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An Analysis of the Capitalisation of CAP Payments into Land Rental Rates in Ireland

ABSTRACT

In this paper the effect of decoupling on the capitalisation of agricultural subsidies into agricultural rents in Ireland are analysed using a dynamic rental equations estimated with a two step system GMM estimator that accounts for expectation error and endogenous regressors. The findings illustrate the importance of institutional details in determining the extent to which subsidies are capitalised. In the period prior to decoupling Pillar 1 subsidies were highly capitalised into Irish agricultural rents in both the short and the long run. Depending on the farm system considered between 58 to 80 cents per euro of subsidies were capitalised into agricultural rents. In the post decoupling period the rate at which Pillar 1 subsidies are capitalised into Irish agricultural rents is found to have declined. This change is likely due to short term character of the Irish agricultural land rental market, where 11 month rental periods predominate, and the freedom that the 2003 reform of the CAP offered farmers to consolidate entitlements established on rented land. The generally very short term nature of Irish agricultural rental contracts offered farmers an opportunity to consolidate entitlements that is unlikely to have arisen in other Member States with agricultural land rental markets characterised by long term contracts. The results in both the pre and post decoupling periods highlight the high degree of inertia of agricultural rents in Ireland, and the importance of accounting for dynamics when investigating the capitalisation of agricultural subsidies into land rents. The high degree of inertia in rents means that the impact of previously capitalised agricultural policy persists through time.

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Stephen O'Neill and Kevin Hanrahan*

Factor Markets Working Paper No. 68/August 2013

1. Introduction

The agricultural sector in the EU, as in the US, is heavily subsidised. Appropriations dedicated to the Preservation and Management of Natural Resources accounted for €60.2bn or 39.8% of the 2013 EU budget.[1] These appropriations are mainly devoted to financing the Common Agricultural Policy (CAP) and the Common Fishery Policy (CFP), with the CAP accounting for over 70% of spending.[2] Initially, agricultural incomes were supported via market supports, however the endemic over-production that resulted lead to the MacSharry Reforms agreed in 1992. These reforms were comprised of reductions in intervention prices for meat and cereals which were offset by increased direct payments. While for cereal farmers the direct payments were based on the area of particular crops grown, subject to set-aside restrictions, for livestock farmers, direct payments were based on headage subject to extensification criteria limiting animal densities per hectare of forage area. However, since these payments were linked to current production outcomes, they continued to distort production decisions and hence input use, as farmers sought to increase their subsidy receipts.

Given the incentive to increase production and the associated increase in input use, one would expect upwards pressure on input prices, particularly for inputs with relatively inelastic supply such as land (Floyd, 1965; Hertel, 1989; Ciaian and Swinnen, 2006). This has important implications for the transfer efficiency of subsidies since the portion of subsidies that is bid into input prices is not reaching its intended recipient, lowering the transfer efficiency of subsidies. As a result the capitalisation of subsidies into input prices, particularly land prices, has attracted considerable attention in the literature (Phipps, 1984; Featherstone and Baker, 1987; Barnard, et al., 1997; Weersink et al., 1999; Shaik et al., 2005 *inter alia*). More recently attention has focussed on land rental rates (see for example Lence and Mishra, 2003; Roberts et al. 2003; Kirwan, 2005, 2009).

Concerns regarding the potential for coupled support payments to distort production and trade, in addition to the impending enlargement of the EU, led to the Mid-Term Review of the CAP (or Fischler reforms) agreed in 2003. These reforms sought to replace payments based on current production with payments based on past production decisions, referred to as "decoupled" payments since they are no longer coupled to current production. In the EU and the US, decoupled payments are tied to the possession of land, although as discussed below the specifics differ across the two regions. To the extent that coupled subsidies are bid into non-land inputs, one may anticipate that a move to decoupled subsidies would increase land values since there is no requirement to actually produce, freeing farmers from the need

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[1] http://ec.europa.eu/budget/figures/2013/2013_en.cfm accessed 1st October 2013.

[2] http://ec.europa.eu/budget/figures/interactive/index_en.cfm accessed 1st October 2013.

to purchase non-land inputs. The inelastic supply of land, in conjunction with the requirement to possess land to claim full decoupled payments, may increase the capitalisation of subsidies into rents.

However, subsidies that are ostensibly decoupled from production may still influence production decisions, for example due to wealth and insurance effects (Hennessy, 1998; Rude, 2000), by improving access to credit (Vercammen, 2003) or by changing farmers' labour supply (Guyomard et al., 2004). Where decoupled payments are based on historical production decisions, there may also be an incentive for farmers to maintain increased production levels if they expect the basis on which payments are made to be updated to include the current period at some future point in time (OECD, 2001; Westcott and Young, 2002). Therefore decoupled payments may continue to be partially capitalised into non-land input prices, reducing the extent to which they are bid into land values.

The institutional arrangements and the requirements attached to decoupled payments may also play a role in reducing the extent to which decoupled payments are capitalised into land rents. For instance, a bond scheme has been proposed (Swinbank and Tangerman (2001), Swinbank and Tangermann (2004)) whereby decoupled payments would not be tied to the possession of land (or any other input) and would be freely tradeable. Such an approach would be expected to greatly reduce the possible extent of capitalisation.

