Two Centuries of Farmland Prices in England

Arvydas Jadevicius[*1], Simon Huston[*] Andrew Baum[**] and Allan Butler*

*Royal Agricultural University, Cirencester, United Kingdom

**Saïd Business School, University of Oxford, United Kingdom

Abstract

The dissemination of robust asset price data can help to improve market efficiency, resource allocation and investment analysis. Beyond commercial decisions, land prices influence housing affordability, food security or low carbon infrastructure. Yet price and return histories for farmland in England are fragmented. To provide perspective, a long farmland price series improves transparency and brings the asset class in line with available commercial and residential real estate. After reviewing the historical backdrop and considering methodology, the research used a chain-linking approach to construct a long-term farmland price series for England. It then adjusted the series for inflation to examine real land prices. The resulting two-century English farmland prices series contributes to farmland market analysis.

Notwithstanding some concerns with long-run chain component heterogeneity, the combined series illuminates English average farmland price dynamics. 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 contributes to understanding of land price dynamics and has policy implications.

Keywords: Chain-linking, Farmland, Prices, Returns, England.

[1]Corresponding author. E-mail: a.jadevicius@gmail.com

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'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

History demonstrates the complexity, contention and evolution of land, and its link to food security and power. For framers, investors and policy makers land price data is instructive. The research generates a long-term farmland price series for England and comments on price changes in the light of alternative investments.

The research illustrates the fluctuation of English farmland prices influenced by policy, social and economic forces. Broadly, over the past couple of centuries Western European farming divides into five distinct periods of agricultural protection: the era of laissez-faire; the great depression; the protectionist revival; the interwar years; and the post-war years (Tracy, 1982; Federico, 2005; Swinnen, 2009). Most European countries followed this pattern, although the UK charted a slightly different course. Following the 1846 repeal of the Corn Laws, which had imposed import tariffs on grain since the 15th century (Hill and Ingersent, 1982), the UK entered an extended era of laissez-faire that effectively ended in 1932. This period began with a 'golden age' of farming, which was relatively short-lived. Between 1870 and 1896, a 'great agricultural depression' led to the impoverishment of many UK farmers and some landlords (ibid.). In contrast, many European countries revived protectionist policies during the great agricultural depression but the UK continued its laissez-faire approach. It was only in response to food shortages, in the latter stages of the First World War, that policy changed temporarily. The introduction of the 1917 Corn Production Act afforded limited protection to agriculture through guaranteed prices for wheat and oats (Whetham, 1974). With repeal of the Act in 1921, the UK returned to its laissez-faire approach to agriculture. As the 'interwar years' continued, the first substantial agricultural market intervention, which signalled the end of the laissez-faire period, was the Wheat Act of 1932. Introduced to counteract a fall in world grain prices and above normal imports (Tracy, 1982), this act became the forerunner of modern farm support programmes (Mollett, 1960). This period also heralded a change in the relationship between UK government and the land since agricultural depression deepened and the likelihood of war with Germany increased (Smith, 1989). The Second World War solidified agriculture's strategic importance to the UK, which formed the basis of the watershed 1947 Agriculture Act (Bowers, 1985). Following this Act, agricultural protection became the norm in the 'post-war period'. However, it was not until the UK joined the EEC and the Common Agricultural Policy

(CAP) that the benefits of agricultural intervention were questioned (Smith, 1989; Bower, 1985).

Different factors interact to affect government intervention in agriculture including farm incomes; proportion of consumer spending on food; farm structure; political organization of farmers; and food shortages (Swinnen, 2009). Both theoretical modelling and empirical evidence support the notion that agricultural policy support payments become capitalized in farmland prices (Swinnen et al., 2008; Latruffe and Le Mouël, 2009). Floyd (1965) theorized that US farm price supports, improve returns to land under the following theoretical conditions: output is not controlled; use of non-tradable marketing restrictions; and that government compensates land removed from production. Alternatively, the theoretical analysis of Courleux et al. (2008) concluded that the Single Farm Payment (SFP) scheme, introduced as part of CAP reform in 2003, led to the capitalization of this payment into farmland prices. The most important factor driving this was the ratio of SFP entitlements to eligible hectares, but others included historical dimensions of previous payments; the elasticity values of land supply and the rate of mandatory set-aside. Empirical evidence tends to support theoretical underpinnings (Kilian et al., 2012). Although agricultural policies, particularly price support, are clear determinants of farmland prices others factors may be significant (Goodwin et al., 2003). Within the farm environment, agricultural commodity prices, farm expansion and farm size tend to drive farmland prices in many countries (Swinnen et al., 2008). Other land price influences include GDP, house prices, share prices, and local growth or decline (Livanis et al., 2006; Feichtinger and Salhofer, 2008).

The importance of good long-term economic and real estate data for market analysis is obvious and well documented (Hand et al., 2001; Wheaton et al., 2009; Wooldridge, 2009; Devaney, 2010; Mitchell et al., 2011). Data on the relative performance of various sectors and long-term time-series analysis can help improve market efficiency (Makridakis et al., 1998; Solomou, 1998). It also underpins investment modelling for, *inter alia*, food security, sustainable development and low carbon infrastructure (Granoff, et al. 2016). 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 parameterized 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.

