1, pp.33-50.
- Ambachtsheer, J., Pollice, R., Waitzer, E. and Vanderpol, S. (2013) *Building a long-term shareholder base: assessing the potential of loyalty-driven securities*. Mercer LLP, Stikeman Elliott LLP, and the Generation Foundation report, pp.34.
- Anglin, P.M. and Arnott, R. (1991) Residential real estate brokerage as a principal-agent problem. *The Journal of Real Estate Finance and Economics*, Vol.4, No.2, pp.99-125.
- Anson, M.P.J, Fabozzi, F.J. and Jones, F.J (2011) *The Handbook of Traditional and Alternative Investment Vehicles: Investment Characteristics and Strategies*. John Wiley & Sons, Inc., pp.528.
- Atack, J. and Margo, R.A. (1996) *Location, Location, Location!" The Market for Vacant Urban Land: New York 1835-1900*. NBER Historical Working Paper No.91, pp.31.
- Bailey, I. (2013) *The appeal of farmland* [Internet]. Available at: <[http://www.savills.co.uk/research\\_articles/173558/144152-0](http://www.savills.co.uk/research_articles/173558/144152-0)>, [Accessed 04 December 2014].
- Ball, M. and Tsolacos, S. (2002) UK commercial property forecasting: the devil is in the data. *Journal of Property Research*, Vol.19, No.1, pp.13-38.
- Ball, M., Lizieri, C.M. and MacGregor, B.D. (1998), *The Economics of Commercial Property Markets*. Routledge, UK, pp. 416.

- Barber, C., Robertson, D. and Scott, A. (1997) Property and Inflation: The Hedging Characteristics of U.K. Commercial Property, 1967-1994. *Journal of Real Estate Finance and Economics*, Vol.15, No.1, pp.59-76.
- Barras, R. (2009) *Building Cycles: Growth and Instability (Real Estate Issues)*. 1st.ed., Wiley-Blackwell, pp.448.
- Baum, A.E. and Hartzell, D. (2012) *Global Property Investment: Strategies, Structures, Decisions*. Wiley-Blackwell, pp.559.
- Bill, P. (2013) *Planet Property*. Matador, pp.250.
- Bloomberg (2015) *World Stock Indexes* [Internet]. Available at: <<http://www.bloomberg.com/markets/stocks/world-indexes/>>, [Accessed 13 February 2015].
- Brooks, C. and Tsolacos, S. (2010) *Real Estate Modelling and Forecasting*. Cambridge University Press, pp.474.
- Burt, O.R. (1986) Econometric Modelling of the Capitalization Formula for Farmland Prices. *American Journal of Agricultural Economics*, Vol.68, No.1, pp. 10-26.
- Case, K. (1997) *Measuring Urban Land Values*. Wellesley College Working Paper No.97-10. In: Glaeser, E.L. and Quigley, J.M. (2009) *Housing Markets and the Economy: Risk, Regulation, and Policy*. Lincoln Institute of Land Policy, pp.432.
- Case, K.E. and Shiller, R.J. (1989) The Efficiency of the Market for Single-Family Homes. *The American Economic Review*, Vol.79, No.1, pp.125-137.
- Case, K.E., Shiller, R.J. and Weiss, A.N. (1993) Index- Based Futures And Options Markets In Real Estate. *The Journal of Portfolio Management*, Vol.19, No.2, pp.83-92.
- Cooper, R.N. and Lawrence, R.Z. (1975) The 1972-75 Commodity Boom. *Brookings Papers on Economic Activity*, Vol.6, No.3, pp.671-724.
- Dallas Fed (2014) *Deflating Nominal Values to Real Values: How to remove the price effect from a data series or change nominal data to real values*[Internet]. Available at: <<http://www.dallasfed.org/research/basics/nominal.cfm>>, [Accessed 04January 2015].
- DEFRA (2006) *Agricultural Land Sales and Prices in England* [Internet]. Available at: <<http://archive.defra.gov.uk/evidence/statistics/foodfarm/farmgate/agrilan dsales/documents/alp.xls>>, [Accessed 03 December 2013].

- Devaney, S. (2010) Trends in office rents in the City of London: 1867-1959. *Explorations in Economic History*, Vol.47, No.2, pp.198-212.