This paper adds to the burgeoning literature on capitalisation of subsidies into land rents by exploring the extent to which coupled and decoupled subsidy payments have been capitalised into land rental rates in Ireland using panel data from the Teagasc National Farm Survey for the years 2000 to 2009 encompassing both the period preceding the move to decoupled payments and the four years after their introduction. In Ireland, the vast majority of farms rent land under the conacre system which consists of short term loans, usually of 11 months duration (Patton et al., 2008; O'Neill and Hanrahan, 2012). Thus rental contracts are renegotiated regularly implying that the effects of policy changes on rents should be more apparent in Ireland than in countries where multi-year contracts are prevalent. As discussed below, as part of the Fischler reforms, farms are allowed to transfer, or consolidate, subsidies from land where rental contracts have expired to other rented or owned land. Given the prevalence of short term contracts in Ireland, many farms had the option of consolidating their entitlements and hence we anticipate that capitalisation should be low in Ireland compared to other EU countries. In essence, many farmers in Ireland are in a position to `escape' from situations where significant portions of their subsidies are being captured by landowners by consolidating their entitlements. Combined with the tradability of entitlements, consolidation moves the decoupled SPS payment in Ireland in the direction of a bond scheme and would be expected to increase the transfer efficiency of the decoupled subsidies. Thus if coupled payments were heavily capitalised into rents, a decline in rents is anticipated.

However, previous research, focussing on the area rented, has revealed considerable inertia in the rental decisions of Irish farmers (O'Neill and Hanrahan, 2012). Anecdotal evidence suggests similar inertia exists in rent-setting leading to uncertainty as to whether consolidation will lead to changes in land rents following the introduction of decoupled payments. Hence, the extent of decoupling is an empirical question. To account for inertia, we estimate a dynamic linear model for land rents using a System GMM approach (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). Our findings suggest that coupled subsidies for dairy, sheep and tillage farms are capitalised into land values with 77 cents, 67 cents and 90 cents of each euro of support being bid into rents respectively in the long run. For cattle farms the point estimate suggests 54 cents per euro of support is bid into rents although this is not statistically different to zero. Following the Fischler reform, there is a reduction in the extent of capitalisation for dairy (41 cents) and tillage (53 cents) farms. The point estimate for cattle farms decreases to 21 cents and becomes statistically significant while, for sheep farms, the point estimate reduces to 35 cents although this is not statistically different to zero.

This research has important policy implications since the greater the incidence of subsidies on rents, the less of the subsidy that reaches the targeted recipient and hence the less impact the policy has on the farm incomes of this group. Indeed, to the extent that land is owned by non-farmers or farmers engaged in unsupported production types, the subsidy may not even reach the intended sector. Even within the supported sector, the incidence of the subsidy is likely to lie disproportionately with farms of larger agricultural area that would be in a position to rent-out land if the payments are heavily capitalised into agricultural land rents. Furthermore, since land is a fundamental requirement for agricultural production to occur, increased land rents/prices may represent significant barriers to entry into the agricultural sector and may also impede restructuring within the sector (Karlsson and Nilsson, 2013). This final consideration is likely to be very important in an Irish context as a very low proportion of agricultural land is transacted on an annual basis, and the principal route through which structural change in Irish agriculture is likely to occur is via the agricultural land rental market.

The paper is organised as follows: we next provide the context to this study, then discuss the methodology employed and introduce the dataset used before discussing our results and presenting some conclusions.

2. Background

Most of the existing literature on the capitalisation of subsidies into rental rates has been carried out using data from the US, although more recently this topic has garnered attention in a European context also (Patton, Kostov, McErlean and Moss, 2008; Breustedt and Habermann, 2011; Ciaian, Kancs and Michalek, 2011; Ciaian and Kancs, 2012).[3] Before discussing the literature on capitalisation of subsidies, it is instructive to give a broad overview of the policy context underlying subsidy regimes in the US and EU in the periods considered.[4]

2.1 United States

In the US, prior to the Federal Agriculture Improvement and Reform (FAIR) Act in 1996, farms received counter-cyclical subsidies called deficiency payments which depended on historical crop yields, the eligible area devoted to each crop and a set of payment rates which were based on the difference between the target price and the national average price received for each crop. The FAIR Act removed the link between these income support payments and production, through the introduction of Production Flexibility Contracts (PFC) payments which are independent of the types, quantities and the market prices of crops grown (Guyomard, Bureau, Gohin and Le Mouël, 2000). The PFC payments were tied to specific plots of land and therefore land transfers directly resulted in transfers of subsidies between farms. This contrasts with the situation in the EU, where the farmer must obtain a specified number of eligible hectares to claim full payments, but there is no stipulation that the particular hectares declared be the same in each period. The PFC payments were introduced during a period of high output prices which were envisioned to continue. However, this proved not to be the case and the Market Loss Assistance (MLA) programme was introduced to compensate farms for low commodity prices. These payments were substantial, amounting to approximately 50% of the amount of PFCs in 1998 and 100% in 1999 and 2000 (Childs, 2001). The MLA payments were also decoupled from production since they were based on base acreage regardless of whether particular crops were currently being grown on the land.

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[3] Latruffe and Le Mouël (2009) provide a detailed review of the literature concerned with capitalization of government subsidies in land prices and rental rates.

[4] Our discussion of the US system of subsidies draws from Kirwan (2005) and the other cited US studies.

In addition to the PFC and MLA payments, farms were also eligible for Conservation Reserve Program (CRP) payments which were paid to landowners in exchange for removing erodible cropland from production (Sumner, 2007) and Loan Deficiency Payments (LDP) which are payments to farms that occur when the world price falls below the loan rate for particular crops including wheat, feed grain, upland cotton, rice and oilseeds (Childs, 2001).

