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Scientific Journal of Agricultural Economics

Welcome to the third volume of the *Scientific Journal of Agricultural Economics.*

In this issue we present three papers that address different aspects related to the rural sector, namely: poverty and small farmer distress; determinants of residential property prices in urban areas including proximity to countryside; and a novel methodological contribution to study farmers' strategic behaviour.

In particular, R.V. Ramanamurthy and Emmadi Naveen Kumar analyse the effects of the recent economic structural transition in India on the rural sector of this country. The focus is placed on small subsistence farmers and how these individuals have been affected in terms of productive choices, productivity, poverty, distress and lack of opportunities, among others. The article also offers a critical view of historical, political and economic factors that have shaped the trajectory of Indian's agrarian structure.

Adam Baxter, on the other hand, offers a hedonic model that was developed with the purpose of identifying relevant factors that explain residential property prices in the proximity of London. These factors were grouped in three classes, namely: structural characteristics (e.g. number of bedrooms); local infrastructure (e.g. proximity to schools); and local amenity (e.g. distance to woodland). The results by Baxter showed the influence of proximity to the countryside in determining residential property prices in the area under study.

Finally, Sara Arancibia, Alexander Abarca and Gonzalo Moya propose the use of the structural equations methodology based on Partial Least Square (PLS-SEM) to study farmers' strategic behaviour. In order to illustrate the potential of this methodology, the authors applied this technique to a sample of farmers in the UK with the purpose of identifying underlying factors that may influence farmers' environmental awareness.

We would like to thank the contributors to this third edition of the journal. We also look forward to the publication of future works in these and other areas related to agricultural economics and agribusiness. We also look forward to receiving contributions from our Third Annual Conference of Agricultural Economics and Agribusiness that will take place at Oxford University on 29th January 2015.

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R.V. Ramanamurthy and Emmadi Naveen Kumar

Small Farmer Economy and Their Crisis in Rural India: A Study in Three Villages

Abstract

The capitalist development in India during the neoliberal phase has brought out some of the fascinating and paradoxical dimensions in its capitalist transition. The incomplete structural transformation and largest share of workforce locked in agricultural sector with declining share in national income pose problems of extreme poverty and deeper inequality in the society. However, such distress is evidently transitory, confining more to section of small peasantry. Interestingly and paradoxically this phenomenon of small farmer distress, without any general crisis of production and productivity, yet poses serious viability crisis cannot be understood fully without a wider analysis of political economy of agrarian question. This is precisely the motivation behind this paper, which poses few questions such as how do we configure the location and dynamics of small peasantry and their struggle in India's agrarian structure and the agrarian transition. Besides the starvation, what are the characteristics of their enterprise and distress? What are the registers of state in which they figure in and how does the state address such problems in reproduction of its hegemony over masses in the neoliberal times? This paper brings evidence for some of the well known characteristics of growing small peasantry in rural Andhra Pradesh.

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Emergence of Small Peasantry and their Crisis Situation

An important change that has occurred in the structure of operational landholdings in the last sixty years (during 1950-2010) is that the share of small and marginal farmers has grown from 56 percent to 84 percent and the share of the area under them has increased from 18 percent to 49 percent. The share of medium farmers has gone down from 35 percent to 16 percent and the share of their landholding has declined from 54 percent to 45 percent. The share of big farmers has shrunk to less than 1 percent with landholding of around 6 percent (Various NSS Rounds). The underlying fact about the structure is that it is overwhelmingly dominated by a class of 'small/marginal-producer-farmers' – a section most vulnerable to the vagaries of markets, institutions and environment. Further, there is growing tenancy in canal irrigated areas, as a

section of medium farmers who played a crucial role during the green revolution has left agriculture by leasing out their lands (Parthasarathy, 2002). They are leasing their land to landless laborers and marginal farmers. Tenancy usually takes place through oral agreements and thus this section of tenants does not have any rights under the existing laws. These tenants, unrecognizable under law due to oral tenancy, are another major vulnerable group who lack access to institutional support. While there is no official data on the extent of tenancy, several primary studies have indicated that 70-80 percent of cultivators in coastal Andhra are tenant farmers accounting for more than 50 percent of land under them (Vijay, 2006; Ramachandran et al., 2010).

While increasing marginalization of agrarian structure in the state did not deter the growth neither production nor productivity. The production of food grains in the state has grown over 3 percent in the state in the post-liberalisation period, which is not only higher than the national growth rate, but higher compared to pre-liberasation period in the state, including `Green Revolution' period. Even the yield growth has kept well over 3 percent during 1983-00, even though there is slight decline in the last one decade. Most of the farmers who committed suicide are small and marginal farmers (Revathi and Galab, 2008). Though more suicides happened among cotton farmers, the general crisis of viability of farmers including foodgrains and non-food grains in the state has been noted by researchers (Ramanamurthy and Mishra, 2012). Thus the state represents this peculiar situation of an agrarian crisis of viability without production crisis that needs a careful examination. Micro details of suicides apart, the big picture in the neoliberal phase is the rise of small and marginal farmers' undertaking high risk crops, with degraded resources, and unsupported institutional structures (Sainath, 2012).

We shall now examine village level evidence for understanding the status of the small farmers, their socio-economic features, costs and returns to their agriculture, income levels, etc, in rural Andhra Pradesh in the succeeding sections.

Understanding Small Farmer`s Economy through Village level Study

Primary information on farm size, crops grown, costs and returns, employment, allied activities, non-agricultural employment and income, credit, welfare transfers, are collected from 454 households in the three villages of Andhra Pradesh. The data is collected during Feb-April 2012. The sample study covered 35 percent of the population households, which was based on a stratified random basis, where 35 percent of all caste households as well as all farm size classes are covered on random basis. The objective of the survey is to understand the economic conditions of small peasantry.

The three sample villages of this study namely, Achampet, Pulimaddi, and Kalavapamula, fall in the three regions of the state, Telangana, Rayalaseema and Coastal Andhra. The first two, Telangana and Rayalaseema are dominated by borewell irrigation, growing paddy under borewell conditions as well as several dry land crops. Achampet is a smaller Telangana village in Medak district with about 250 households and 1100 population. It has an arable land of 560 acres, most of it is irrigated through borewells. The traditional landlords, belonging to Reddy community, have totally sold of their lands which are acquired by marginal and small farmers belonging to backward castes and dalits. Thus the village is an example of rise of new class of

farmers as owner-cultivators most whom earlier being farm labour from 'below'. Pulimaddi is dry village in Karnool district of Rayalaseem region of the state. The village has an arable land of 1500 acres, one third of whom is owned by the traditionally dominant caste of Reddies. The rest if owned by backward caste and dalits farmers. The village grows dry crops like pulses under extreme water scarcity. The small peasantry in the village can be said to have emerged from `above' and `below'. Kaluvapamula is a developed irrigated village in Krishna district. The village has more than hundred-years history of irrigation, growing sugarcane and paddy as principal crops. The traditional rich Kamma farmers own more than 80 percent of the agricultural land and majority of them, having diversified into non-agricultural professions, now lease their lands to tenants belonging to landless and marginal farmers who belong to dalits and backward castes. The village has population of 1780 with 448 households and 1900 acres of cultivated land.

Land Ownership

In terms of land ownership, there are some crucial differences. In Telangana and Rayalaseem villages, namely Achampet and Pulimaddi, which are both largely unirrigated, landed households constitute 91 and 69 percent, respectively. The higher land ownership is because, in the former village government has distributed some unculturable waste land of 2 acres per head and in the latter, some poor households belonging to dalits and backward castes had managed to buy small pieces of land during 1980s and 1990s, to join the ranks of marginal and small farmers. These lands, however, are being cultivated in the Pulimaddi. In the third village, Kalavapamula, which is in the coastal heartland Krishna district, landed households constitute only 31 percent and landless 69. No land distribution or re-distribution had ever occurred in the village. The sample, when seen from class distribution, has about 74 percent of marginal, small and semi-medium farmers, who in our observation constitute the petty commodity producers in agriculture. Their petty commodity producer classification is based not only on the smallness of their size holding alone, but their predominant dependence on family labour for cultivation and simultaneously hiring out as wage labour within agricultural sector and outside. The petty commodity producer class therefore constitute 70-80 percent in each of the village in the form of owner-cultivators, owner-cultivator-tenants and landless tenants.

Agricultural Credit

From the study, we observe that the total institutional credit in the three villages now stands at 68.6 per cent while non-institutional credit at 37.4 percent. The share of institutional credit in Achampet, Pulimaddi and Kalavapamula are found to be 53.5, 73.4 and 68.6 percent respectively. Such inter-village differences are quite possible as far as bank credit is concerned. Out of the three, in Kalavapamula and Achampet, credit distribution appear to be fairly equal among different classes, while in Pulimaddi the large farmers get bulk of the bank credit. However, in Kalavapamula, 80 percent of farmers belong to one caste, and most of them are absentee landlords, who take these loans and re-lend it to tenant farmer. It is the tenant farmers who are denied bank loans, they depend on commission agents and private money lenders.

For marginal and small farmers, the SHG loans now constitute 40 to 50 percent of their loan. While it is known whether it is used only for agricultural purpose, there is a considerable amount of money is being pumped into poor households through these loans. For tenant farmers, these loans these loans surely matters a lot. Further, for tenant farmer in Kalavapamula, the cooperative bank in the village has distributed Joint-Liability-Group loans upto Rs.5000 per farmer. While banks are still grappling with the issue of credit to tenant farmer, in this village due to local political pressure, the JLG group loans are issued.

Farm costs and returns

There are nine principle crops growth in the three villages, namely, paddy, cotton, maize, groundnut, horse gram, jowar, sunflower, tobacco, black gram and sugarcane. The returns on paddy cultivation have slightly improved after five-year run of poor returns during 2007-12. We observed that, in the surveyed year, paddy market prices and procurement prices barely covered Cost A1 (which is only paid-out costs) and not Cost A2 (which includes rental cost). Except in Pulimaddi, where rice grown belongs to superfine, in both other villages, returns over Cost A1are too meagre and returns over Cost A2 are negative. Similarly, for cotton, maize, sunflower, tobacco, rabi paddy, jowar the returns over Cost A1 are too meagre and returns over Cost A2 are negative in most cases. Thus it is clear from this table that farming the state has become largely unviable. Except for large farmers in the irrigation-endowed reasons who shall farm themselves as cultivators, the incomes from farming from most crops are either too meagre to sustain their consumption or negative.

Table 1. Farm Costs and Returns in Andhra Pradesh in 2011-12 (Rs.)