UK data on commercial and residential property markets is plentiful. London is considered 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 is available at national and local levels, in various frequencies, regularities and length which allows for detailed and robust property market analytics. However, land value is distinct from site or property values with the latter including the former. Effectively, property is a composite good with appreciating land and depreciating buildings (Rambaldi *et al.* 2015) There is a growing interest from the property investment community in rural 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 as compared to residential or commercial series. Typically, data on land is collected for a single area or certain time-period (Albouy and Ehrlich, 2013).

Main contribution

The main contribution of this research is to redress the farmland price series information deficit. It generates a long-term land price series for England to inform landowners, investors, farmers, developers and policy makers. Superficially, the series suggests an acceleration of land price inflation. However, in recent times this could simply be an illusion due to differences in indices methodology construction. Without further research into performance of stocks and gold prior to war, it would be rash to suggest that land provides investors a relative 'safe haven' and better hedge against inflation compared to other asset classes. Clearly, land prices are subject to bouts of instability.

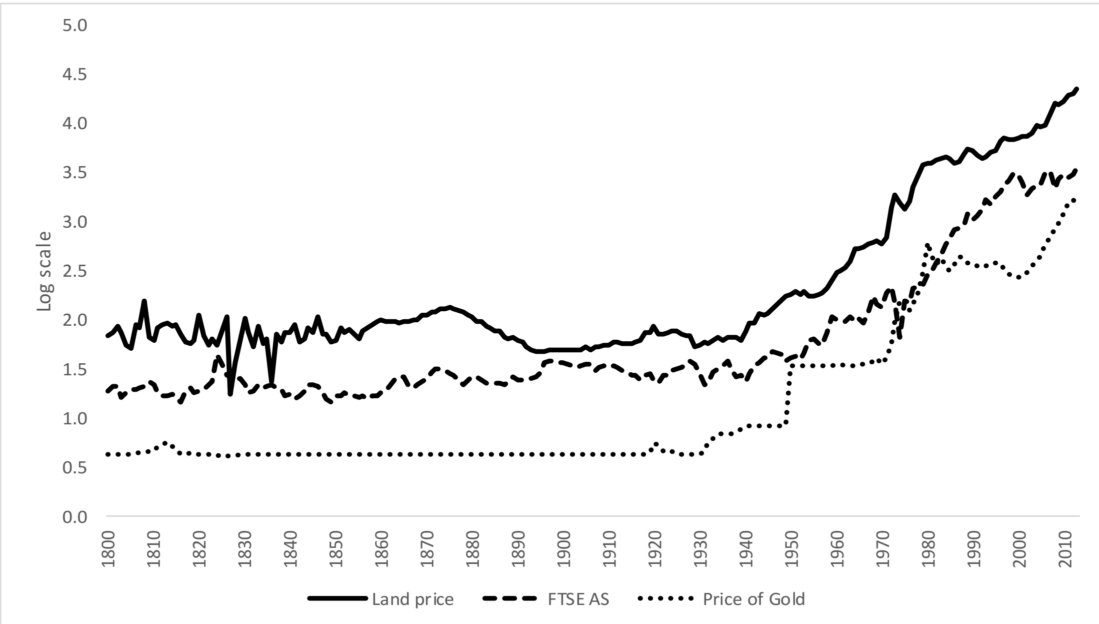
Nevertheless, as Table 1 and Figure 1 below illustrate, in aggregate, over the long-term, land appreciated. Figure 1 illustrates land prices between 1850 and 1920 didn't vary much year on year. Table 1 general growth statistics (1800-2013) does not picked up this sub-sample detail. Aggregate land price statistics also disregard net income and other land ownership benefits like tax, succession planning or status. Over the period 1800-2013, the range of returns to land were huge but the real geometric mean (see methodology section) of annual price changes was 0.71 per cent for land, 0.45 per cent for the FTSE index and 0.00 per cent for gold. Farmland real price growth was 0.33 per cent annually over extended 1781-2013 period. Over the nineteenth and mid-twentieth centuries, despite fluctuations, the three asset classes saw little real net appreciation until the early 1970s when 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 and gold prices were respectively 103 and 67 per cent higher. The FTSE followed, and in 1975 the All Share price index grew by136%. Positive real price growth slowed in the 1990s but resumed over the most recent decade.

Table 1. Nominal and real growth for farmland and gold prices and stock market index

Nominal price growth (1800-2013)					
	Mean(G)	**Std. Dev.**	**Min.**	**Max**	**Count**
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
Real price growth (1800-2013)					
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.

Figure 1. Nominal values of agricultural land (£/ha), FTSE all share index and gold ($/ounce) (1800-2013)



Source: FTSE All Share series come from GFD (2015) and LSE (2015); Gold series are derived from Officer and Williamson (2015).

* Land prices in £/ha

** FTSE All Share series is 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)

Literature review

In order the evaluate the relative performance of land compared to other asset classes and gain insights into the land price dynamics, the research reviews a range of economic, real estate and industry literature. Benjamin Franklin famously said, “You may delay, but time will not, and lost time is never found again” (Gilbert 1895, p. 582). The diverse literature also invokes a long-term view for land price analysis (Makridakis et al., 1998; Solomou, 1998; Generation, 2011; 2012; Ambachtsheer et al., 2013).