- Dimson, E., Marsh, P. and Staunton. M. (2002) *Triumph of the Optimists: 101 Years of Global Investment Returns*. Princeton University Press, pp.352.
- Dimson, E., Marsh, P. and Staunton. M. (2003) *Triumph of the Optimists*. Arrowstreet Capital, LP., pp.7
- Dimson, E., Marsh, P. and Staunton. M. (2014) *The growth puzzle*. Credit Suisse Global Investment Returns Yearbook 2014, pp.17-29.
- Edel, M. and Sclar, E. (1973) *The Distribution of Real Estate Value Changes: Measurement and Implications, Metropolitan Boston 1870-1970*. Boston Studies in Urban Political Economy, Working Paper No.4, pp.164.
- Eicholtz, P. (1997) A Long Run House Price Index: The Herengracht Index 1628-1973. *Real Estate Economics*, Vol.25, No.2, pp.175-192.
- F. Black, (1986) Noise. *Journal of Finance*, Vol. 41, No.3, pp.529-543.
- Fama, E. and Schwert, G.W. (1977) Asset returns and Inflation. *Journal of Financial Economics*, Vol.5, No., pp.115-146.
- Fama, E.F. (1965) The Behavior of Stock-Market Prices, *The Journal of Business*, Vol.38, No.1, pp.34-105.
- Fama, E.F. (1970) Efficient Capital Markets: A Review of Theory and Empirical Work, *The Journal of Finance*, Vol.25, No.2, pp.383-417.
- Fama, E.F., Fisher, L., Jensen, M.C. and Roll, R. (1969) The Adjustment of Stock Prices to New Information, *International Economic Review*, Vol.10, No.1, pp.28.
- Farmland Market (2006) Land Prices Series. No.65, pp.22-23.
- Francis, F.N. (2000) *An econometric model of land prices in England*. Unpublished PhD Thesis, University of Nottingham, pp.234.
- Freshwater, D. (2013) *The Future Global Food Situation and Its Financial Implications for US Agriculture: Is This Time Different?* AEC Staff Papers No.484, pp.
- FTSE/EPRA (2015) *FTSE EPRA/NAREIT Global Real Estate Index Series*[Internet]. Available at:<<http://www.ftse.com/products/indices/epra-nareit>>, [Accessed 09 April 2015].
- Generation (2011) *A Manifesto for Sustainable Capitalism*. Generation Investment Management LLP, pp.4.
- Generation (2012) *Sustainable Capitalism*. Generation Investment Management LLP Report, pp.27.

- GFD (2015) *Equities to 1693* [Internet]. Available at: <[https://www.globalfinancialdata.com/Databases/Data.html#Equities\\_to\\_1693](https://www.globalfinancialdata.com/Databases/Data.html#Equities_to_1693)>, [Accessed 09 February 2015].
- Gruneberg, S. and Hughes, W. (2005) UK construction orders and output: A comparison of government and commercially available data 1995-2001. *Journal of Financial Management of Property and Construction*, Vol.10, No.2, pp.83-93.
- Hand, D., Mannila, H. and Smyth, P. (2001) *Principles of Data Mining*. The MIT Press, pp.546.
- Hartzell, D., Hekman, J.S. and Miles, M.E. (1987) Real Estate Returns and Inflation. *Real Estate Economics*, Vol.15, No.1, pp.617-637.
- Hoesli, M. (1994) Real Estate as a Hedge against Inflation: Learning from the Swiss Case. *Journal of Property Valuation and Investment*, Vol.12, No.3, pp.51-59.
- Hoesli, M., Lizieri, C. and MacGregor, B.D. (2008) The Inflation Hedging Characteristics of US and UK Investments: A Multi-Factor Error Correction Approach. *The Journal of Real Estate Finance and Economics*, Vol.36, No.2, pp.183-206.
- Holden, K., Peel, D.A. and Thompson, J.L. (1991) *Economic Forecasting*. Cambridge University Press, pp.224.
- Hoyt, H. (1933) *One hundred years of land values in Chicago. The relationship of the growth of Chicago to the rise in its land values, 1830-1933*. The University of Chicago, US, pp.452.
- IPD (1999) *The UK Property Cycle - A History from 1921-1997*. Investment Property Databank / the Royal Institution of Chartered Surveyors, London, pp.57.