Village/Crop	Price (Rs/Qt)	Yield (Qt/acre)	Cost of Production		Return per Qtl	
Achampet (Medak Dist)			**cost A1**	**Cost A2**	**Over cost A1**	**Over Cost A2**
Paddy Kharif	1018	19.4	788	1149	230	-130
Paddy Rabi	1025	17.8	1014	1407	11	-382
Maize	1189	14.3	803	1293	385	-103
Pulimaddi (Karnool Dist)						
Bengal Gram	3537	6	2338	3536	1199	1
Cotton	3777	4.7	3316	4835	461	-1057
Groundnut	3426	7.1	2076	3081	1350	345
Jowar	1324	15.8	677	1129	647	195
Paddy Kharif	1600	20.6	816	1162	783	437
Sunflower	3264	5.6	2888	4163	375	-899
Tobacco	5425	7	3766	4786	1658	638
Kalavapamula (Krishna Dist)						
Paddy Kharif	1081	24.5	840	1093	241	-12
Paddy Rabi	926	26	857	1096	68	-169
Sugarcane	2157	42.7	1428	1912	729	245
Black Gram	3562	4	1774	1774	1787	1787

Field Study

Household Income levels

What is the composition of agrarian structure in the village? Is there a differentiation? According our field survey of the three villages, there is a little differentiation between the class of marginal, small and semi-medium households on one hand and large farmers on the other. We could also see this in terms of sources of income of the households. The average annual farm income for marginal, small and semi-medium farmers are Rs.7,341, Rs.12,171, and Rs.25,135 respectively. For medium and large farmers, it is Rs.99,353 and Rs.2,26,813 respectively. Marginal, small, semi-medium and medium households draw 33, 13, 35 and 22 percent of income from agriculture and allied activities, while large farmers draw 79 percent of their income from it. However, among the former, landless, marginal and small, while deriving major portion of their incomes from non-farm activities, they draw this more from wage labour, while medium farm households are able to diversify into regular employment, trading and self-employment. Thus while petty producers in agriculture hang on to agriculture, it is not their principal source of their income, including the landless. This conveys the fact that there is a considerable growth of non-farm activities within and outside the village with which the petty commodity producers along with the proletarians participating, suggesting a definite process of 'semi-proletarianisation'.

Within the farming income, we found that 30-40 percent income is earned through animal hustandry and agricultural wage income constitutes 74-82 percent of their income for marginal, small and semi-medium farmers. For non-cultivating landlord class, the rental income constitutes a major source of income in the village. Thus, for the petty producer class of tenants, their farm income was negative, while their principal livelihood is derived from wage labour, subsidiary source remained diary and animal husbandry.

Table 2. Average Household Net Income from Agricultural Activities (Rs.)

	Farm	Animal Husbandry	Rental	Wage	Total
Landless	0	4667	0	14278	18946
Marginal	7341	10880	0	11611	29833
Small	12171	6377	0	8067	26616
Semi-medium	25135	8998	870	14578	49580
Medium	99353	13480	0	9281	122113
Large	265813	409	0	337	266558
Non-cultivators	0	2835	21861	9720	34416
In percentage					
Landless	0	25	0	75	100
Marginal	25	36	0	39	100
Small	46	24	0	30	100
Semi-medium	51	18	2	29	100
Medium	81	11	0	8	100
Large	99.7	0.2	0.0	0.1	100
Non-cultivators	0	8	64	28	100

As for diversification concerned, there is a marked decline of traditional non-farm activities (basically traditional services) in the villages. Activities such as Pot-making, ironsmiths,

carpenting, washermen, and weaving activity are mostly dead. There is a rise of new non-farm sector such as finance, commission agents, pesticide/seed deelers, trading, hotel, petty shops, grocers, vegitable vending, cloth merchants, eatable vending, transport, driving, photographers, motor mechanics, television mechanics, phone recharging, electricians, winding works, plumbers, masons, television cable collection operators, drinking water suppliers, zerox centers, stationaries, private school teachers, bus/truck/van/auto/harvester/poclainer/tractor drivers, NREGA mate workers, technical assistants, SHG organisers, nurses, ANM workers, Anganwadi workers, mid-day meal workers, tailors, petty venders, liquor shop, medical shops, etc are the new job activities thriving in the village. Who own these activities, obviously those who can invest capital, mostly belonging to mostly upper castes and then to some extent backward caste, and most dalits are yet to access to these opportunities. This is the reason, they are forcing themselves to peasantise themselves, support themselves through animal husbandry and wage labour. We can observe that trading, regular employment and profitable self-employment activities and long term migration are monopolised by landed and upper caste households, which are enabling them to depeasantise themselves.

Table 3. Average Household Net Income from Non-Agricultural Activities(Rs)

	Trade	**Casual**	**Regular**	**Self-employment**	**Others***	**Total**
Landless	5295	7898	16465	13097	20108	62863
Marginal	18967	1953	5869	19190	14731	60710
Small	47865	2194	8892	14460	51196	104606
Semi-medium	23970	3919	43598	11534	9194	92214
Medium	53591	118	15616	6625	347546	423497
Large	0	0	17778	52006	0	69784
Non-cultivators	15006	6469	74132	1778	50679	148064
In percentage						
Landless	8	13	26	21	32	100
Marginal	31	3	10	32	24	100
Small	37	1	5	8	49	100
Semi-medium	26	4	47	13	10	100
Medium	13	0	4	2	81	100
Large	0	0	25	75	0	100
Non-cultivators	10	4	50	1	35	100

*Others includes income through traditional activities, migration and NREGA.

The average annual net non-farm income for marginal, small and semi-medium households in the sample villages is Rs.60,710, Rs.1,04,606 and Rs. 92,214 respectively (Table 13). For medium and large households it is Rs.92, 214 and Rs.4,23,497 respectively. In percentage terms 65-75 percent for small households. However, there are reportage problems for medium and large farmers about their non-farm earnings, which are much higher than what they were willing to report. Overall, we see that there is a huge increase in non-farm income sources and decline of farm incomes for petty producers, even in farm incomes it is allied activities that fetch them little money than farming where much of the surplus is squeezed out by money lenders, traders, landlords, input suppliers etc.

Concluding Remarks

As our village evidence suggest, rural Andhra Pradesh is undergoing increased peasantisation and growth of petty commodity production. Marginal, small and semi-medium farmers constitute 85 percent of total farm households and operate equal amount of area. The consolidation of this class is happening from 'below' as well as 'above'. Petty production, which operates essentially with family labour in the state is substantially commercialized and participates in generalized commodity production. This class can survive extremely depressing conditions of agriculture like unviable prices, crop risk, and demand deflation through over-exploitation of family labour and self-starvation. Curiously, they derive major portion of their incomes from wage income much more in non-farm sector and to a lesser extent in farm sector. This is in tandem with fact of declining share of agriculture and increase in that of non-farm sector in the national income. The growing number of small and marginal farmers –self-exploiting subsistence 'petty producers in a thriving capitalist system is perhaps the paradox to stay here for a long time to come. This is a result of a range of historical, political and economic factors that have shaped the trajectory of Indian development process.

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Adam Baxter

An Investigation into the Causes of Residential Property Price Variation in London's Surrounding Area

Abstract

Hedonic modelling is a common method for identifying causes in house price variation and has been used extensively to identify the effects of both individual variables on the national housing market and the wider causes of house price variation on a local level. No research using hedonic modelling specifically to explain house price variation in the area surrounding London has been identified and the object of this article is to contribute to filling this research gap. Waverley in Surrey was selected as the research area, due to the large numbers of commuters, and its diversity in respect of the three groups of variables which were tested in relation to this question, structural characteristics, local infrastructure and local amenity. Data was collected for one hundred house transactions and subject to a multiple regression analysis. The findings were that the number of bedrooms was the single biggest determiner in house price variation, followed by whether the house was detached. Local amenity also proved to be a major factor, with situation within a town as opposed to a more rural setting, or outside the AONB having a large, negative effect on house price. Some factors which have been proved to have an impact on house prices elsewhere, such as distance to the nearest woodland and local schools, were not proven to have an effect in Waverley.

Keywords: House Prices, Hedonic Modelling, Mapping, QGIS

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1. Introduction

The housing market is one of the most important markets in the UK economy. Partly, because housing is a basic human need, and consequently the housing availability is a major social concern (OECD, Not Dated). Homeownership is preferred to other forms of tenure, because it offers a range of benefits, including holding a valuable asset, capital gains tax exemptions, and

despite fluctuations, a generally upward house price trend, leading to considerable gains (Stephens, 2011).

Much research has been carried out on the local causes of house prices. A process called hedonic modelling has widely been used to try and ascertain the causes of house price variation (Fotheringham et al, 2015).The causes of house price variation have been modelled with a focus on both the impact of a single aspect of house price, such as English nature, nationwide, and on the wider causes of house price variation in a focussed area. Whilst research has been conducted in both rural and urban areas, Surrey, which forms part of the London commuter area is unusual in that many of its inhabitants combine aspects of both rural and urban lifestyles, and consequently house prices in these areas may have a different set of causes.

The principle objective of this article is therefore to discover the main causes of house price variation in a focussed area, Waverley, which lies in South West Surrey. A literature review outlines the causes of house prices, firstly nationwide, before focussing on a more local level. From the literature review, three categories of local causes are established, structural characteristics, local infrastructure and local amenity. Data was then collected and analysed in accordance with the methodology, which also underlines the underlying philosophy of the research. Finally, the Results and Discussion sections detail and explore the findings, with reference back to the literature review for context and commentary.

2. Review of Literature

Stephens (2012) argues that the UK housing market is exceptionally volatile amongst developed countries, citing four boom and bust cycles since 1970. Cyclical increases in UK house prices begin in the South East, before spreading over the remainder of the country, the South East also suffers greater price fluctuations. This is known as the ripple effect. These staggered changes are caused by different effects of national shocks in different areas, for instance changes to income has a larger positive effect in the South, different rates of economic growth between the regions resultant from differing market structures, such as higher debt gearing in the South (Meen, 1999).