Stocks and bonds

In this section, we refer to previous work reporting returns on asset types. In doing so, we will use the term 'return' to mean the total return – income plus capital appreciation measured annually. We will also discuss real returns (returns net of inflation).

To measure total return, we need evidence of annual income (dividends for stocks, coupons or interest payments for bonds, and rent for real estate). The absence of this evidence, limits us to a study of capital appreciation, or a price series. It is important to bear in mind this distinction between series of total returns and prices.

We begin our discussion with evidence of long-term stock and bond returns, which is reasonably plentiful. For example, 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. Siegel (2014) urged investors to take a long-term view of returns by demonstrating that stocks provided real annual returns of five per cent over the last 200 years. Stocks outperformed other traditional investment assets including bonds and gold.

Earlier, Mehra and Prescott (1985) and Mehra (2003) 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 returns for equities of seven per cent. The authors originated 'the equity premium puzzle' – the phenomenon for US stock returns to be considerably higher than rationally can be accounted by their relative volatility compared to returns for Treasury Bills.

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 survivorship bias and focus on periods that with hindsight are known to have been successful. As such, Dimson et al. (ibid.) advocated a greater international diversification across various asset classes.

Real estate returns and prices

Historically, Clark (2002) explores the complex evolution of UK housing markets over the extended period 1550–1909. The more recent, commercially orientated literature, re-affirms real estate's dynamic complexity (Ball et at., 1998; Baum and Hartzell, 2012; Bill, 2013). One problem with identifying bubbles in asset markets is the lack of sufficiently long-term data to detect if asset prices deviate significantly from fundamental values. (Ambrose *et al.* 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) studied the 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. 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 (now MSCI) (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. Annualized property returns over the 1970-1997 period stood at 12.3 per cent, while returns for gilts and equities were surprisingly both respectively higher at 13.1 and 16.8 per cent over the same period. Within these returns, nominal income return varied between four per cent (in 1949) and 9.1 per cent (1993) producing two-thirds of the nominal total returns, with capital growth averaging less than three 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. After, adjusting the transaction values for inflation, their 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 displaying similarities to Wheaton et al.'s (ibid.) observations for the US, with real rental growth over the 92-year period close to zero (0.1 per cent p.a.).

Land prices

In 1821, Ricardo and Von Thunen (1826) made first contributions to systematic study of land prices (McDonald and McMillen 2011.). 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, highlighting farmland market heterogeneity.

Four other challenges complicate farmland valuation. The first is options around the transition into development land. Politics, the vagaries of planning and urban population growth muddy the waters of peri-urban agricultural land markets but it would be unwise for investors to bet on always realising planning gains or 'unearned increments'. Second, the post-Brexit subsidy regime is uncertain (Swinbank, 2017). Third, as well as its diversification benefits, land investment provides significant tax deferral advantages (Oltmans, 2007; Bailey, 2013; Freshwater, 2013). Finally, land and its associated country pursuits enhance social status (Lund 2016).

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's (1997, in Glaeser and Quigley, 2009) examination of land values in the Boston area over the 1900 – 1997 period suggested superior returns. According to Case, 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 beginning of eighteen 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, between 1600-1624 net returns on land and mortgages were respectively 4.63 per cent and 10 per cent. However, this gap contracted early in the eighteen century. Between the years 1704 and 1713, land generated 4.81 per cent net returns while mortgages offered 5.50 per cent. While for the later the period 1805-1814, net returns were 2.82 per cent and five 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' purchase, or YP) than government securities. Even allowing for its ancillary consumptive advantages, the premium exceeded rational explanation. Offer therefore criticized 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 suggest that total 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 hypothesized that changes in rents influences short run dynamic behaviour of land prices while it is 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 four per cent.

However, as with Eichholtz (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 Sturmey's (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 review that compared to other asset classes the evolution of land prices is currently an under-researched area. Therefore, a re-examination of this topic is needed.

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 organizations. 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 nine 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 (Britton, 1949; Ward, 1959) 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 using historical records Oxford Institute contained 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 MSCI (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 MSCI 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 five hectares and above, and includes all types of farms, with or without buildings and residential property, if 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 supplements the 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 several 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's (2006) agricultural land sales and price series for England from 1944 to 2004.

Table 2. UK land price series

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

Except for the IPD series, the focus of the work discussed in Table 2 is on price appreciation rather than on the measurement of total returns. This is unfortunate, as it makes a comparison of returns on different asset types including farmland impossible before 1981.

The scarcity of long run evidence of rental income from farmland may in time be rectified, although this will require significant primary research. It is explained partly by the widespread owner-occupation of farmland as opposed to tenanted farms producing income and by distortions created by rent controls. The government collects and publishes rent data, but only back to 2005; Savills also has a rent series, again covering only recent history. Our long-term study limits itself to prices.

Methodology

Clearly, existing land price series present some disparities. It is possible to question some as they are produced by commercial organizations 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, this study combines existing series into one using an 'annual chain-linking' approach. Chain-linking is not the only methodology available to link series as 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, whereas simple averaging distorts true dynamics of the series. Averaging is certainly an easy solution when combining overlapping series. However, the process does not consider individual series variations and related characteristics, such as seasonality or / and cyclicality. Gruneberg and Hughes (2005) employed a more robust series blending techniques, involving correlation analysis to detect which of the series had a greater statistical relationship. The authors used competing and overlapping construction series to build a reliable market series which commentators then used to model UK construction orders and output. Series viability was established from significant correlation coefficients.