In the US, farm bills are introduced every 5 to 7 years and so the Farm Security and Rural Investment (FSRI) Act of 2002 was introduced to succeed the FAIR Act. The FSRI Act introduced Counter-Cyclical Payments (CCPs) to replace the ad-hoc MLA payment and, more significantly, allowed producers to update their historical acreage and yield information on which PFC payments were made according to planting during the post-1996 periods.[5]

In the context of the FAIR Act, Lence and Mishra (2003) explore the impact of the PFC payments, MLA, CRP payments and LDP on cash rental rates for farmland in Iowa and find that MLA and PFC payments, which are decoupled from production, are almost completely bid into land rents. On the other hand, Lence and Mishra find that CRP payments are not capitalised into rents. Surprisingly, Lence and Mishra find that deficiency payments and payments linked to price support programs are associated with lower rents. Their results also suggest that market revenues are bid into land rents. An important consideration when estimating the extent to which subsidies are bid into land rents is the fact that rents are generally set prior to the realisation of market returns and, in some cases, subsidies giving rise to expectation error which potentially biases estimates (this issue is discussed in detail in the Methodology section below). Lence and Mishra use lagged realisations of the explanatory variables within a GMM estimation approach to over come this potential source of bias.

Roberts, Kirwan and Hopkins (2003) conduct a similar analysis to that of Lence and Mishra using Census of Agriculture data for the US. PFC payments in 1997 were known in advance removing the possibility of expectation error and this allows the effect of PFC payments to be identified in 1997 and also in 1992 (where 1997 values are used to instrument those of 1992). The strongest estimates in Roberts et al. are obtained using instrumental variable (IV) regression on the change in rents and change in government payments between 1992 and 1997. Their results suggest that between 34 and 41 cents per dollar of government subsidies are bid into land rents, substantially lower than the figures reported by Lence and Mishra for Iowa.

Kirwan (2009) explores capitalisation of subsidies within the US using 3 approaches. Firstly he uses data from the US Census of Agriculture to estimate that 20-25 cents per marginal subsidy dollar is capitalised into land rents, and hence captured by landowners, while 70-75 cents per dollar is captured by the tenants by modelling tenants' net returns in place of rental rates. Kirwan goes on to explores the extent to which capitalisation differs across regions and finds that in some regions landowners do not appear to capture any of the subsidies, while in the other regions between approximately 17 and 48 cents per dollar of subsidies is capitalised into agricultural land rents. Next, Kirwan augments the Census of Agriculture data with data from the 1999 Agricultural Economics and Land Ownership Survey (AELOS), to explore the capitalisation of subsidies following the introduction of the unanticipated MLA payments, and finds that 34 cents per dollar are bid into rents. Finally, by adding data from the 2006 Agricultural Resource Management Survey (ARMS), Kirwan explores capitalisation between 1997 and 2006, finding that 26 cents of subsidies were capitalised during this period, which includes 4 years after the introduction of the FSRI Act.

In contrast to the preceding studies which consider farm level average per acre rents and average subsidies per acre, Kirwan and Roberts (2010) use field level data from the USDA's Agricultural and Resource Management Survey (ARMS) Phase II survey conducted in 2006and find that between 14 and 24 cents of the marginal subsidy dollar are bid into land rents.

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[5] The reader is referred to Sumner (2003) and Kirwan (2009) for a detailed discussion of the changes introduced under the FSRI Act.

In the US, a significant minority of farms rent land under crop-sharing contracts rather than cash rental contracts. The Agricultural Resource Management Survey (ARMS) data provides information regarding the type of rental contract which Qiu, Gervais and Goodwin (2010) use to estimate that landlords capture approximately 38% of total subsidies under cash leases compared with approximately 86% under crop-share contracts. In contrast to the studies previously cited which adopted IV approaches to deal with measurement error in the subsidies, Qiu et al. proxy expected subsidies and expected net market earnings using five-year county average values.

Woodard, Paulson, Baylis and Woodard (2010) estimate a spatial hedonic model for Illinois cash rents using panel data from the Illinois Farm Bureau Farm Management (FBFM) Association for 1996 to 2008. Their results for the entire period suggest capitalisation of 27 cents per dollar but when the sample is divided into pre and post the 2002 FRSI, capitalisation is found to be only 8 cents pre-FSRI and 47 cents post-FSRI. While Woodard et al. argue that this is not unexpected given the greater predictability of government subsidies under the FSRI farm bill, it does raise questions given the expectation that FSRI Act would reduce the extent to which subsidies to US agriculture were coupled to production.

Hendricks, Janzen and Dhuyvetter (2012) use a panel dataset of Kansas farmers from 1990 to 2008 to estimate a dynamic rental equation to account for inertia using System GMM (as in this paper). They find that the coefficient of lagged rent is 0.675, indicative of considerable inertia in rental rates. The short run capitalisation of subsidies is estimated to be 7 cents per dollar before correcting for the share of rented land that is based on share-cropping contracts, although this is found not to be statistically significantly different from 0. After adjusting the dependent variable to account for the type of rental contract (cash versus share-cropping) the short-run (long run) capitalisation of subsidies into agricultural rents increases to 12 cents (37 cents) per dollar of subsidies.

2.2 European Union

Since the Treaty of Rome (1957), EU farmers have received income support under the Common Agricultural Policy (CAP). Initially, as in the US, these payments took the form of price supports, however following the MacSharry Reforms, which were agreed in 1992, support shifted towards direct income support payments based on area planted and the number of livestock farmed. Due in part to concerns regarding the production distorting effects of such payments, the Single Payment Scheme (SPS) was introduced in 2005 following the Fischler reforms to CAP agreed in 2003.