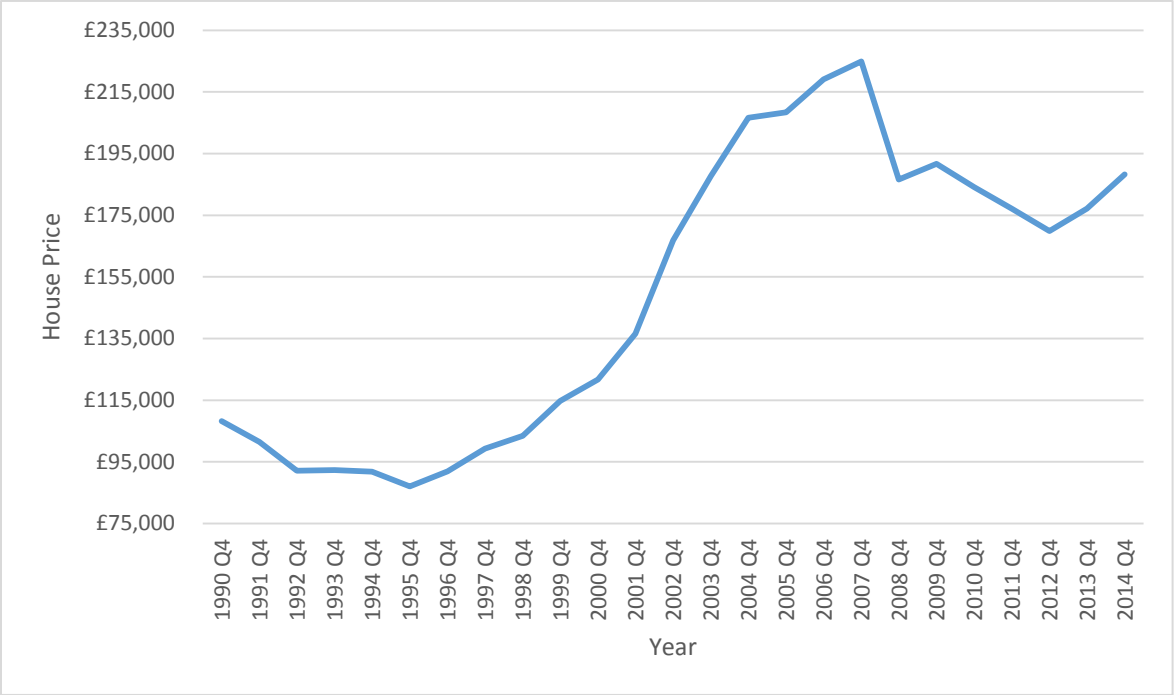
Like Stephens, Lloyds Banking Group (2010) identified four cycles, noting that periods of rapid house price growth always ended with a collapse in prices. This suggests there is a speculation element to the cycle. The most recent ‘bust’ cycle followed the 2007-2008 credit crisis. Figure 1 shows the house price increase following the early 1990’s recession and house price crash, the rapid increase in house prices between 1995 and 2007, followed by the next crash in 2007.

As shown in Figure 1, price growth between 1997 and 2006 was a phenomena across the developed world. Kyung-Hwan and Renaud (2009) attribute this largely to the increased credit availability, though housing supply failed to keep pace with demand during the period (see

section below). The house price cycle and the business cycle have also become increasingly intertwined, and so house prices increased as businesses thrived (Dufrénot and Malik, 2012). This is probably due to the importance of income in determining house prices, and the importance of the financial sector in both the housing market and the wider economy (Kyung-Hwan and Renaud, 2009). Rising incomes in fast growing economy's rapidly increased house prices as demand outstripped supply.

Kyung-Hwan and Renaud (2009) cite two main causes of the house price crash in 2007. Firstly, there was some downward readjustment of house prices, as purchasers recognised that prices had become too high across the developed world, and secondly the financial crisis, which began in the US and spread internationally.

FIGURE 1. REAL UK AVERAGE HOUSE PRICE 1990 Q4-2014 Q4



Source: Adapted From: (Housepricecrash.co.uk, 2015)

The 'credit crunch' began when house prices started to fall in the United States. As a consequence many houses went into negative equity. People who had believed house prices would continue to rise purchased houses, then 'flipped' and purchased another, benefitting from the capital gain, were stymied. Sub-prime mortgages, let to people with incomes lower than usually accepted or bad credit histories were not paid when debtors were relying on flipping to

pay the mortgage. As the financial crisis spread, and job security became a major concern, increasing numbers defaulted on their mortgages (Perry, 2010).

Mortgages, which included a mixture of sub-prime and standard mortgages where packaged together and sold to investors in a process called 'Securitization.' Whilst spreading risk in this way usually good, defaults were so widespread that large numbers of investors lost huge sums, and consequently demand for mortgage related risks fell. As mortgage related products are very difficult to value, institutions did not know the extent of their losses. Investors lost confidence and started avoiding risk completely, severely restricting credit availability. (Perry, 2010). Credit availability is a crucial element of affordability for house purchasers, and therefore the credit crisis severely restricted demand and therefore house prices.

It was the securitization of US mortgages by UK (and the rest of the developed worlds) banks and the following reduction in liquidity which spread the crisis internationally (GB. Parliament, 2010).

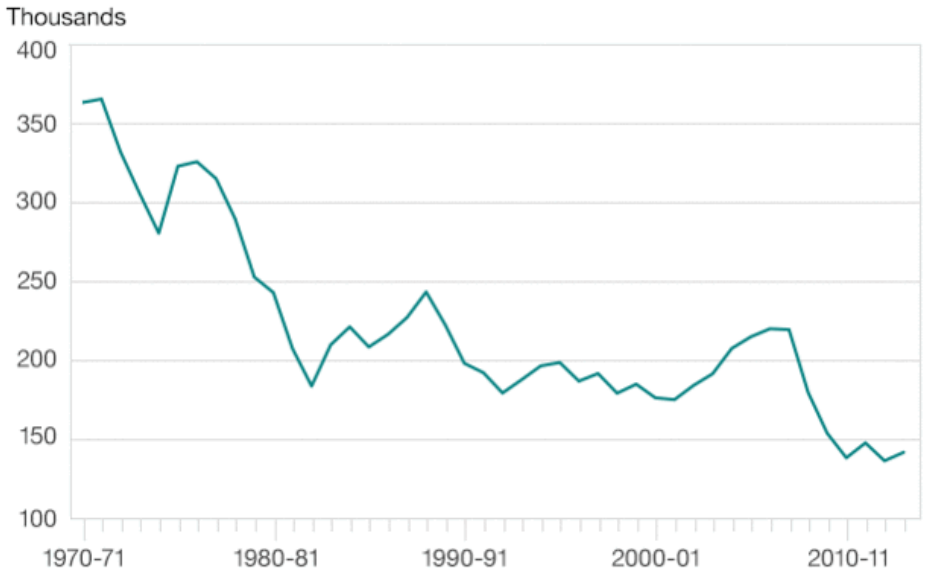
Savills (2014) operate an estate agency in Guildford, which neighbours Waverley, operating across the market (though specialising more in upmarket properties). They have found that the majority of demand for Surrey houses are from people already living within the county (people moving from London second). Ninety-four percent of properties purchased through Savills were for owner occupation as a primary residence. Though this may represent the market as a whole, Savills sell few properties in need of substantial refurbishment, which may be more attractive to investors. The data was also entirely collated from the Savills deal book. Therefore it will not necessarily be representative of Waverley, as Savills operates largely at the upper end of the market (89% of its sales were for over £750,000, compared with an average in Waverley of £363,171 (Land Registry, 2015)). Savills analysis is therefore indicative rather than definitive, as it excludes the larger part of the market.

Fordham Research found in their 'West Surrey Strategic Housing Market Assessment, Executive Summary' (2009), that 77.6% of houses were owner occupied in Waverley (the large part of South West Surrey). Given that this was higher than Guildford (the other area Savills Guildford operate in) this suggests that more people are buying to let than the Savills sample suggests, though the significant majority of purchasers remain owner occupiers.

UK housing supply overview

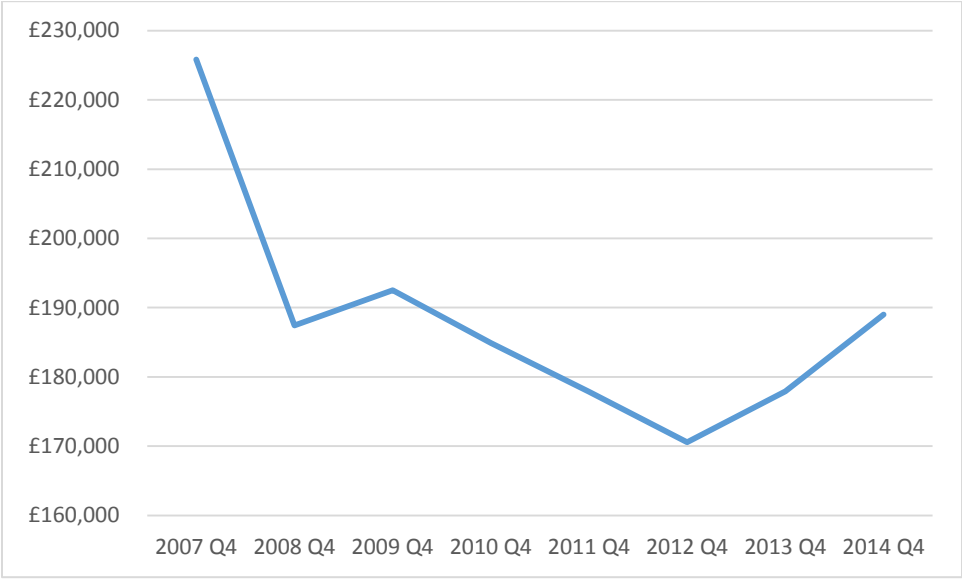
There is presently a huge shortage of housing. Wilson (2010) reported to Parliament that there were 1.8 million households on the waiting list for council property in England alone. Despite a 2007 commitment to build 240,000 new homes in the UK every year, just 141,000 homes were built in 2014. (BBC, 2015). The trend for number of houses built in the UK has been downwards since the 1970's (see Figure 2).

FIGURE 2. UK HOUSE BUILDING SINCE 1970



Source :(BBC, 2015)

FIGURE 3. UK HOUSE PRICES- 2007 Q4- 2014 Q4



Source: (Adapted from housepricecrash.co.uk, 2015)

Following the 2007-2008 financial crisis, demand for housing fell dramatically, despite falling house prices, due to the lack of mortgage finance availability (Wilson, 2010). Builders were

unwilling to build houses which they were unable to sell. Furthermore, houses are supply inelastic, as they take time to plan and build, as Stephens (2012) argues that UK housing supply is especially unresponsive to demand. Therefore the price implications of the upsurge in demand has not been mitigated by a responding increase in supply, increasing prices, as Savills Guildford saw with a 6.6% rise in prime house prices between the 3rd quarters of 2013-2014 (Savills, 2014). This is illustrated by Figure 3, which shows a sharp drop in house price following the financial crisis, followed by a sharp increase as demand recovered during the recovery.