For theoretical and empirical reasons, however, 'Chain-Linking' is considered as a better series combination approach. In contrary to series averaging, 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' (OECD, 2005, p.97). In other words, the chain linking technique combine two series without losing time-series properties.

Chain linking has been used by major organizations, 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 five 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:

$$Z_t = \frac{Y_t}{1 + \left(\frac{X_t - X_{t-1}}{X_{t-1}}\right)} \tag{1}$$

where Z_t is new chain-linked series, Y_t is the base series, X_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. Table 3 below illustrates an example.

Table 3. Example for chain-linking two series

Year	RICS Series	DEFRA series	DEFRA series (%)*	Old index rebased	Chained index
1992		3617.00	4.81	3791.06/(1+4.81%)	4397.51
1993		3791.06	11.55	5141.50/(1+11.55%)	4609.14
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:
$R_t = V_{t+1}/V_t - 1$, where V_t is the current value of the series and V_{t+1} is the value of the series in a following period *t*

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; 2005). This premise of the efficient market hypothesis (EMH) has been well documented (Shiller, 2003; Malkiel, 2003; 2005) 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 characterize 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):

$$R_t = (V_t - V_{t-1})/V_{t-1} \tag{2}$$

where R_t is asset returns over the time period *t*, V_t is the current value of the asset at the time period *t*, and V_{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:

$$TR_t = (Y_t + V_t - V_{t-1})/V_{t-1} \tag{3}$$

where TR is the total return of an asset and Y_t is the income received from time *0* to *1*.

As noted, Y_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:

$$\widehat{R_t} = \frac{1}{t}\sum_{t}^{1} R_t \tag{4}$$

where $\widehat{R_t}$ is the average return on an asset over the period *t*.

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

$$R(G) = \sqrt[t]{[1 + R_1] * [1 + R_2] * \ldots * [1 + R_t]} \tag{4}$$

where $R(G)$ 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

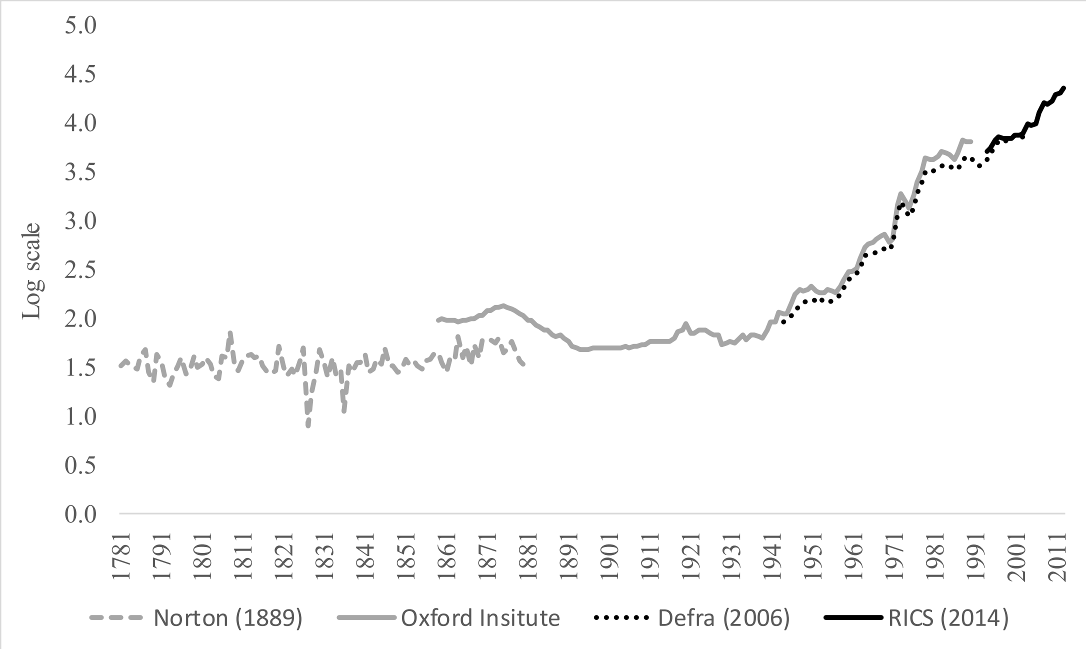
The study uses four independent series to construct long ranging English farmland series. First and the most recent RICS/RAU farmland price series (£ per hectare) for the 1994-2013 period acts as the basis for the future chain-linked data-set (RICS, 2014). Second is DEFRA's (2006) average price of agricultural land in England, available for the 1944-2004 period. Both combined series extend land prices time series from 2013 to 1944. The third series is the Oxford Institute's series of land prices, 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 helped to vet the series comparability.

First, the RICS/RAU farmland price series was extended by chain-linking it with DEFRA's (2006) farmland series. The correlation coefficient of the levels series over the period 1994-2004, when the two series overlap, is 0.88. Very strong positive correlation provides *premia facia* linking evidence. The combined series was then further 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. Unfortunately, it transpires that both Oxford Institute's and Norton's et al. series are not so well correlated, only registering a 0.43 correlation coefficient.