The SPS involves direct payments based on production during the reference period 2000-2002. Decoupling direct income support from current production activities, it is claimed, removes the policy based incentives faced by farmers to alter current production decisions. Thus these payments were decoupled from production in a similar manner to the PFC payments in the US. One important distinction, is that while PFC payments in the US were tied to specific plots of land, in the EU SPS farmers must be in possession of a specified number of hectares to obtain a full payment, but importantly there is no requirement that the farmed area comprise of the same parcels in each period. Hence, under the SPS farmers in the EU have greater flexibility to trade land (e.g. via land rental markets) while maintaining their SPS payment. We would therefore *a priori* expect that capitalisation would be lower in the EU than in the US. However, since a requirement to possess a specific amount of land based on the area farmed during the reference period would have created serious problems for farmers whose rental agreements had expired, an option to ”consolidate” entitlements was offered (DAF, 2004). The consolidation option meant that farmers whose land rental agreements had expired could effectively transfer payments from areas which they no longer rented to land which they still possessed.[6] These farmers are then required to maintain an

[6] Under the consolidation option farmers with entitlement established in part or in full on rented-in land could reduce the area used to claim their entitlement by a maximum of 50%. The value of each

area equal to the portion of their declared land for which the rental agreements had not expired. The farmers that have exercised the consolidation option may effectively no longer have a requirement to rent-in land to satisfy the SPS land requirement or at least have a reduced demand for rented in land. Hence the land requirement is less binding in Ireland than in other European countries due to the "conacre" system of short term land rental agreements in operation.

Under the SPS, EU Member States had a number of options for how the scheme would be implemented, with most countries including Ireland, Scotland and Wales, adopting the historic approach whereby payments were farm-specific, based on production decisions during the reference period (2000-2002). Other countries, such as England and Germany adopted what is known as a dynamic hybrid model under which the payment model transitioned over time from a mixture of a flat are payment and a historically determined payment to a regional flat area payment whereby all farms within a region receive an equal payment per hectare. Other countries, including Northern Ireland and Sweden, adopted a static hybrid model wherein the payment received is a mixture of a historically determined and a flat area payment with no further transition towards a flat area payment model.[7] Member States that joined the EU in 2004 and 2007 (with the exception of Malta and Slovenia who operate under the SPS) were allocated payments under the separate Single Area Payment Scheme (SAPS) which consisted of flat rate per hectare payments applied to all farms.

The capitalisation of CAP payments into European land rents has received relatively little attention until quite recently. Early work in this area was conducted by Fuchs (2002), who aggregates Farm Accountancy Data Network (FADN) data for specialist crop farms to regional levels for 53 regions in the EU for the years 1989-1999 and estimates that approximately 7 cents per additional euro of subsidies is bid into rents. Patton, Kostov, McErlean and Moss (2008) explore the capitalisation of the pre-Fischler reform payments into land rents in Northern Ireland using data from the Farm Business Survey from 1994 to 2002. Rental contracts in Northern Ireland are also based on the 'conacre' system. Patton et al. (2008) find that coupled subsidies such as special beef premium (41 pence per £1 of subsidies) and suckler cow premium (42 pence per £1 of subsidies) are heavily capitalised into agricultural land rents, while the ewe premium is fully capitalised into land rents. The greater capitalisation of sheep payments is attributed to the fact that sheep production requires few inputs besides land, limiting the extent to which other factors of production capture these subsidies. Hill-livestock compensation allowance (58 pence per £1 of subsidies) and less favoured area payments (£1.20 per 1£ of subsidies) are also found to be bid into rents. Patton et al. find that while dairy net returns are bid into land rents, this is not the case for net returns to cattle and sheep– with a negative, though statistically insignificant, relationship found to exist between these returns and land rents found.

Using data for the German federal state of Lower Saxony in 2001, Breustedt and Habermann (2011) estimate a spatial econometric model for rents, and find that a one euro increase in rental rates in a farm's neighbourhood increases the farm's rents by 72 cents. They explore the incidence of EU per-hectare payments for eligible arable crop land and find that an additional euro of premium payments increases rents by 38 cents.

Ciaian, Kancs and Michalek (2011) raise a number of issues with previous regression based approaches to estimating the capitalisation of subsidies into rents, issues identified include selection bias due to payments being based on farmers' past management choices, endogeneity due to unobserved factors such as productivity influencing rents and the SPS

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entitlement (€/ha) is increased following consolidation so that total farmer receipts from the SPS were unaffected.

[7] The full set of implementation approaches taken by each country is provided in European Commission (2012). The distinction between the various systems is elaborated on by Swinbank *et al.* (2004) and Kroll (2008).

payments, and the inability of many of the approaches employed in the literature to capture general equilibrium effects whereby subsidies to agriculture put upwards pressure on all rental rates even for farms that have not rented land. Ciaian et al. apply a generalized propensity score matching estimator to a balanced panel of FADN data for the EU-15 from 2004 to 2007. They find that the extent of capitalisation depends on the level of SPS per hectare, with higher SPS being less capitalised into agricultural land rents. The extent of capitalisation found by Ciaian et al. also varies across countries ranging from 2 percent in Denmark and Greece to 11 percent in Spain when averaged across all farms, although capitalisation also varies within countries across different farm sizes. Their results for Ireland suggest that for all farms, only 5 percent of the SPS payment is capitalised into rents and that the degree of capitalisation is fairly constant across different farm sizes in Ireland at 4 percent for farms below 10 hectares and 5 percent for farms above 10 hectares.

Ciaian and Kancs (2012) explore the capitalisation of SAPS payments into land rents in the new EU Member States using FADN data for 2004 and 2005.[8] A first-difference estimator is used to remove the effects of time invariant omitted variables and selection bias is controlled for by including the Inverse Mills Ratio (IMR) based on a probit model for whether the farm rents land. They find that between 18 and 20 cents per euro of SAPS payments are bid into land rents and that selection bias does not appear to be an issue since the coefficient on the IMR variable is statistically insignificant.