Previous Research

Smith (2014) studied the effect of structural characteristics of houses (measured by detachment), local infrastructure (measured by distance to the motorway) and locational characteristics (Distance to a water body, quarry or whether the property faced agricultural land) on house prices in South Leicestershire and North Northamptonshire. Via a hedonic pricing model, detached houses were found to command the highest prices, on a sliding scale, with semi-detached achieving the second highest prices, and flats the lowest. Likewise, price increased as driving distance to the motorway decreased, and price reduced when nearby a quarry or water body, but increased when facing agricultural land. His findings however, did not analyse the importance of these factors when combined.

Economists and valuers are consistent in that structural characteristics of houses affect their values. Smith (2012) found that detached houses commanded the highest prices, with semi-detached achieving the second highest prices, and flats the lowest. Similarly, it was found in a study in South London that detached houses achieved the highest value (May *et al*., 2011). Additionally it has also been found that a wide range of structural characteristics, including floors, number of bedrooms, detachment and gardens all influence house prices in Liverpool (Abdulai and Owusu-Ansah, 2011). Their findings were that between 2000, until 2008, the number of bedrooms made the most significant difference to house prices, followed by whether there was a garage, and the number of showers.

Sirmans *et al.* (2005) compiled recent hedonic price studies determining house prices in America. Similar to Abdulai and Owusu-Ansah, they found that bedrooms, plot size (land sold with the house), the number of rooms and garage spaces all positively affected price. In both studies, age was found to largely have a negative effect.

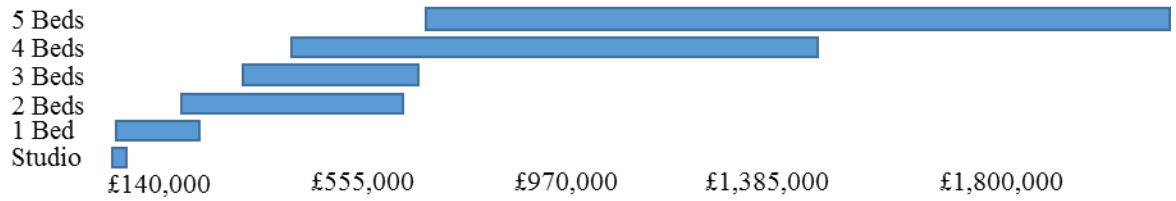
The number of bedrooms have been consistently found to positively impact house price. Beyond Abulai and Owusu-Ansah, and Sirmans findings, Nationwide (2009) found that extending a house to add an additional bedroom adds between 11% and 20% to the value of a house. Foxtons found in Guildford, which neighbours Waverley, that average house price increased substantially with every extra bedroom. However, finding a more extreme trend, that the average three bed house was 23% more valuable than the average two bed, the average four bed 62% more

valuable than the average three bed and the average five bed 47% more valuable than the average four bed.

Figure 4 shows the price range achieved by houses in Guildford, categorised by the number of bedrooms. Whilst it clearly shows that the number of bedrooms has a positive impact on house price, the high degree of overlap, and the extent of the range points to other factors also having a bearing. Whilst the range between two and three bedroom houses seems especially similar, the same report found that two bedroom houses sold for an average of £376,800, whilst three beds sold for an average of £461,980. This demonstrates the positive relationship between number of bedrooms and house prices in Guildford.

The graph also shows increasing ranges as number of bedrooms, and therefore price increases. This implies that more factors influence wealthier buyers than buyers who can only afford houses with fewer bedrooms.

FIGURE 4. HOUSE PRICE RANGE BY NUMBER OF BEDROOMS IN GUILDFORD



Source: (Foxtons, Undated)

Local infrastructure can have both a positive, or negative impact on house prices, depending on whether they provide amenity or dis-amenity. May *et al.* (2011) found through a Hedonic pricing model that values in South West London were reduced by proximity to high voltage overhead transmission lines, which have a negative impact on human health, and by 'inferior' good attributes, such as terracing, in contrast to normal good attributes, such as being detached. The research found that positive local amenity factors only increased value when serious negative amenity was absent, and when this was not the case the effect was ambiguous.

Many people in Surrey commute by train to work in London. Poon (1978) found that houses in the immediate vicinity of railway lines suffered serious dis-amenity in North America, though he only studied houses a maximum of 1,400 feet from the line, and so excluded the effects on properties benefitting from close access to the railway but unaffected by the dis-amenity aspect. Debrezion *et al*. (2011) studied a wider area, and found that houses within 15 kilometres enjoyed a 25% premium in Holland. This suggest that the price decrease associated with the negative externalities of the railway were extremely localised whilst convenient access to the railways at a distance beyond the negative externalities had a positive effect.

Rosiers *et al.* (2001) explored the effect primary schools have on house values in Quebec. They compared the positive influence of proximity to schools, offering benefits for families including reduced travel costs, the opportunity to walk to school and reduced hazards to children, with school size, creating externalities of noise, traffic, and property damage. The findings were that the value maximising distance from a school was 400 metres. The value minimising size was 300-450 pupils suggesting that larger schools attract other services to an area that buyers found attractive, or that larger schools were located in areas containing services which buyers found attractive.

Steven Gibbons (2012) of the London School of Economics compared house prices on Local Educational Authority boundaries in the UK, which determine set catchment areas for admission into state schools, allowing him to compare the value of houses in very close proximity to each other. His findings were that living in an area with a good primary school attracted a house price premium of around 3%, whilst there was a 12% difference in the price paid for houses in the catchment areas of the very best and worst schools.

An individual's house lies at the centre of that person's life, and consequently the amenity of the immediate vicinity and wider area is supremely important, in determing a large part of a house's value (Kauko, 2002). Furthermore, a study in Italy found that it was location, not structural characteristics that played the biggest part in bargaining a selling price (Semeraro and Fregonara, 2013).

Surrey Houses (undated), produce an online Surrey focused property guide, it cites good access to urban amenity, (including London, international airports and a huge range of shopping and restaurants), combined with Surreys extensive woodland and heathland countryside as Surrey's most attractive features to house buyers. Though the website is written with the objective of attracting people to buy Surrey houses (Therefore revealing the preferences, and consequently the spending preferences of Surrey House Buyers.), no evidence is offered and the website is not academic. However, a nationwide study, incorporating one million house conveyances, carried out by Gibbons *et al.* (2014) revealed that English nature does have significant amenity value. Finding in particular that proximity to rivers, inland bare ground and broadleaved woodland increased prices. Highly relevant to Surrey (which is 70% greenbelt (surreyproperty.com, undated) - Gibbons found that areas inside a green belt enjoyed 3% price increases. The study predicts that environmental amenity will effect house prices between 11%-35% in South West Surrey.

The rules of scarcity power are; as relative scarcity increases (The ratio of demand increases relative to supply), the higher the price. Bourassa *et al.* (2005) found that this applied equally to amenity value in the locality of houses, finding that a water view attracted a greater premium in cities where few properties enjoyed one, and added far less value where lakes proliferated. Likewise, White and Leefer (2007) found that location near forestry was not a statistically significant cause for variance in house price, when a similar study one-hundred miles away had

done. The area in which forestry attracted a premium was only 27% forested, contrasting with 73% in the area where it was not statistically significant. Surrey is Britain's most wooded country, with around 20% coverage (Forestry Commission, Not Dated).

The difference in effects of the above variables, depending on the location in which they are located leads to the concept of sub-markets, the theory that the housing market as a whole comprises of a multitude of interconnected micro-markets. Sub-markets can be spatial, for instance an area can have its own micro housing market, or non-spatial, in that houses with similar features may be considered to be in the same market, even if they are not in the same locality, though it is important to consider that people buy into an area, and so houses too distant from each other cannot be considered substitutes. The best way to define non-spatial submarkets is therefore by price, as buyers are restrained by their budget, and therefore have to substitute within their means (Pryce, 2007).

Bramley et al (2008) argue that there are plethora of causes for [spatial] housing submarkets, which can include the quality of local schools and housing quality. Surrey's housing is itself a submarket, as many of London's workforce choose to enjoy a more rural lifestyle by purchasing Surrey houses, substituting a London situated alternative.

Overview of Waverley

Waverley is a borough in south west Surrey. It covers an area of 345 km^2 and had a population of 121,572 at the time of the 2011 Census (ONS, 2011).

Waverley is a relatively affluent area, with higher house prices and high rates of car ownership than much of the country (Waverley Borough Council, 2008). 64% of the working population were employed in the service industry sector, 86% of households had either zero or one dimension of deprivation out of four, which counted a single person in the household unemployed and long term ill health as deprivation dimensions (ONS, 2011).

The structural make-up of Waverley's housing also points to above average affluence. There were 20,455 detached, 13,517 semi-detached and 7,163 terraced houses in Waverley at the time of the last census (ONS, 2011). This contrasts with the remainder of England, in which the majority of houses were semi-detached, followed by terraced and finally detached houses (ONS, 2011).

Waverley is a hugely popular commuter area. Whilst a popular rather than academic article, it is noteworthy that five of the seven inclusions in a recent Country Life (2014) article, "The Best Places to Live for Commuters: Surrey" were located within Waverley. Around 2,000 people were commuting to the City of London or Canary Wharf in 2011 (Census Information Scheme, 2014).

3. Methodology

The local causes of house price variation within the London commuter area was identified as a research gap in the literature review. This section will outline and justify the methods used to collect and analyse the data.

The Research Questions and Objectives

Based on the literature review and the research gap, the following research questions are considered:

Primary research question:

- What are the major factors influencing house prices in the Waverley area of Surrey?

Secondary research questions:

- To establish whether there is a relationship between structural characteristics and house prices.
- To establish whether there is a link between distance to services and house prices
- To establish whether houses located within Ofsted 'Outstanding' rated school catchment areas enjoy a premium.
- To establish whether there is a relationship between local amenity and house prices.
- To establish whether houses located in more rural areas attract a premium.

In considering these questions, the following hypotheses are proposed:

H1: Surrey house prices are affected by the structural characteristics of the house.

H2: Proximity of good local services affects house prices.

H3: Quality of local amenity affects house prices.

In order to test these hypotheses, a number of variables were considered. In particular, the 'Structural Characteristics' hypothesis will be tested by analysing data regarding type of house,

whether it is detached, semi-detached or terraced; and the number of bedrooms (NBR). The 'Local Services' hypothesis will be tested by analysing data regarding distance from the nearest state primary (4-7 or 7-11) school (NPS); distance from the nearest state secondary (11-16) school (NSS); distance from Nearest Train Station (DTS); and distance from Open Access Countryside (DAC). Finally, the 'Local Amenity' hypothesis will be tested by analysing data regarding whether the properties situation is within the Surrey Hill Area of Outstanding Natural Beauty (AONB); the Nature of the settlement in which the property is situated, whether it is a town, village, hamlet or in open countryside; and distance from the nearest woodland (DWD).