Figure 2 graphs all four series. Table 4 presents the key statistical properties of selected series and their correlation estimates.

Figure 2. England farmland prices (1781-2012) (£/ha)



Source: Norton et al. (1889); Lloyd (1992); DEFRA (2006); RICS (2014)
*Norton et al. (ibid.) series were converted from acres to hectares dividing land values by 2.47

Table 4. Series summary statistics and correlation estimates

Summary statistics	Series			
	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
Correlation coefficients	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

* Land prices (£/ha)
** Correlation in levels

Results

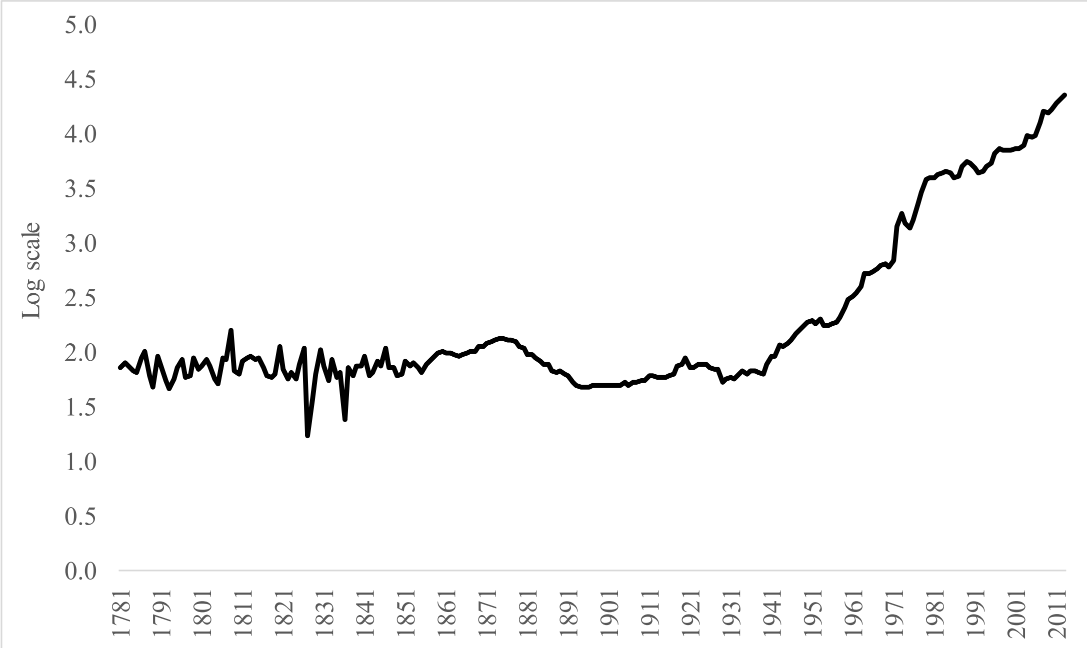
UK farmland price growth

The Figure 3 below presents a 233-year nominal series of the average price of agricultural land in England. The results suggest that, despite bouts of instability, farmland hardly appreciated until the 1970s. The introduction of the Town and Country Planning Act 1947, altered the dynamics of housing supply and inflated the value of peri-urban land outside green belts (Cheshire 2014). One possibility is that 'survivor's bias' could have generated spurious results. The phenomenon artificially inflates or deflates performance by restricting analysis to designated category assets (here restricted to continuously farmed land). In effect, the series could have side-lined farmland which transitioned from agriculture to urban development and hence ignored peri-urban planning gains, enabled by information and transportation technology. 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 characterized 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 three 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).

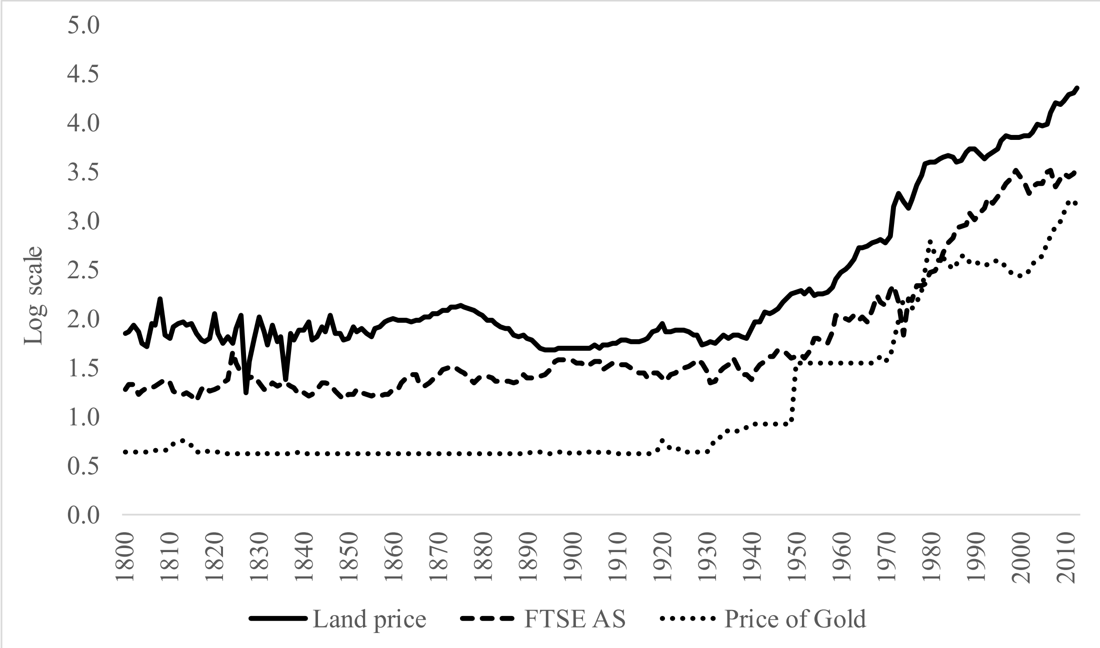
Figure 3. Chain linked average price of agricultural land in England (£/ha) (1781-2013)