- IPD (2014) *IPD UK Annual Rural Property Index* [Internet]. Available at: <<http://www.ipd.com/indices/index.html?country=UK&col=2>>, [Accessed 15 November 2013].
- Jadevicius, A. and Martin, D.N. (2014) *Univariate time-series modelling of UK farmland prices*. 21st Annual Conference of the European Real Estate Society (ERES), Bucharest, Romania, pp.14.
- Kahneman, D. (2012) *Thinking, Fast and Slow*. Penguin, pp.512.
- Knight Frank (2015) *English Farmland Index – Q1 2015* [Internet]. Available at: <<http://content.knightfrank.com/research/157/documents/en/q1-2015-2810.pdf>>, [Accessed 05 November 2013].



- Kuethe, T.H., Walsh, N. and Ifft, J. (2013) *Farmland versus Alternative Investments Before and After the 2008 Financial Crisis*. Journal of the ASFMRA, pp.120-131.
- Lee, K. and Ni, S. (2002) On the dynamic effects of oil price shocks: a study using industry level data. *Journal of Monetary Economics*, Vol.49, No.4, pp.823-852.
- Liesner, T. (1989) *One hundred years of economic statistics: United Kingdom, United States of America, Australia, Canada, France, Germany, Italy, Japan, Sweden*. Economist Publications, London, pp.344.
- Lizieri, C.M. (2009) *Towers of Capital: Office Markets and International Financial Services*. 1st.ed., Wiley-Blackwell, UK, pp.344.
- Lloyd, T. (1992) *Present value models of agricultural land prices in England and Wales*. Unpublished PhD thesis, University of Nottingham, pp.347.
- LSE (2015) *FTSE ALL-SHARE* [Internet]. Available at: <<http://www.londonstockexchange.com/exchange/prices-and-markets/stocks/indices/summary/summary-indices.html?index=ASX>>, [Accessed 09 February 2015].
- Makridakis, S., Wheelwright, S.C., and Hyndman, R.J. (1998) *Forecasting: Methods and Applications*. 3rd.ed., John Wiley & Sons, Inc., pp.642.
- Malkiel, B.G. (2003) The Efficient Market Hypothesis and Its Critics. *Journal of Economic Perspectives*, Vol.17, No.1, pp.59-82.
- Malkiel, B.G. (2005) Reflections on the Efficient Market Hypothesis: 30 Years Later. *Financial Review*, Vol.40, No.1, pp.1-9.
- Marshall, W. (1790) *The rural economy of the Midland counties: including the management of livestock in Leicestershire and its environs; together with minutes on agriculture and planting in the district of the Midland Station; Vol.2*. Printed for G. Nichol, pp.482.
- Matysiak, G., Hoesli, M., MacGregor, B.D. and Nanthakumaran, N. (1996) The long-term inflation-hedging characteristics of UK commercial property. *Journal of Property Finance*, Vol.7, No.1, pp.50-61.
- McGough, T. and Tsolacos, S. (1995) Forecasting commercial rental values using ARIMA models. *Journal of Property Valuation & Investment*, Vol.13, No.5, pp.6-22.
- McGough, T. and Tsolacos, S. (2001) *Do Yields Reflect Property Market Fundamentals?* REFIG working paper series (REFIG WP 2001-01), Cass Business School, pp.15.

- McGough, T. and Tsolacos, S. (2002) *Modelling the development sector of the property market*. In Guy, S. and Henneberry, J. (2002) *Development and Developers: New Perspectives on Property (Real Estate Issues)*. Blackwell Science Ltd., pp.320.
- McKenzie, R. (2006) *Review of Linking Practices for the Index of Industrial Production in OECD Countries*. The Organisation for Economic Co-operation and Development, Paris, pp.12.
- Mehra, R. (2003) *The Equity Premium: Why is it a Puzzle?* National Bureau Of Economic Research Working Paper 9512, pp.40.
- Mehra, R. and Prescott, E.C. (1985) The Equity Premium: A Puzzle. *Journal of Monetary Economics*, Vo.15, No.2, pp.145-161.
- Mitchell, J., Solomou, S. and Weale, M. (2011) *Monthly GDP Estimates for Inter-War Britain*. Cambridge Working Papers in Economics (CWPE), University of Cambridge, pp.30.