Moro, Guastella, Sckokai and Veneziani (2013) use FADN data for field cropping farms in Italy for the years 1994 to 2008 to explore the extent of the capitalisation of agricultural subsidies into agricultural land rents pre- and post-decoupling. They apply an estimation approach proposed by Wooldridge (1995) that allows for selection bias in panel data, and an extension by Semykina and Wooldridge (2010) that allows for endogenous explanatory variables. This estimation strategy involves, in its first stage, estimating probit equations for the decision to rent land separately for each year with the explanatory variables from the rental equation, some variable(s) which influence whether a farm rents but do not influence how much rent is paid and a set of instruments for the endogenous variables. In the second stage, a pooled instrumental variable regression is used to estimate the effects of the explanatory variables on rents with the IMRs from the first stage's probit models included as covariates to control for selection effects. It should be noted that this approach is suitable only for static panels. Moro et al. find that by using an estimation strategy that ignores endogeneity a significant negative effect for coupled subsidies and an insignificant effect for decoupled payments. However, using the approach of Semykina and Wooldridge in which the impact of endogenous explanatory variables is accounted, Moro et al. find that neither the coupled or decoupled subsidies exert a significant effect on agricultural land rents.

The foregoing review of the literature examining the capitalisation of agricultural subsidies into agricultural land rents reveals significant variability both in terms of the estimated influence of government subsidies on rental rates and in the methodologies that have been employed to date. Amongst the issues potentially facing the econometrician when trying to establish the degree of capitalisation of subsidies into rents are spatial correlation[9], inertia requiring the use of dynamic models, endogeneity due to expectation error and/or selection bias. While methods exist to simultaneously deal with a number of these problems, no model is a panacea. We next discuss the empirical approach taken in this paper.

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[8] The new Member States are Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland and Slovakia.

[9] Accounting for spatial correlation requires the availability of information regarding farms geographic location which unavailable in this study. Authors such as Lence and Mishra (2003), Breustedt and Habermann (2011) and Karlsson and Nilsson (2013) did not face this limitation.

3. Methodology

The canonical approach to estimating the capitalisation of subsidies assumes that the rental rate per hectare paid by farm i in period t (R_{it}) can be expressed as a function of expected market-based returns (M_{it}) and the expected levels of the various government subsidies (G_{it})

$$R_{it} = \alpha + \beta E[M_{it}] + \omega E[G_{it}] \quad [1]$$

As discussed by Hendricks et al. (2012), the rental rate paid by a farmer in a particular year may in part depend on the rental rate paid by the farmer in the previous period – this is particularly likely where land is rented for periods in excess of a year. While the system of agricultural land rental in Ireland is predominantly short term `conacre' rentals, anecdotal evidence suggests that there is considerable inertia in rent setting by farmers in Ireland. Furthermore, allowing for time invariant unobserved heterogeneity (μ_i) and including a random error term leads to the econometric model in [2]:

$$R_{it} = \gamma R_{it-1} + \alpha + \beta E[M_{it}] + \omega E[G_{it}] + \mu_i + \varepsilon_{it} \quad [2]$$

The long run effect of net market returns and government subsidies are given by $\frac{\beta}{(1-\gamma)}$ and $\frac{\omega}{(1-\gamma)}$ respectively (Hendricks et al., 2012)). Since the farmers' expectations regarding market returns and subsidies are in general unobserved, in the literature it is common to use realised values in place of expectations, while allowing for the fact that this introduces expectation error, which is akin to measurement error. The expectation error associated with market returns is denoted ε^M, while the expectation error for government subsidies is denote ε^G. Equation 2 can be re-written:

$$R_{it} = \gamma R_{it-1} + \alpha + \beta M_{it} + \omega G_{it} + \mu_i + \varepsilon_{it} - \beta\varepsilon_{it}^M - \omega\varepsilon_{it}^G$$

$$= \gamma R_{it-1} + \alpha + \beta M_{it} + \omega G_{it} + \mu_i + \upsilon_{it} \quad [3]$$

The estimation of equation [3] will lead to a bias in the estimated coefficients. To see this, consider two identical farmers, A and B with similar expectations regarding their income per hectare so that they should be willing to pay the same rental rate (R^A=R^B). If farmer A's realised market return is greater than expected, then $M^A > M^B$ but R^A=R^B. The econometrician would base estimates on the effect of income on rents on the variation of realised income ($M^A - M^B$) rather than the variation in expected income which is 0 in this example. Mathematically, we can express this bias as: $plim\ \hat{\beta} = \frac{cov(R_{it},M_{it})}{var(M_{it})} = \frac{var(E(M_{it}))}{var(E(M_{it}))+var(\varepsilon_{it}^M)}\beta$. A similar bias may exist where government subsidies are not known with certainty when rents are being determined.

A number of approaches could be applied to overcome this expectation error bias. Firstly, one could seek a variable that captures expectations directly (e.g. Kirwan and Roberts, 2010). Secondly, if one knows the extent of expectation bias from some other source, then an adjustment to the realised variable could be made. A third approach, and that which is taken in this paper (as well as much of the recent literature), is to use an instrumental variable (IV) approach whereby variables that are correlated with realised returns but are not correlated with the expectation error are used as instruments for the realised values (Roberts et al., 2003; Lence and Mishra, 2003; Hendricks et al., 2012 and Patton et al., 2008 *inter alia*).