UK farmland real price growth

The impression of substantial farmland price growth depicted in Figure 3 is 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. Visual series analysis suggests three distinct transition periods. 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 (as measured by the geometric mean) was 0.33 per cent.

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



Source: 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: $R_t = N_t/PI_t * 100$, where R_t is real value, $N_t$is nominal valueand $PI_t$is price index at the time period *t* (O'Donoghue et al., 2004; Dallas Fed, 2014)

Table 5. Nominal and real land price growth

Nominal land price growth					
	Mean(G)	**Std. Dev.**	**Min.**	**Max**	**Count**
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
Real land price growth					
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

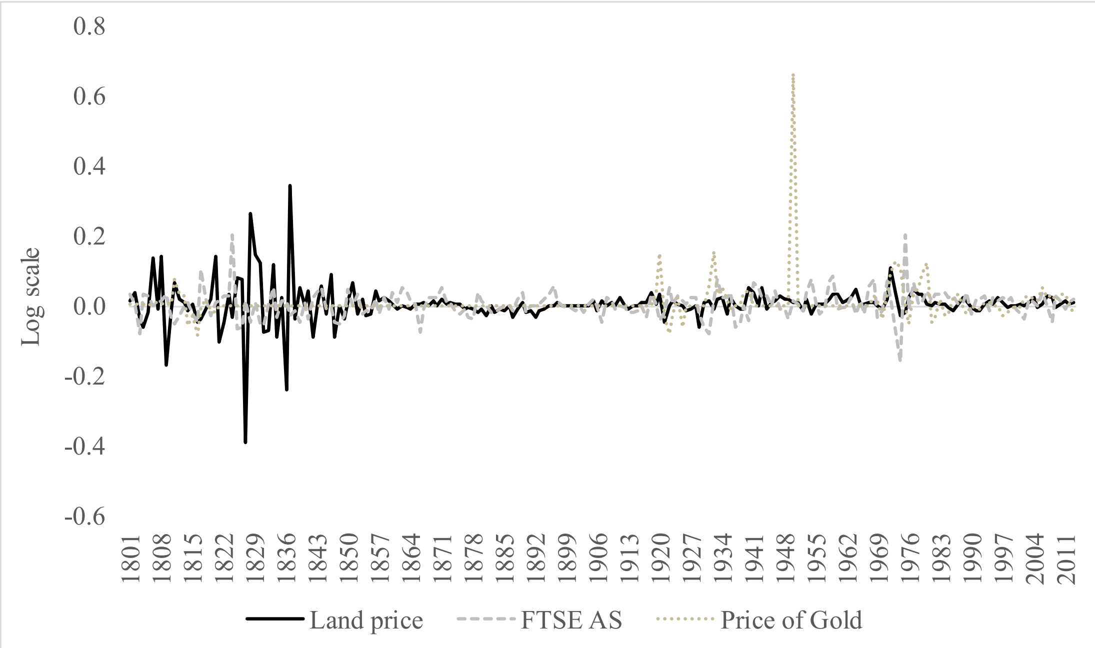
* Growth is a geometric mean returns over the sample period.

Interestingly, these estimates share similarities to 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 (Eichholtz, 1997). Taking a long-term view, the escalation of UK farmland prices was significant, aligning with Dutch housing

(Eichholtz, ibid.), and beating inflation, US commercial office values (Wheaton et al., 2009) and office rents in the City of London (Devaney, ibid.).

This evidence of farmland performance is more meaningful when it is compared 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 growth series of agricultural land (£/ha), FTSE all share index and the price of gold ($/ounce) (1800-2013)