A hedonic pricing model has been specifically applied to the Waverley area of South West Surrey. Waverley especially builds on the work carried out by May et al. (2011) in South London, as many of its inhabitants work in London, and have made the lifestyle choice to commute, suggesting they will have different preferences in housing to their London residing counterparts.

Information on house prices was collected from the Waverley Borough in Surrey. Waverley was selected because it is a major commuter area (ONS, 2014.) In addition, it contains a range of settlements ranging from towns to open countryside, and contains large areas designated as an AONB, aiding researching whether buyers are seeking greater rural amenity.

Data was collected by creating a map on QGIS mapping software, showing the location of the different houses, and the spatial variables. Information on house prices and the structural characteristics of the property were taken from residential property website 'Zoopla.com, (Zoopla, 2015)' which has a free database of property transactions incorporating information from the HM Land Registry, selling agents and other sources. The distance between the houses and variables location was then measured in a straight line. Distance were measured from an estimation of the centre of the house. Distance to woodland and the nearest open access countryside were measured to the nearest fringe or boundary, distances to schools and stations were measured to the estimated centre of those buildings. Measurements were taken using the mapping tool on QGIS.

'GIS' is an abbreviation of 'Geographical Information System.' It operates by recording longitudinal and latitudinal data for various map layers, which are built up on top each other. The bottom layer is the base map, in this case an OS Vectormap, which shows the areas physical features. The remaining layers are either vectors, which appear as individual points or rasters, which show an area, collectively known as shape files. A benefit of the QGIS system is that shape files can be imported from other maps. This allowed shape files showing borough boundaries, UK AONB's and areas of Open Access Countryside to be important and included in the data (QGIS, Not Dated).

No previous study of this nature is believed to have utilised GIS mapping software before. By importing shape files, GIS offers fast, accurate mapping of features which are either time

consuming, or impossible to map accurately as part of a study. Additionally, GIS is more accurate than most mapping programmes (ESRI, Not Dated)

The literature review established that house prices are cyclical, and can be affected by a wide range of factors. As measuring the effects of these factors was beyond the scope of this study, the time period from which data collected was restricted to January 2014 to February 2015.

A hedonic pricing model is a mathematical equation from which information on numerous independent variables can be processed, to predict (house) prices. This reveals information regarding how numerous variables impact house prices. To create a hedonic model, data must be processed through a multiple regression, which tests for correlation between the independent variables and the dependent variable (house price) (Monson, 2009).

Some factors affecting house prices, such as the settlement the house is situated in are categories rather than linear data. For these, 'dummy variables' where used for which a '1' designated it was within that category, and a '0' that it was not. The 'dummy variables' are outlined in Table 1 below (Gould, 2011). The tested model was as follows.

$$\begin{aligned} Ln(Price) = {} & \beta_0 + \beta_1 Detached + \beta_2 SemiDetached + \beta_3 LnNBR + \beta_4 LnDPS \\ & + \beta_5 OutsideCatchmentPS + \beta_6 LnDSS + \beta_7 OutsideCatchmentSS \\ & + \beta_8 LnDTC + \beta_8 LnDAC + \beta_9 OutsideAONB + \beta_{10} Town + \beta_{11} Village \\ & + \beta_{13} OpenCountryside + \beta_{14} LnDWD \end{aligned}$$

Ln ('Price') represents the achieved sold price of houses in the Waverley Area, which is expressed as a natural logarithm. LnX means that variables are expressed as a natural logarithm to best capture non linearity (Abdulai and Owusu-Ansah, 2011), excluding dummy variables, as 0 does not have a logarithm. This was done prior to the multiple regression in Microsoft Excel. Use of logarithms also allowed estimation of the elasticity of the effect of distance of different variables on price (Colwell, 1990). 'LnD' is detached houses, 'NBR' is the number of bedrooms, 'DPS' is distance to Primary School, 'BelongToCatchmentPS' is whether the school is within the catchment of an Ofsted 'outstanding' rated state primary school, 'DSS' is the distance to the nearest secondary school, 'BelongToCatchmentSS' is belonging to the catchment of an ofted outstanding secondary school, 'DTC' is the distance to the nearest train station, 'DAC' is the distance to open access countryside, 'InsideAONB' is situation within the Surrey Hills AONB, 'Town' is situation within a town, 'Village' is situation within a village, 'OpenCountyside' is situation with open countryside, 'DWD' is Distance to Nearest Woodland. The Multiple regression was completed by use of the statistical program, SPSS.

TABLE 1. DUMMY VARIABLES

Group	Variable	Number Analysed	Research Group
House Type	Detached	42	Structural
	Semi-Detached	34	
	Terraced	24	
Available State Primary School	Inside Catchment Area of Outstanding Primary School	4	Local Infrastructure
	Outside Catchment Area of Outstanding Primary School	96	
Available State Secondary School	Inside Catchment Area of Outstanding Secondary School	29	
	Outside Catchment Area of Outstanding Secondary School	71	
Surrounding Countryside Quality	Inside AONB	39	Amenity

Source: Authors Own

Ordinary Least Squares is a multiple regression technique which draws the best fit line to minimised the squared deviation between the line and points (Hoyt, 2003). This allows for the best determination of the impact of the variables upon house prices (May *et al.*, 2011). Multicollinearity is a situation in which multiple variables correlate to a statistically significant degree of accuracy. This creates problems as it makes the models estimates overly responsive to changes in the model, and consequently are less reliable (Frost, 2013). To prevent multicollinearity, one dummy variable should be excluded from each tested dummy variable

group (May et al., 2011). These are 'terraced house', 'belong to catchment area of outstanding primary school', 'and belong to catchment of outstanding secondary school' and 'Hamlet.'

4. Results

This section outlines the results of the multiple regression and the resultant hedonic pricing model. Firstly the statistical results are applied to the null and alternate hypotheses in order to establish general rules regarding housing prices in Waverley. Latterly, the model is expressed as formula and demonstrated by two theoretical examples.

Table 2 summarises the results from the multiple regression. The significance column contains the 'P' values, a 'P' value lower than 0.05 is statistically significant. The coefficient shows the impact that variable has on house prices when expressed as a formula (below).

R^2 figure shows the percentage of variance in the dependent variable resultant from the independent variables. An R Square value of .772 shows that the model incorporates 77.2% of causes for house price variance in the Waverley area. However, adding more variables always increases to the R^2 figure, where as adjusted R^2 decreases when an additional variable improves the model less than would be expected by chance. Therefore this model explains between 76%-77% of house price variance in Surrey.

TABLE 2. RESULTS SUMMARY

Variable	Coefficient	Significance
House Price (Constant)	12.696	0.000
Detached (X2)	0.457	0.000
Number of Bedrooms (X5)	0.554	0.000
Distance from London Railway Connection (X12)	-0.083	0.025
Outside AONB (X14)	-0.164	0.013
Within Town (X17)	-0.337	0.001
Within Village (X18)	-0.180	0.009
R^2 .772 Adjusted R^2 .757		

Source: Authors Own

In relation to the three hypotheses (i.e. H1, H2 and H3) established in Section 3, the following results were found. Firstly, as both increasing the number of bedrooms, and the structural characteristic 'detachment' are statistically significant, it is concluded that H1 is supported by the

data. Secondly, increasing distance from a London railway connection was found to have a significant negative coefficient, and therefore decreased house prices. The impact of distance to both primary and secondary schools, and location within the catchment areas where not found to be statistically significant and so were removed from the model. Therefore the hypothesis H2 was partially supported by the data. Finally, the independent variables 'Outside AONB' (which tested whether local amenity affected house prices); 'Within Town'; and 'Within Village' (which tested whether rural or urban amenity was more highly valued) are statistically significant. All had negative coefficient implying that they lower the value of properties situated in those locations. Therefore the Hypothesis H3 is supported by the data. Whilst within town and within village were statistically significant, 'Within Countryside' only became so when 'Within Village' was removed. This reduced the R^2 value and therefore diminished the overall accuracy of the model, and therefore 'Within Countryside' was excluded from the final model.

The information presented in Table 2 can be expressed as a formula, as shown below. The logarithm of a predicted price can be found via multiplying the logarithm of the variables by the coefficient. For instance the logarithm of the number of bedrooms multiplied by the coefficient for the number of bedrooms satisfies that part of the formula. Dummy variables cannot be expressed as a variable, and therefore those coefficient will by either multiplied by 1, or 0 to eliminate them from the equation.

$$LNPredictedPrice = LNConstant(12.696) + Detached(0.457) + LNNumberofBedrooms(0.554) + LNDistancetoLondonRailwayConnection(-0.083) + OutsideAONB(-0.164) + WithinTown(-0.337) + WithinVillage(-0.18)$$

As an example, consider a hypothetical house were a detached house, with four bedrooms, five miles from the station, located inside the AONB, in the countryside. In this case the formula becomes:

$$LNPredictedPrice = 12.696 + 1(0.457) + LN4(0.554) + LN5(-0.083) + 0(-0.164) + 0(-0.337) + 0(-0.18)$$

In considering this expression, the predicted price for this example is £972,304. Table 3, on the other hand, shows the mean percentage increase in value of a house benefitting from an additional bedroom.

TABLE 3. IMPACT OF ADDITIONAL BEDROOMS

Number of Bedrooms	2	3	4	5
Average Price	413,098	451,476	745,231	1,048,400
Percentage Change For Additional Bedroom	N/A	9%	65%	41%

Whilst the literature review agreed bedrooms and house prices had a positive relationship, there was wide disagreement surrounding how much additional value a bedroom adds. The results find that additional bedrooms add significantly to a houses value.

5. Discussion

The first set of factors investigated by the model were structural characteristics, which as tested by house type, whether it was detached, semi-detached or terraced, and the number of bedrooms.

The house type was found to positively impact house price, as the type 'detached' attracted a premium. Similarly, Daniel May et al (2011) and Lewis Smith (2014) found that detached houses, then semi-detached, then terraced where the most highly valued. The multiple regression did not however find semi-detached and terraced properties to be statistically significant. This may partly be due to the lower numbers of these properties in Waverley, in proportion to the rest of the country (ONS, 2011), and the resultant smaller sample size of terraced houses. Smith (2014) also found poor significance scores for certain housing types, in his case terraced and detached houses. He attributed the problem to the variation in the nature and quality of the houses, in comparison to May et al. (2011) study, where all houses were 1930's built. This problem may have been compounded in this case by data not being available for variables which have previously been proven to affect house prices. For instance Abdulai and Owusu-Ansah, (2011) found gardens had a positive impact on price, whilst Sirmans (2005) also found that plot size was important. The nature of the database, zoopla.com, makes it impossible to collect data on this variable. Causes of variations outside the dataset would then have gone unrecorded, and shown more randomness in the price achieved by terraced and semi-detached houses than is actually the case.