- Mouzakis, F. and Richards, D. (2004) *Modelling rents in key European office markets - modern panel data techniques versus traditional approaches*. REFIG working paper series (REFIG WP 2004-04), Cass Business School, pp.30.
- MSCI (2015) *MSCI World Real Estate Index* [Internet]. Available at: <[http://www.msci.com/resources/factsheets/index\\_fact\\_sheet/msci-world-real-estate-index.pdf](http://www.msci.com/resources/factsheets/index_fact_sheet/msci-world-real-estate-index.pdf)>, [Accessed 13 February 2015].
- Neild, R. (2008) *Riches and Responsibility: The Financial History of Trinity College, Cambridge*. Ganta Editions, Cambridge, p.180.
- Norton, Trist and Gilbert (1889) *A century of land values: England and Wales*. The Times, pp.128-131, In: Carus-Wilson, E.M. (1962) *Essays in Economic History, Vol.3*. Edward Arnold, pp.401.
- O'Donoghue, J., Goulding, L. and Allen, G. (2004) *Consumer Price Inflation since 1750*. Economic Trends No.604, Office for National Statistics, pp.38-46.
- OECD (2005) *CHAIN LINKING* [Internet]. Available at: <<http://stats.oecd.org/glossary/detail.asp?ID=5605>>, [Accessed 155 November 2013].
- Offer, A. (1991) Farm Tenure and Land Values in England, c. 1750-1950. *The Economic History Review, New Series*, Vol.44, No.1, pp.1-20.
- Officer, L.H. and Williamson, S.H. (2015) *The Price of Gold, 1257 - Present. MeasuringWorth* [Internet]. Available at: <<http://www.measuringworth.com/gold/>>, [Accessed 09 February 2015].

- Oltmans, A.W. (2007) *A new approach in farm business analysis to fit a changing farmland investment market*. International Farm Management Association (IFMA) Congress Proceedings, pp.152-157.
- ONS (2014) *Consumer Price Inflation, June 2014* [Internet]. Available at: <<http://www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2014/index.html>>, [Accessed 10 November 2014].
- Painter, M.J. (2010) The Portfolio Diversification Impact Of A Farmland Real Estate Investment Trust. *International Business & Economics Research Journal*, Vol.9, No.5, pp.115-124.
- Ricardo, D. (1821) *On the Principles of Political Economy and Taxation*. 3rd.ed., John Murray, London, pp.333.
- RICS (1999) *The UK Property Cycle - a History From 1921 to 1997*. The Royal Institution of Chartered Surveyors, London, pp.57.
- RICS/RAU (2014) *RICS/RAU Rural Land Market Survey & Land Prices* [Internet] Available at: <<http://www.rics.org/uk/knowledge/market-analysis/ricsrau-rural-land-market-survey-h2-2013/>>, [Accessed 10 November 2014].
- Robjohns, J. (2006) Methodology Notes: Annual chain-linking. *Economic Trends*, No.630, pp.25-28.
- S&P (2015) *Dow Jones Global Select Real Estate Securities Index* [Internet]. Available at: <<http://www.djindexes.com/realestate/>>, [Accessed 13 February 2015].
- Savage, S.L., Danziger, J. and Markowitz, H.M. (2012) *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty*. Wiley, pp.416.
- Savills (2013) *Market in Minutes: Q2 Farmland Market*. Available at: <<http://210.v3.savills-vx.com/pdfs/rural-mim-jul13.pdf>>, [Accessed 05 November 2013].
- Savills (2015) *Farmland Values* [Internet]. Available at: <<http://www.savills.co.uk/research/uk/rural-research/farmland-values.aspx>>, [Accessed 05 November 2013].
- Scott, P. (1996) *The Property Masters: A History of the British Commercial Property Sector*. 1st.ed., Taylor & Francis, pp.364.
- Scottish Government (2007) *Methodology Glossary - Tier 2 - Chain Linking* [Internet]. Available at: <<http://www.scotland.gov.uk/Topics/Statistics/About/Methodology/chainlinking>>, Accessed [14 April 2014].

- Shiller, R.J. (2003) From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives*, Vol.17, No.1, pp.83-104
- Shiller, R.J. (2006) *Irrational Exuberance*. 2nd.ed., Crown Business, pp.336.