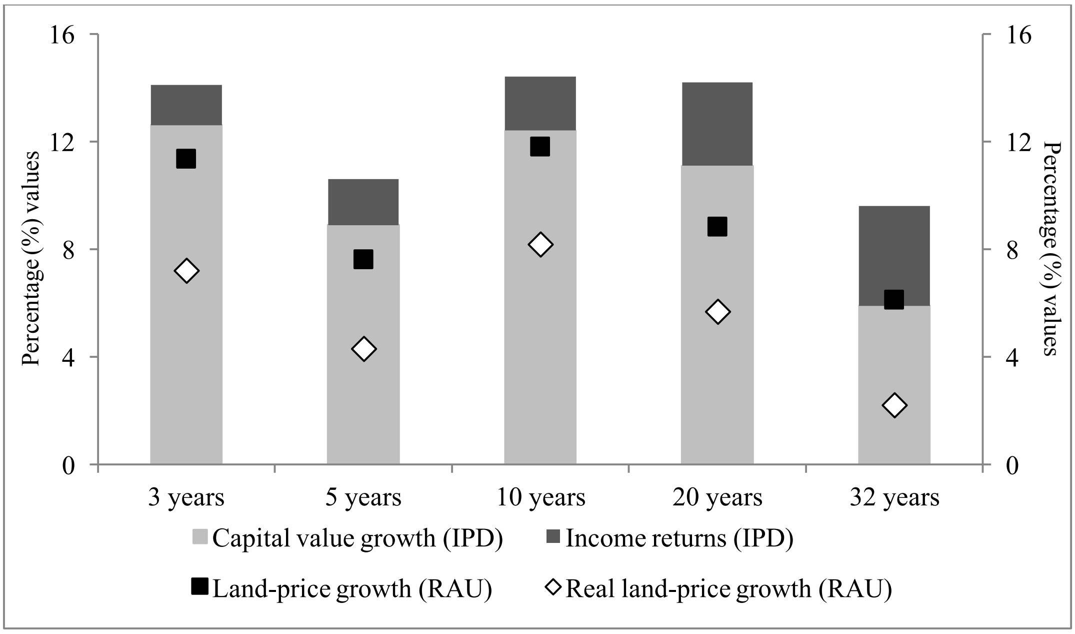
Source: FTSE series come from GFD (2015) and LSE (2015); Gold values obtained from Officer and Williamson (2015).

What about farming income?

The price series analyses exclude farm income whose incorporation would enable the computation of annual returns and would enrich the current study. MSCI (2014) does include income in its UK Annual Rural Property Index which boosts total annual returns from a farmland by about 1.5 per cent (Figure 6). Unfortunately, MSCI's data only stretches back to 1988. By addressing this so called 'performance measurement' issue (Baum and Hartzell, ibid., p.475), were an imputed income return added to price series, it is likely that even passively managed farmland total returns would comfortably exceed the inflation rate. In some respects, as a safe haven, farmland behaves 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.

Figure 6. Farmland total returns



Source: MCSI (2014) and authors' calculations
* Returns are arithmetic mean over the designated period

Conclusion

This research extended the English farmland price series to cover the past two centuries of data. The extended series helps to reduce information asymmetry and improve resource allocation for investment analysts, farmers, developers, planners and other stakeholders. The combined series illuminates English average farmland price dynamics and changing land market fortunes. The acknowledged issues around long-run chain component heterogeneity does not undermine the substantive contribution of the research to extend the UK series back. To construct the series, we adopted a chain-linking approach. The constituents for the longitudinal data-set were Norton's et al. average price per acre of agricultural land, the Oxford Institute land prices series, DEFRA's average price of agricultural land in England, and RICS/RAU's farmland price series. From 1781 to 2013, the geometric mean of UK farmland real price growth was 0.33 per cent annually. Later, from 1801 to 2013 growth accelerated to 0.71 per cent. The low correlation between the two earliest indices may not indicate a break but is likely due to different indices methodology. From the time series data, which ignores rental income and the various tax advantages of holding land, we infer that land, in aggregate, provided investors a 'safe haven' or hedge against inflation. To transform the times series into a robust investment performance measure would require inclusion of data on farm incomes, plot spatial heterogeneity and tax.

The linked series provides a springboard for further farmland price research, geared around the paper's limitations. First is macroeconomic modelling of farmland fundamental price drivers such as GDP or evidence of long-term rental income. Whilst Brexit has unsettled the forecasting landscape, models still facilitate informed comparison of returns on farmland with other asset types. The second research avenue is data-intensive farm-scale modelling to reflect spatially differentiated net income prospects. At the micro level, farm prices depend on expectations of long-run income streams from diverse sources, including production, transfer payments or peri-urban development opportunities. The final area for future farmland price research involves incorporating nuanced cultural and social dimensions of land holding in different settings.

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.

Ambrose, B. W., P. Eichholtz and T. Lindenthal, (2013), 'House Prices and Fundamentals: 355 Years of Evidence,' *Journal of Money, Credit and Banking*, 45, pp 477-491.

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>, [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.

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.

Black, F. (1986) Noise. *Journal of Finance*, Vol. 41, No.3, pp.529-543.

Bloomberg (2015) *World Stock Indexes* [Internet]. Available at: <http://www.bloomberg.com/markets/stocks/world-indexes/>, [Accessed 13 February 2015].

Bowers, J.K. (1985) British agricultural policy since the Second World War. *The Agricultural History Review*, Vol.33, No.1, pp.66-76.

Britton, D.K. (1949) The Sale Value of Farm Land Between the Wars. *The Farm Economist*, Vol.6, No.1, pp.125-133.

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.

Cheshire (2014) 'Turning houses into gold: the failure of British planning' LSE Centre Piece working paper spring 2014, available at: http://cep.lse.ac.uk/pubs/download/cp421.pdfhttp://cep.lse.ac.uk/pubs/download/cp421.pdf (accessed 20/01/17).

Clark, G. (2002). 'Shelter from the storm: housing and the Industrial Revolution. 1550–1909'. *The Journal of Economic History* 62 (2) pp. 489-511.