Expectation error is not the only complication that arises when using estimates of equation [3] to identify the capitalisation of agricultural subsidies into rental rates. Unobserved heterogeneity, if ignored, will result in serial correlation, since μ_i is time invariant and unobserved, and will also bias the estimated coefficients if μ_i is correlated with the explanatory variables. Furthermore, correlation between the lag (R_{it-1}) and μ_i will lead γ to be overestimated in an OLS regression and will cause standard errors to be inconsistent

(Arellano and Bond, 1991). On the other hand Nickell (1981) shows that the within transformation (or LSDV estimator) also leads to bias in this context.[10] One approach to deal with this problem is to transform the data by differencing or using forward orthogonal deviations (Arellano and Bover, 1995) to remove the μ_i.[11] Differencing the data, we obtain the following model:

$$\Delta R_{it} = \gamma \Delta R_{it-1} + \beta \Delta EM_{it} + \omega \Delta G_{it} + \Delta v_{it} \quad [4]$$

However ΔR_{it-1} (= R_{it-1} - R_{it-2}) is correlated with $\Delta v_{it} = v_{it} - v_{it-1}$, since R_{it-1} is a function of $v_{it,}$ meaning that OLS on first-differences is not consistent – essentially differencing the data has introduced endogeneity. A standard approach to dealing with endogeneity is to use instrumental variables for the endogenous variable, ΔR_{it-1} in this case (Anderson and Hsiao, 1981).[12] Valid instruments may include ΔR_{it-2} and R_{it-2} since neither is directly related to v_{it} or v_{it-1} and hence to Δv_{it}. Further lags of R (i.e. "levels") and ΔR (i.e. "differences") would also be suitable instruments. Although this approach provides a consistent estimate of γ, a disadvantage of using a standard IV regression approach is that each additional lag that is used reduces the sample on which the model may be ran by 1 year. In short panels this may represent a considerable loss of information.

As proposed by Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991), within a Generalised Method of Moments (GMM) framework, we can solve this problem of information loss by varying the number of lags used as instruments depending on the period being instrumented, increasing the number of available instruments. GMM allows us to find the optimal weighting of these instruments. For example for an observation in year 3, we can use R_{i1} as a valid instrument for ΔR_{i2}, for year 4 we can use R_{i1} and R_{i2} as instruments for ΔR_{i3} and for year t we can use R_{i1}, … , R_{it-2} as instruments for ΔR_{it-1}.[13] Using levels of the endogenous variables as instruments for their differences is known as "difference GMM".

Blundell and Bond (1998) argue that levels of the variable are poor instruments for differences when the series is highly persistent and that considerable efficiency gains can be achieved by using lagged differences as instruments in the levels equation, with larger gains in precision when γ is higher. The estimator which takes advantage of these additional moment conditions is known as the system GMM estimator.[14]

In one-step GMM an arbitrary choice is made about the variance-covariance matrix for the errors (Ω), e.g. homoskedasticity, providing a consistent estimator of β. In two-step GMM the residuals can be obtained using the one-step estimator and are used to estimate the variance-covariance matrix ($\hat{\Omega}_{\beta_1}$). The two-step GMM estimator is thus:

$$\hat{\beta} = \left(X'Z\left(Z'\hat{\Omega}_{\beta_1}Z\right)^{-1}Z'X\right)^{-1}\left(X'Z\left(Z'\hat{\Omega}_{\beta_1}Z\right)^{-1}Z'Y\right)$$

Where X is a matrix of explanatory variables, Z is a matrix of instruments and Y is a vector of containing the dependent variable for each individual. This two-step estimator suffers from downward bias in the standard errors, however Windmeijer (2005) suggests a correction to

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[10] Whilst estimating [2] using OLS offers an upper bound estimate for γ, the within (i.e. fixed effects) estimator tends to underestimate γ (in short panels) offering some guidance for where the true value should lie (Bond, 2002).

[11] Demeaning the data would also remove μ_i. However this is unattractive since the demeaned error term would be correlated with lags of the explanatory variable.

[12] Market income and government subsidies are also instrumented as discussed later in the paper.

[13] Since the number of instruments is quadratic in T, instrument proliferation is a concern, since the endogenous variable may be over-fitted, so that the endogeneity remains (Roodman, 2009).

[14] This approach requires an additional assumption that the change in rents is not correlated with time-invariant unobserved heterogeneity (μ_i)

reduce this small-sample bias. Roodman (2009) recommends that time dummies are included to allow for universal period-specific shocks which may violate the assumption that errors are correlated only within individuals and not across them. Arellano and Bond (1991) developed a test for serial correlation in the idiosyncratic errors in the differenced equation. While first order autocorrelation is likely to be present by construction since Δv_{it} and Δv_{it-1} both include v_{it-1}, higher order serial correlation would render some lags invalid as instruments. Sargan (1958) offers a means to test the exogeneity of the chosen instruments if the model is over-identified and the errors are assumed to be homoskedastic.[15] Hansen (1982) generalises this test to allow for heteroskedastic errors, although these tests are weak when many instruments are used so a degree of caution is required.

Two further statistical issues warrant discussion. Firstly, the Teagasc NFS does not geo-code farms so it is not possible to explore spatial correlation. Secondly, there is the potential for selection bias whereby factors which influence whether a farm rents land also influence the farms market income and/or subsidy receipts. While Moro et al. (2013) use an approach developed by Semykina and Wooldridge (2010) to deal with selection bias and endogeneity, this approach is only valid for static panels and hence is not pursued here.[16] Moro et al. do not report whether the Inverse Mills Ratio in their model is significant which would indicate the presence of selection bias, however, Ciaian and Kancs (2012) do not find evidence of selection bias in their model which offers some reassurance in this regards. Nevertheless the inability to control for the possibility of selection bias is a limitation of this study.