- Shiller, R.J. (2014) *Speculative Asset Prices (Nobel Prize Lecture)*. Cowles Foundation Discussion Paper No. 1936, Yale University, pp.46.
- Siegel, J.J. (2014) *Stocks for the Long Run: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies*. 5th.ed., McGraw-Hill Professional, pp.448.
- Smith, E.L. (1928) *Common Stocks As Long Term Investments*. The Macmillan Company, pp.129.
- Solomou, S. (1998) *Economic cycles: Long cycles and business cycles since 1870*. Manchester University Press, UK, pp.112.
- Stevenson, S. (2007) A comparison of the forecasting ability of ARIMA models. *Journal of Property Investment & Finance*, Vol.25, No.3, pp.223-240.
- Sturme, S.G. (1955) 'The Sale Value of Farm Land', *The Farm Economist*, Vol.8, No.1, pp.19-26. In: Lloyd, T. (1992) *Present value models of agricultural land prices in England and Wales*. Unpublished PhD thesis, University of Nottingham, pp.347.
- Stutely, R. (2010) *The Economist Guide To Economic Indicators*. 7th.ed., Economist Books, pp.256.
- Taleb, N.N. (2008) *The Black Swan: The Impact of the Highly Improbable*. Penguin, pp.394.
- Thaler, R.H. and Sunstein, C.R. (2009) *Nudge: Improving Decisions About Health, Wealth and Happiness*. Penguin, pp.320.
- Thompson, R.J. (1907) An Inquiry into the Rent of Agricultural Land in England and Wales During the Nineteenth Century. *Journal of the Royal Statistical Society*, Vol.70, No.4, pp.587-624.
- Tuke, A. (2002) Analysing the effects of annual chain-linking on the output measure of GDP. *Economic Trends*, No.581, pp.26-33.
- Tuke, A. and Reed, G. (2001) The effects of annual chain-linking on the output measure of GDP. *Economic Trends*, No.575, pp.37-53.
- Valuation Office Agency (2011) *Property Market Report 2011* [Internet]. Available at: <[http://www.voa.gov.uk/dvs/\\_downloads/pmr\\_2011.pdf](http://www.voa.gov.uk/dvs/_downloads/pmr_2011.pdf)>, [Accessed 03 November 2014].
- Vivian, A. (2007) The UK Equity Premium: 1901-2004. *Journal of Business Finance & Accounting*, Vol.34, No.9/10, pp.1496-1527.

- Walsh, J. (2001) Agricultural land prices statistics and indicators. *Economic Trends*, No.571, Ministry of Agriculture, Fisheries, and Foods, pp.58-73.
- Wheaton, W.C., Baranski, M.S., Templeton, C.A. (2009) 100 Years of commercial real estate prices in Manhattan. *Real Estate Economics*, Vol.37, No.1, pp.69-83.
- Wilson, P.J., Okunev, J., Ellis, C. and Higgins, D.M. (2000) Comparing univariate forecasting techniques in property markets. *Journal of Real Estate Portfolio Management*, Vol.6, No.3, pp.283-306.
- Wong, S.K., Yiu, C.Y. and Chau, K.W. (2012) Liquidity and Information Asymmetry in the Real Estate Market. *The Journal of Real Estate Finance and Economics*, Vol.45, No.1, pp.49-62.
- Wooldridge, J.M. (2009) *Introductory econometrics: a modern approach*. Cengage Learning, pp.888.
- World Bank (2012) *Note on the Statistical Capacity Indicator* [Internet]. Available at: [http://siteresources.worldbank.org/INTWBDEBTSTA/Resources/Note\\_on\\_Statistical\\_Capacity\\_Indicator\\_BBSC\\_Nov2012.pdf](http://siteresources.worldbank.org/INTWBDEBTSTA/Resources/Note_on_Statistical_Capacity_Indicator_BBSC_Nov2012.pdf) >, Accessed [18 November 2014].
- World Bank (2014) *Agriculture, value added (% of GDP)* [Internet]. Available at: <http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS>>, [Accessed 10 November 2014].
- Yaffee, R.A. and McGee, M. (2000) *An Introduction to Time Series Analysis and Forecasting: With Applications of SAS and SPSS*. Academic Press, pp.528.