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.

Courleux, F., Guyomard, H., Levert, F. and Piet, L. (2008) How the EU Single Farm Payment should be modelled: lump-sum transfers, area payments or… what else? SMART–LERECO working paper No 08-01, available at: https://ideas.repec.org/p/rae/wpaper/200801.html [Accessed 07/02/17]

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/agrilandsales/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.

Eichholtz, P. (1997). A Long Run House Price Index: The Herengracht Index 1628-1973. *Real Estate Economics*, Vol.25, No.2, pp.175–192.

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.

Federico, G. (2005), *Feeding the World. Princeton*, University Press, Oxford, UK, pp.416.

Feichtinger, P. and Salhofer, K. (2011), *The Valuation of Agricultural Land and the Influence of Government Payments*. Factor Markets Working Paper No. 10, December 2011, Available at: http://aei.pitt.edu/58513/http://aei.pitt.edu/58513/ [accessed 07/02/17].

Floyd, J.E. (1965). The effects of farm price supports on the returns to land and labor in agriculture. *Journal of Political Economy*, Vol.73, No.2, pp.148-158.

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 09April 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>, [Accessed 09 February 2015].

Gilbert, J.H. (1895). *Dictionary of Burning Words of Brilliant Writers*: *Cyclopædia of Quotations from the Literature of All Ages.* Harvard University, W.B. Ketcham.

Goodwin, B.K., Mishra, A.K. and Ortalo-Magné, F.N. (2003), What's wrong with our models of agricultural land values? *American Journal of Agricultural Economics*, Vol.85, No.3, pp.744-752.

Granoff, I., Hogarth, J.R. and A. Miller (2016) 'Nested barriers to low-carbon infrastructure investment' *Nature Climate Change* 6, 1065–1071 doi:10.1038/nclimate3142

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.

Hill, B.E. and Ingersent, K.A. (1982), *An economic analysis of agriculture*. (2nd Edition). Heinemann Educational Books, London.

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.

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.

Kilian, S., Antón, J., Salhofer, K. and Röder, N. (2012), Impacts of 2003 CAP reform on land rental prices and capitalization, *Land Use Policy*, Vol.29, No.4, pp.789-797.

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.

Latruffe, L. and Le Mouël, C. (2009), Capitalization of government support in agricultural land prices: What do we know? *Journal of Economic Surveys*, Vol.23, No.4, pp.659-691.

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.

Livanis, G., Moss, C.B., Breneman, V.E. and Nehring, R.F. (2006). Urban sprawl and farmland prices. *American Journal of Agricultural Economics*, Vol. 88, No.4, pp.915-929.

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].

Lund, B (2016). Housing *Politics in the United Kingdom: Power, Planning and Protest*, Bristol, Policy Press.

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.

McDonald, J. and D. McMillen (2011). *Urban Economics and Real Estate: Theory and Policy*. 2nd.2nd edEd. John Wiley & Sons, 2011., pp. 551.

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.

Mollett, J.A. (1960), The Wheat Act of 1932 a Forerunner of Modern Farm Price Support Programmes, *The Agricultural History Review*, Vol.8, No.1, pp.20-35.

MSCI (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].

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>, [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. Measuring Worth* [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.

Rambaldi. A. , McAllister. R., Fletcher, C. (2015). 'Decoupling land values in residential property prices: smoothing methods for hedonic imputed price indices. Brisbane, The University of Queensland, *Economics Working Papers*, available at: http://www.uq.edu.au/economics/abstract/549.pdfhttp://www.uq.edu.au/economics/abstract/549.pdf (accessed 17/02/17).

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.

Smith, M.J. (1989), Changing agendas and policy communities: agricultural issues in the 1930s and the 1980s. *Public Administration*, Vol.67, No.2, pp.149-165.

Solomou, S. (1998) *Economic cycles: Long cycles and business cycles since 1870*. Manchester University Press, UK, pp.112.

Sturmey, 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.

Swinbank, A. (2017) *World Trade Rules and the Policy Options for British Agriculture Post-Brexit.* Briefing Paper 7, UK Trade Policy Observatory, University of Sussex, pp.12.

Swinnen, J., Ciaian, P. and Kancs, D.A. (2008), Study on the Functioning of Land Markets in the EU Member States under the Influence of Measures applied under the Common Agricultural Policy (No. 04/2008). *EERI Research Paper Series*.

Swinnen, J.F. (2009), The growth of agricultural protection in Europe in the 19th and 20th centuries. *The World Economy*, Vol. 32, No.11, pp.1499-1537.

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.

Tracy, M. (1982). *Agriculture in Western Europe; challenge and response 1880-1980* (2nd Ed.). Grandada Publishing, London, pp.419.

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.

Walsh, J. (2001) Agricultural land prices statistics and indicators. *Economic Trends*, No.571, Ministry of Agriculture, Fisheries, and Foods, pp.58-73.

Ward, J.T. (1959) *Farm Rents and Tenure.* Estates Gazette, London, pp.95.

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.

Whetham, E.H. (1974), The Agriculture Act, 1920 and Its Repeal—the" Great Betrayal". *The Agricultural History Review*, Vol.22, No.1, pp.36-49.

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 >, Accessed [18 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.