Alternatively, sub-markets may be the cause. Waverley has above average house prices (Waverley Borough Council, 2008), and a far higher proportion of detached houses to terraced and semi-detached compared to national average (ONS, 2011). As non-spatial submarkets are best defined by price (Pryce, 2007), Waverley may suffer from a shortage of 'affordable' houses for a certain budget, increasing the values of houses with inferior good attributes due to the shortage of normal goods.

The number of bedrooms was also proved to positively impact house price in Waverley, and also proved to be the factor with the greatest influence on house price. Abdulai and Owusu-Ansah, (2011) and Sirmans (2005) similarly found a positive relationship between house price and the number of bedrooms. The literature review highlighted a discrepancy between Nationwide's (2009) view that additional bedrooms added between 11% and 20%, and Foxton's findings in Guildford, that the average house price increases by as much as 62% when an additional bedroom is added. The results show that whilst a three bedroom property only commands, on average a 9% premium over a two bed, a four bed is 65% more expensive than a three bed. Like Foxtons, the findings were that increasing from a three bed to a four bed is the most valuable increase, as Foxtons found a 47% increase from four to five beds, comparable to the 41% found in this study.

The second set of factors researched where the local service provisions in the vicinity of the house. This was tested by collecting data on local schools and railway services. The literature review explored the findings of Rosiers *et al*. (2001), who found that schools could have a positive or a negative impact on price in Canada, depending on whether the benefits of parents getting their children into a good school were outweighed by the negative externalities, such as anti-social behaviour. Likewise, Steve Gibbons (2012) found that the difference in the price of very similar houses when one was inside the catchment area of a good school, and the other did not was between 3% and 12%. The hedonic model conversely showed no significance for any of the four variables tested, the distance to both the nearest primary and secondary school, or membership of the catchment area of an outstanding primary or secondary school.

One reason the distance to schools may not have been statistically significant, when it was found to be so in Rosiers study is that this study included houses which were much farther from schools than in Rosiers case. Rosier's data was focussed on houses far closer to the school, with a mean distance of 696 metres, compared to 2.3 km from a primary school and 3.7 km for secondary schools. As Rosier found the value maximising distance from a school is 400 metres. As few houses in the data were located within half a kilometre of a school, the area in which they have the biggest effect likely did not have sufficient presence to be significant in the model.

The reason that membership of a catchment area for a good school is harder to explain. It may be that every school essentially serves the entirety of the village or town in which it is located, and the catchment area of the outstanding school is not sufficient to choose that location over any other, especially as all but one of the schools in the area are rated at least good by Ofsted, whilst only one secondary and one primary school are rated outstanding. Gibbons, conversely implies his research was carried out in a scenario where the quality of schools in a locality vary dramatically. His finding, that the difference in house price in the catchment of a top and bottom school, all other things being equal is 12% to an extent supports the finding that where the schools are, by and large, so competitive with each other, there will be little effect.

Local services were proved to affect house prices when distance to the station was proved to have an inverse linear relationship with house prices. Debrezion *et al.* (2011), also found that house prices increased when within 15km of a railway station. Railway stations are especially important to Waverley homebuyers, as two thousand Waverley residents work in London. The reason that the model did not show the effects of dis-amenity caused by railway lines, as Poon (1978) did, is likely to be due to the small numbers of houses built in the close vicinity of the lines, largely run through non-developed areas.

Locational characteristics were also found to affect house prices. As situation outside the AONB and within a town or village was found to negatively impact house prices to a statistically significant degree. Situation within the countryside or hamlet was found to not be statistically significant, as was distance to the nearest woodland or open access countryside.

The essence of Gibbons' et al. (2014) argument, that English nature adds significantly to the value of house prices correlates with the finding that the AONB adds substantial value to houses. However, the assertion that broadleaved woodland would add substantially to value was not found to be the case. The findings of Bourassa, that water features only added to property value when they were scarce, and White and Leefer, that woodland did not add to property value in an area which was 70% woodland seem to also be true in Surrey, which despite only having 20% woodland coverage, is the UK's most wooded region (Forestry Commission, Not Dated). Much of this area is in Waverley, and the research found a mean distance of just 0.15km to nearest trees, with many houses, especially in the south and south west of Waverley actually located with a woodland.

The reason for neither countryside, nor hamlet testing as statistically significant appears to be a definition problem when collating data, as it is often difficult to decide whether a house, with near neighbours is within a hamlet or not. In an attempt to overcome this problem, the two sets where grouped together and the model showed that it was statistically significant that situation within countryside or hamlet increased price. However, this meant that either village, or town had to be dropped from the multiple regression, to prevent problems with multi-collinearity, and whichever was left in then failed to test as statistically significant. The view was taken that the model was stronger with both town and village left within the equation.

Distance to the nearest open access countryside was tested due to its proliferation over Waverley (see appendix…) in order to explore if convenient access to the countryside, as well as the amenity of nearby natural beauty was an influencer of house price. It appears to have had no influence on house price. This may be due to little value being placed on access to the countryside, but alternatively may be resultant from home buyers generally being unaware that nearby countryside is open access.

6. Conclusion

The objective of this study was to establish the causes of variation in house price in Waverley, by investigating the effect of structural characteristics, local infrastructure and local amenity on house prices.

The effect of structural characteristics was tested by house type, and the number of bedrooms. Both of these groups tested as statistically significant, and consequently the null hypothesis, that structural characteristics would not affect house prices, was rejected, and the alternate hypothesis, that both increased number of bedrooms and increasing levels of detachment will attract a higher sale price, was accepted.

The effect of local infrastructure was tested by distance to the nearest primary and secondary schools, whether the house was within the catchment area of a school rated as 'outstanding' by Ofsted, and the distance to nearest railway station. The only variable which tested as statistically significant was distance to the nearest railway station, therefore the null hypothesis, that local infrastructure would have no impact on price, was rejected, only alternate hypothesis 1; that house prices and distance to local service will have an inverse linear relationship was accepted. The reason that schools did not appear to affect house prices, was explained by the similarly high standards of the majority of schools in the area.

The effect of local amenity was tested by whether houses lay within the Surrey Hills AONB, the distance to woodland, the settlement type the house was situated in and the distance to Open Access Countryside. The settlement type and the location within the AONB tested as statistically significant, whilst distance to woodland and open access countryside did not. Therefore the null hypothesis, that local amenity would not affect house prices was rejected, and both alternate hypotheses, that nearby local amenity will attract a premium and that houses in more rural locations will be more expensive were accepted.

The results from Waverley contained several anomalies from other findings which were outlined in the literature review. Therefore to firmly establish the causes for the school variables and distance to woodland not testing as a statistically significant cause of house price fluctuations in Waverley, and to further test their importance to people living in commuter areas a study in another commuter area, where ideally woodland is less common and schools are more variable in quality.

There was also a non-conclusive finding that there may be a clinical shortage of affordable homes in Waverley which is seriously distorting the market. If this is the case, it is a matter of public importance that it is uncovered and provision is made for the building of more affordable homes. This research should perhaps be focussed on the number expressing interest, making offers on semi-detached and terraced houses, as well as the prices they achieve compared with other areas of the South East.

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Sara Arancibia, Alexander Abarca and Gonzalo Moya

Decision Making in Agriculture: A Methodological Contribution

Abstract

The objective of this article is to present a new statistical technique with potential to be used in agriculture in order to identify farmers' perceptions and attitudes. This technique corresponds to structural equations based on Partial Least Square (PLS-SEM). To illustrate the applicability of this technique in agriculture, a model applied to farmers in the UK is proposed. This model is based on three constructs in which variables that influence farmers' perception on environmental awareness are identified. These constructs correspond to awareness of global warming; use of transgenic; and environmental awareness. The results revealed that environmental awareness is positively affected by global warming awareness and negatively affected by the use of transgenic.

Keywords: PLS Model; Environmental Awareness, Global Warming Awareness; Use of Transgenic

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1. Introduction

The Structural Equation Modeling approach (SEM) began to be used as an alternative to regression-based approaches that analyze only one layer of links between the dependent and independent variables. In contrast, SEM models allow for simultaneous modelling of relationships between multiple independent and dependent constructs (Gefen et al., 2000). This allows researchers to construct unobserved variables and measure them by means of indicators in order to explicitly model the measurement error for the observed variables. This gives the investigator the flexibility to prove statistically substantive/theoretical hypotheses using empirical data (W. Chin, 1998; Haenlein & Kaplan, 2004).

There are two approaches to estimate the relationships in a structural equation model (Hair et al., 2010; Hair et al., 2013). "One is the more widely applied Covariance-based SEM (CB-SEM) approach. It is primarily used to confirm or reject theories (i.e, a set of systematic relationships between multiple variables that can be tested empirically). It does this by determining how well a proposed theorical model can estimate the covariance matrix for a sample data set. The other is Partial Least Squares SEM (PLS-SEM, also called PLS path modeling), which is the focus of this paper. Each is appropriate for a different research context. In situations where theory is less developed, researchers should consider the use of PLS-SEM as an alternative approach to CB-SEM. This is particularly true if the primary objective of applying structural modelling is prediction and explanation of target constructs. The estimation procedure for PLS-SEM is an ordinary least squares (OLS) regression-based method rather than the maximum likelihood (ML) estimation procedure for CB-_SEM.

PLS-SEM uses available data to estimate the path relationships in the model with the objective of minimizing the error terms (i.e, the residual variance) of the endogenous constructs. In other words, PLS-SEM estimates coefficients (i.e., path model relationships) that maximize the R^2 values of the endogenous constructs. This feature achieves the prediction objective of PLS-SEM. Therefore PLS-SEM is the preferred method when the research objective is theory development and explanation of variance (prediction of the constructs). For this reason, PLS-SEM is regarded as a variance-based approach to SEM" (Hair et al., 2013, p 14)

The PLS methodology has gained a mayor recognition in different academic areas such as information management systems (Dibbern et al., 2004)); electronic commerce (Pavlou and Chai, 2002); organizational behaviour (Higgins, et al., 1992); marketing (Reinartz et al., 2004), and agriculture (Rodriguez-Train et al., 2013; Chen, 2013).