4. Data

Each year, the Teagasc National Farm Survey (NFS) of approximately 1,200 Irish farmers is conducted.[17] The survey data is nationally representative of Irish dairy, cattle, sheep and tillage farmers. Although the Teagasc NFS does not contain data on the rental rate paid for particular parcels of land, it does contain information on the total amount of rent paid and the total area rented in, allowing the calculation of an average rental rate per hectare rented-in. Ideally the dataset would contain information on market returns and subsidies specific to the area rented in, however such detailed data are not available. Facing similar data shortcomings, authors including Ciaian and Kancs (2012) use average values per hectare *farmed* in place of average values per hectare *rented* and we do likewise.. In Ireland it is not uncommon for farmers to rent land from family members for nominal amounts. We therefore exclude rents of less than 20 euro per hectare which are considered to be unreliable reflections of the true rental cost of land (n=45). A small number of farms report implausibly high subsidies or market incomes per hectare (e.g. 2000 euro per hectare) which would bias results so, in order to prevent this bias, we remove a small number of farms that report values greater than 3 standard deviation from the mean for any of the key explanatory variables or rent per hectare (n=103).

Since we anticipate differences in the extent of capitalisation depending on whether subsidies are coupled or decoupled from production we separate subsidies into Pillar 1 and Pillar 2 payments. Prior to 2005, Pillar 1 subsidies were coupled to production, while post-2005 these subsidies were replaced with the SPS and hence were decoupled from production. Pillar 2 payments are intended to support rural development and environmental protection and place limitations on the activities farms can pursue, hence while they are not considered to be coupled to production in that payment levels do not depend on production they may

[15] The use of multiple lags as instruments means that in GMM models are generally over-identified.

[16] Although Semykina and Wooldridge (2013) have also advanced an approach to deal with selection bias in a dynamic panel context, their approach is not valid when the explanatory variables are endogenous as is the case here. The authors thank Professor Semykina for helpful comments regarding this point.

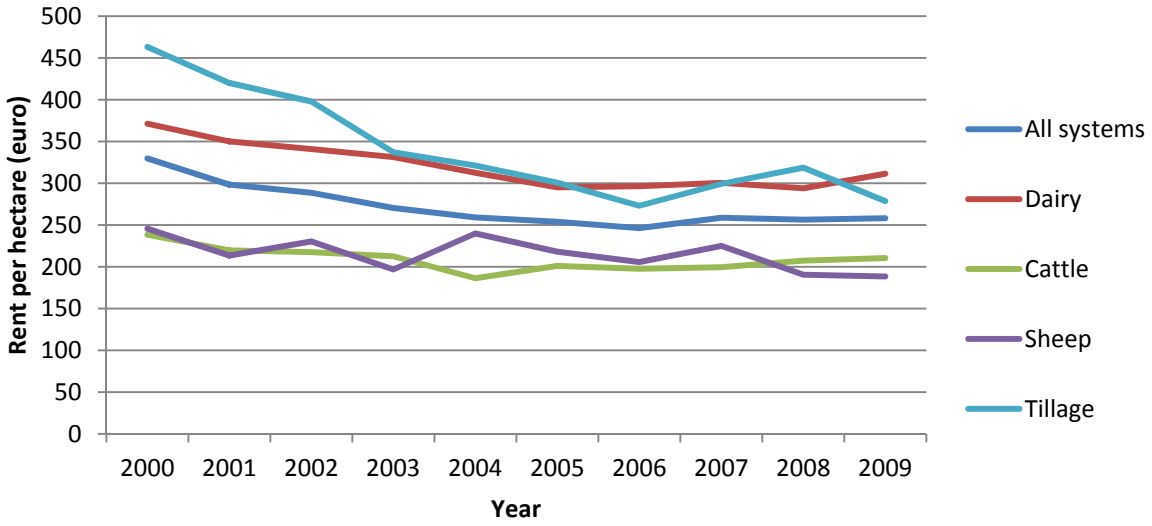
[17] The Teagasc NFS is part of the Farm Accountancy Data Network (FADN) of the European Union (EU).

nonetheless influence production decisions since they may constrain the intensity of the agricultural activities practiced. We estimate the model separately for the pre-decoupling and post-decoupling periods using an unbalanced panel of 10,890 observations for 2,082 farms. Figures A1 to A3 in the appendix illustrates the distribution of the key explanatory variables for each system by year, while Figures A4 to A6 illustrates the considerable inertia that exists for these variables also.

5. Results

Figure 1 illustrates that the average rental rate per hectare of agricultural land as recorded by the Teagasc NFS has declined substantially in the years immediately preceding the shift to decoupled payments in 2005 but that rents over the period 2005 to 2008 have remained relatively constant. Average rents per hectare paid by dairy farms and tillage farms are higher than those paid by cattle and sheep farms which reflects important differences in the average quality of land farmed in the different farming systems, with land farmed by tillage and dairy farms on average of superior quality than that farmed by the average cattle and sheep farm. It should be noted that, dairy and cattle are the most popular systems in Ireland with approximately 36% of the farms within the Teagasc National Farm Survey's sampling frame engaged in dairy production, while 43% of farms are engaged in cattle rearing, 13% in rearing sheep and 7% of farms are tillage farms.

Figure 1. Average rent per hectare by farm system



Source: Teagasc NFS.

In Ireland dairy and tillage farms tend to be more profitable than sheep and cattle farms and this is reflected in the rents paid for land as illustrated in Figure1. This can be seen also in Figure 2, which displays the average income per hectare obtained from Pillar 1 subsidies, Pillar 2 subsidies and via the market for each year in our sample. Only dairy and tillage farms on average earn positive market returns while cattle and sheep farms on average are loss making in the absence of subsidies. There is also a clear distinction in the extent to which the farms tend to be reliant on subsidies, with tillage farms tending to receive a smaller proportion of their incomes from Pillar 2 subsidies.