One of the strengths of the methodology is that it can identify relationships and influences between constructs. In addition, the PLS method does not require large samples or specific distributions, making it very attractive for studies which do not have large samples.

The application considered in this article was developed with the purpose of identifying a possible direct relationship between global warming and the use of GMOs on the factor farmers' environmental awareness. This application is used to illustrate how this methodology can contribute in problems related to agriculture, farmers' decision making and where to allocate resources to affect a determined factor.

2. Graphical description of SEM

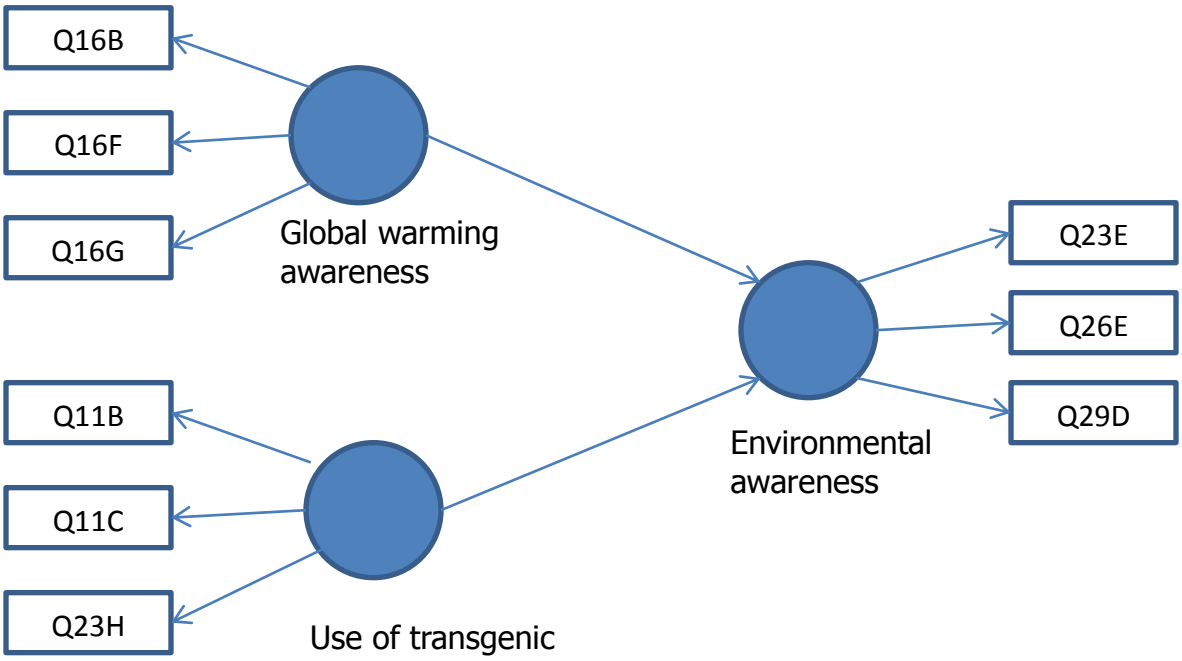
The SEM can be interpreted using path referred to as paths analysis. The concept of causal analysis in the social sciences refers to the set of strategies and modelling techniques used to

explain causal phenomena using empirical data (Casas, 2002). In these cases endogenous variables are explained by exogenous variables.

The graphic description offers a representation of the relationships that exist between variables. As pointed out by Barclay et al. (1995), the first step in a PLS study is to explicitly specify the structural model (the arrows that link the constructs) as well as the relationships between indicators and constructs in the measurement model (arrows between indicators and constructs) (Cepeda and Roland, 2004).

The following figure presents a structural equation model with three constructs and is used to discuss key aspects of the methodology and its relevance in terms of decision making in agriculture.

Figure 1. Example of a model



The environmental awareness factor (which is represented as a circle) is a construct or latent variable that corresponds to a dependent or endogenous variable. This is because there are factors that affect this construct which correspond to changes in global warming awareness and the use of Genetically Modified Organisms (GMOs) (i.e. these factors are exogenous constructs because there are not constructs in the model that affect them). The three constructs are measured

by observable variables which are represented as rectangles. The arrows between factors indicate a direct relationship between factors.

3. Background and the proposed conceptual model

In order to estimate the causal relationships between the constructs or factors, it is necessary to develop a literature review and consider the knowledge and experience of experts in the field with the purpose of establishing relevant hypotheses. In this context, the three factors presented in Figure 1 are described as follows.

Environmental awareness

Environmental awareness is a complex concept, whose meaning has changed over the years. According to Cerrillo (2010), environmental awareness is an ambiguous and multifaceted concept which involves both social and cultural phenomenon. For the current investigation, the following definition of environmental awareness proposed by Jones and Dunlap (2002) is employed: "The degree of concern for environmental problems and support initiatives to address and indicate a willingness to contribute to a solution" (p. 485).

Global warming awareness

The issue of global warming has been studied by a number of researchers who agree that global warming is the increase in the mean temperature of Earth climate system. This is due to the increase in greenhouse gases emission and has caused droughts, more intense storms, melting glaciers and rising sea levels, among others.

For the current investigation, a modified version of the definition of global warming proposed by Madruga and Garrido-Morales (2012) is considered: Knowledge of factors that cause an increase in the mean temperature of Earth climate system.

Use of transgenic

The issue of Genetically Modified Organisms (GMOs) or transgenic has generated an intense debate in terms the impact of their use in agriculture on the environment and health of people. In this debate, several researchers warn about the significant development of GM food in agriculture. (Galperin et al. 2013).

In this article, the use of transgenic refers to genetically modified organisms for human consumption that are based on DNA manipulation, that is, foods derived from genetic intervention (Campos, 2013).

4. The proposed model

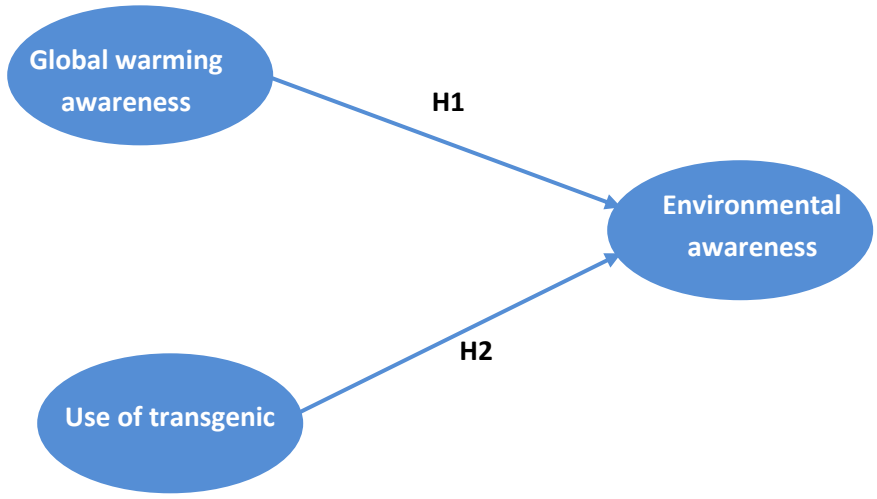
The proposed structural model is shown in Figure 2. In this model, two hypotheses are proposed to be tested by means of the structural equation PLS method. Relationships are represented by arrows indicating the influence between constructs.

In considering this model, the hypotheses to be tested are:

H1: Environmental awareness is directly and positively influenced by global warming awareness.

H2: Environmental awareness is directly and negatively affected by use of transgenic.

Figure 2. The proposed conceptual model



5. Material and methods

Sampling

It was not possible to find a perfectly random sample of farmers in UK. However, a non-probabilistic cluster sampling was adopted as a second best. Each cluster corresponds to a

relevant region in the UK. Using this sampling strategy, a sample composed of 152 was obtained.

Methodology

The model of farmers' perception on environmental awareness was adjusted to the data by means of the Structural Equation Modeling (SEM). This methodology estimates a number of dependency interrelations simultaneously (Gerbing and Anderson, 1988). At the same time, it evaluates the measurement model of the different variables employed (Barroso et al., 2006; Byrne, 2006). In particular, the PLS (Partial Least Square method) was applied in order to verify the validation and reliability of the measurement and structural models by quantifying the relationships between the constructs and the effects of them on farmers' perception on environmental awareness.

The objective of the structural equations PLS method is to predict the dependent variables of the model by maximizing their explained variance (R^2). In this way, the estimation of parameters seeks to minimize the residual variances of endogenous variables. The coefficient of determination (R^2) is a measure of the proportion of an endogenous construct´s variance that is explained by its predictor constructs (Hair et al., 2013).

In the model shown in Figure 3, reflective observable variables are presented which means that the observable variables reflect the factor that we want to measure. They are characterized by their high correlation. The percentage of variance of the reflective observable variable explained by the factor or latent variable is measured by the square of the λ outer loadings. The outer loadings are the estimated relationships in reflective measurement models. They determine an item´s absolute contribution to its assigned construct.

In order to analyse the reliability of the items in the case of reflective variables, the most accepted rule is to consider a minimum threshold of $\lambda \geq 0.707$ for the indicator to be accepted as part of the construct (Carmines and Zeller, 1979). This is because the shared variance between the construct and its indicators is larger than the variance error. A value larger than 0.0707 implies that more than 50% of the variance (λ^2) of the observed variable is shared with the construct (Cepeda and Roldán, 2004). Recent studies have revealed that values between 0.4 and 0.7 can be accepted if the values of **Average variance extracted** (AVE) and composite reliability are not negatively affected.

"The Average variance extracted AVE is a measure of convergent validity. It is the degree to which a latent construct explains the variance of its indicators.

The Composite reliability is a measure of internal consistency reliability, which, unlike Cronbach´s alpha, does not assume equal indicator loadings. Should be above 0,70 (in exploratory, 0,60 to 0,70 is considered acceptable. The Cronbach´s alpha is a measure of internal consistency reliability that assumes equal indicator loadings. In the context of PLS-SEM, composite reliability is considered a more suitable criterion of reliability". (Hair et al., 2013; p115).

6. Results and Discussion

Model estimation delivers empirical measure of the relationships between the indicators and the constructs (measurement models), as well as between the constructs (structural model).

This section presents the results of the model based on the responses given by the farmers in the sample. In the adjustment of the model presented as follows, both hypotheses were statistically significant. The results are presented in two steps: results of the adjustment of the measurement model; and results of the adjustment of the structural model.

Results of the adjustment of the Measurement model

The measurement model shown in Figure 3 describes how each latent variable is explained by means of the manifest variables. This model has good psychometric properties that validate the estimation of latent variables. Methodological aspects that should be checked are the fulfilment of certain criteria of validity and reliability of the measurement model. Individual reliability of the item, composite reliability, convergent validity and discriminant validation all satisfy the required parameters.

Figure 3. Measurement model

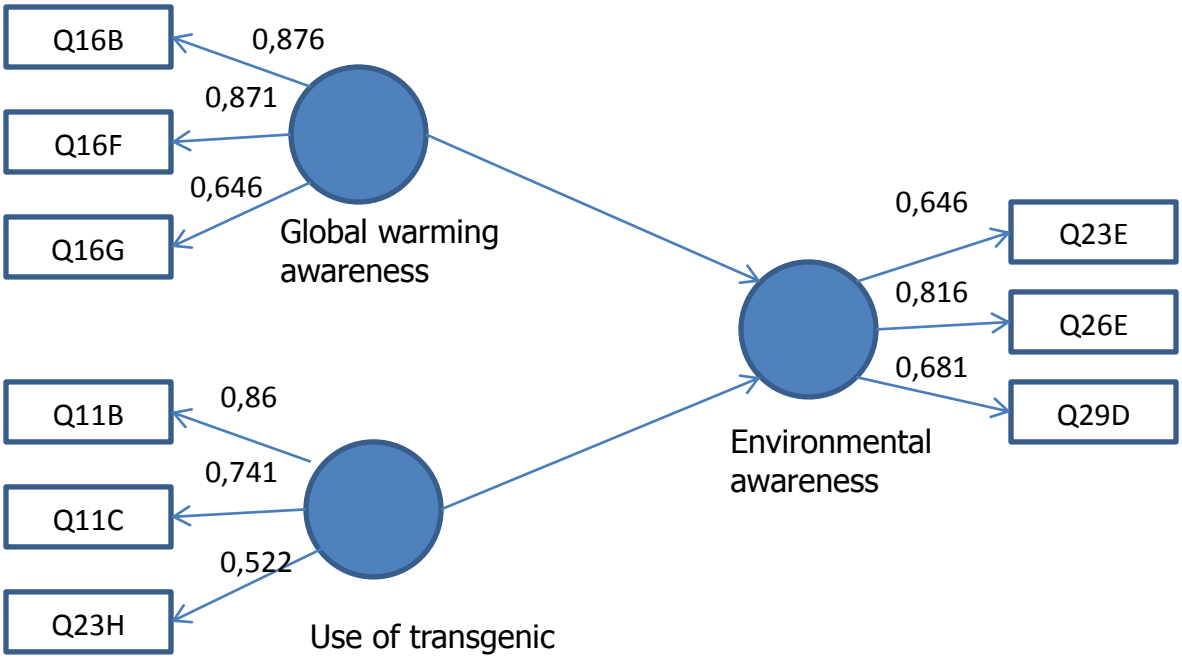


Table 1. Variables in the constructs

Variable	Global warming awareness
Q16B	I am taking actions to minimize the contribution my farms makes to global warming
Q16F	I am taking actions to minimize the impacts of global warming on my farm
Q16G	Global warming will impose additional costs on my business

Variable	Use of transgenic
Q11C	I would welcome the opportunity to grow GM crops on my farm
Q11B	I have no concerns about buying animal feed containing GM ingredients
Q23H	It will be impossible to feed a growing world population without increasing use of synthetic fertiliser and crop protection chemicals

Variable	Environmental awareness
Q23E	Biodiversity is crucial for maintaining the productivity of agriculture
Q26E	Maintaining nature and the environmental value
Q29D	In decision-making I take the environment into consideration, even if it lowers profits

Table 2. Indicators of the model

Construct	Indicator	Outer loadings	AVE Average variance extracted	Composite reliability
Global warming awareness	Q16B	0.876	0.6478	0.8442
	Q16F	0.871		
	Q16G	0.646		
Use of transgenic	Q11B	0.866	0.5241	0.7605
	Q11C	0.741		
	Q23H	0.522		
Environmental awareness	Q23E	0.646	0.5155	0.7596
	Q26E	0.816		
	Q29D	0.681		

Table 2 shows that the individual reliability of the items is verified with most of the loads λ near or larger than 0.7. A level near or larger than 0.707 implies that about 50% of the variance (λ^2) of the observed variable is shared with the construct (Cepeda and Roldán. 2004). In spite that the λ value for Q23H, Q16G and Q23E is lower than the value suggested by these researchers, it affects neither reliability nor the value of AVE. Consequently, these values are considered acceptable to measure the construct.

In addition, the composite reliability of all the constructs takes a value larger than 0.7 as required. This index measures the internal consistency of the indicators that form part of the construct. That is, the observable variables measure the latent variable.

The value of the average variance extracted (AVE) is higher than the minimum value of 0.5 implying that the construct shares more of the 50% of its variance with its indicators. The remaining variance is explained by the measurement error (Fornell and Larcker, 1981). Its objective is to evaluate whether the set of items that are supposed to measure the construct are indeed measuring the construct and not another concept.

With respect to the discriminant validity, in all the cases the constructs share more variance with their indicators than with the rest of the constructs which indicates that the constructs measure different concepts. The rule of discriminant validity is: the square root of the AVE of each

construct should be higher than its highest correlation with any other construct (Fornell- Larcker criterion).

Table 3. Discriminant validity table

Construct	EA	GW	T
Environmental awareness (EA)	0,7180	0	0
Global warming awareness (GW)	0,4546	0,8049	0
Use of trangenic (T)	-0,2341	-0,0729	0,7239

Results of the adjustment of the Structural model

Once validity and reliability of the measurement model are verified, the structural model is evaluated. This model captures the hypothesised causality relationship between the constructs.

The first step is to check whether the parameters of the relationships between the constructs are significant. For this purpose, a t-student equivalent is estimated by means of re-sampling techniques, particularly the one referred to as bootstrapping.

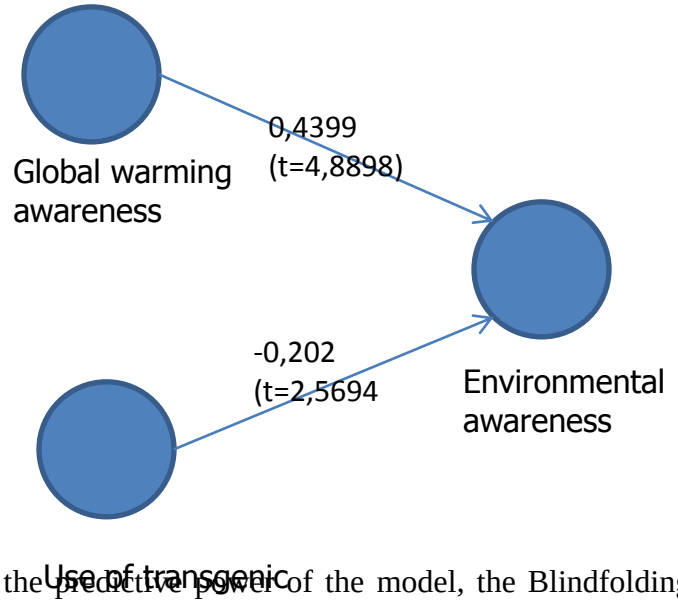
The t values in Table 3 revealed that the coefficients of latent regressions are highly significant.

The path coefficients of the standardised regression (β) measure the strengths of the relationships between the constructs or the proposed hypotheses of causality. For this index, desirable values are higher than 0.3.

Table 4. Bootstrapping results

Hipótesis	**Relación**	**Beta**	**t valor**
H1	Global warming awareness -> Environmental awareness	0,4399	4,8898
H2	Use of transgenic -> Environmental awareness	-0,202	2,5694

Figura 4. Structural model



In order to evaluate the predictive power of the model, the Blindfolding procedure is adopted (Tenenhauset et al. 2005). In carried out by means of the Q2 index in which part of the data of a construct is omitted during the estimation of the parameters. After that, the omitted data is estimated using the estimated parameters during the first step of the process (Chin, 1998b). The Q2 value in an indicator of the model´s predictive relevance. In the structural model , Q2 values larger than zero for a certain reflective endogenous latent variable indicate the path model´s predictive relevance for this particular construct. The obtained results are all positive which indicates that the predictive relevance of the model is verified.

The explained variance by means of the R^2 index shows that the variance of the construct that is explained by the model, which has to be larger than 0.1. This requirement is satisfied for the endogenous construct. It is important to highlight that the model explains 24.7% of this construct.

Table 5. Results of $\boldsymbol{R^2}$ and Q^2

Endogenous construct	R^2	Q^2
Environmental awareness	0,247	0,101

In summary, the model presents good psychometric properties that validate the estimation of the latent variables.

It is important to highlight that unlike CB-SEM , PLS-SEM does not optimize a unique global scalar function. "The lack of a global scalar function and the consequent lack of global goodness-of-fit measures are traditionally considered major drawbacks of PLS-SEM. When using PLS-SEM, it is important to recognize that the term fit has different meanings in the contexts of CB-SEM and PLS-SEM. Fit statistics for CB-SEM are derived from the discrepancy between the empirical and the model-implied (theoretical) covariance matrix, whereas PLS-SEM focuses on the discrepancy between the observed (in the case of manifest variables) or approximated (in the case of latent variables) values of the dependent variables and the values predicted by the model in question". Hair et al., 2013, p 78).

The strongest effect on environmental awareness is given by the construct global warming awareness which is reflected in a standardised beta value of 0.4399. This indicates that an increase in one standard deviation in global warming awareness, environmental awareness increases approximately by 0.44 standard deviations. In relation to the construct use of transgenic, the results revealed that an increase in one standard deviation of this construct, environmental awareness decreases by 0.2 standard deviations.

7. Conclusions

This article introduces the structural equations methodology referred to as Partial Least Square (PLS) as a potential tool to analyse farmers' decision making. The advantage of this methodology is that it can be used to explore causal relationships between constructs and identify interrelations between all the factors that determine a relevant factor to be measured. This methodology can be applied to small samples and to variables that do not follow a normal distribution.

The focus of PLS-SEM is more on prediction than on explanation, which makes PLS-SEM particularly useful for studies on the sources of competitive advantage and success driver studies (Hair et al., 2013)

The methodology was applied to a case study in the UK with the purpose of determining whether factors related to global warming awareness and the use of transgenic influence farmers' environmental awareness. The results revealed that environmental awareness is strongly affected by these constructs.

This case study illustrates the advantage of the methodology proposed in this article and it possible application in the agricultural sector. This can not only inform about farmers' motivation, but also ways in which resources may be allocated in order to induce beneficial behaviour.

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