Figure 2. Breakdown of average income per hectare by farm type

Figure 3 indicates considerable inertia in land rental rates in Ireland despite the 'conacre' system of short-term rental contracts, if there were complete inertia, rents would lie along the black 45° line when plotted against the previous year's rent. The degree of inertia in land rents appears similar in both the pre- and post-decoupling periods.[1] Thus a dynamic model appears warranted.

Figure 3. Evidence of inertia in rental rates

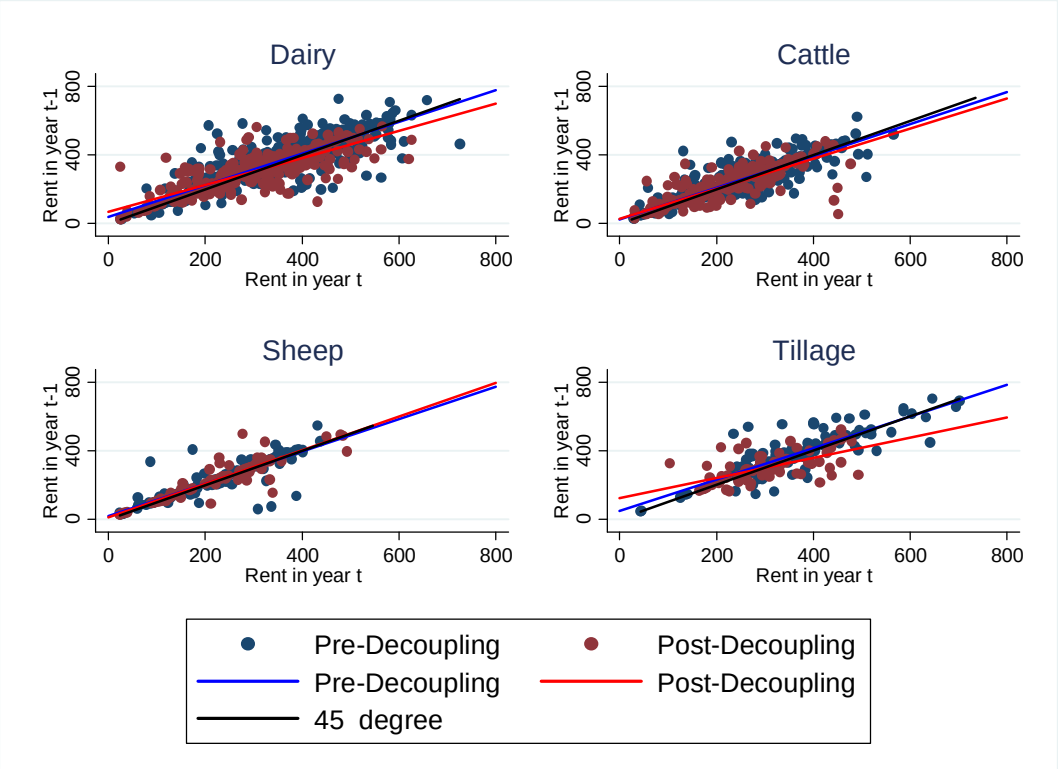


Table 1 presents the results for the pre- and post-decoupling periods using the two-step System-GMM estimator applying the Windmeijer correction for small sample bias and a full set of year dummies. Specifications including additional control variables such as the percent of land used for crops and pasture, the percent of farm labour that is paid and soil quality were estimated but these variables were insignificant and hence were excluded from the final analysis. The Arellano-Bond serial correlation tests reveal that although there is first order serial correlation, there is not second order serial correlation which would invalidate our estimates. Hansen tests for the validity of instruments, also reported in Table 1, suggest that the instruments are exogenous as required. The Arellano-Bond serial correlation tests reveal that although there is first order serial correlation, there is not second order serial correlation which would invalidate our estimates. Hansen tests for the validity of instruments, also reported in Table 1, suggest that the instruments are exogenous as required.

Table 1. Two-step Robust System GMM for pre-decoupling and post-decoupling periods

	Dairying	**Cattle**	**Sheep**	**Tillage**
Pre-decoupling				
Lagged Rent per hectare	0.811***	0.886***	0.620***	0.646***
	(0.056)	(0.063)	(0.123)	(0.089)
Market Income per hectare	0.056**	0.059	0.069	0.048
	(0.025)	(0.042)	(0.057)	(0.049)

[1] The inertia of the explanatory variables is illustrated in Figures A4 to A6 in the appendix.

Pillar 1 payments per hectare	0.145**	0.061	0.254***	0.316***
	(0.069)	(0.052)	(0.097)	(0.091)
Pillar 2 payments per hectare	0.103	0.163	-0.012	-0.069
	(0.068)	(0.120)	(0.123)	(0.109)
Post-Decoupling				
Lagged Rent per hectare	0.700***	0.645***	0.735***	0.522***
	(0.069)	(0.088)	(0.129)	(0.137)
Market Income per hectare	0.027	-0.083*	-0.041	0.040
	(0.025)	(0.045)	(0.085)	(0.035)
Pillar 1 payments per hectare	0.122***	0.074*	0.092	0.252**
	(0.045)	(0.040)	(0.086)	(0.117)
Pillar 2 payments per hectare	0.129	0.073	0.045	0.091
	(0.088)	(0.098)	(0.110)	(0.156)
Statistical tests:				
Pre-Decoupling				
Hansen p-value	0.550	0.552	0.405	0.642
AR(1) p-value	0.0001***	0.0001***	0.037**	0.022**
AR(2) p-value	0.454	0.267	0.124	0.782
Post-Decoupling				
Hansen p-value	0.112	0.361	0.371	0.141
AR(1) p-value	0.0001***	0.019**	0.055*	0.006***
AR(2) p-value	0.540	0.358	0.725	0.265

* = Significant at 10%, ** = Significant at 5%, *** = Significant at 1%.

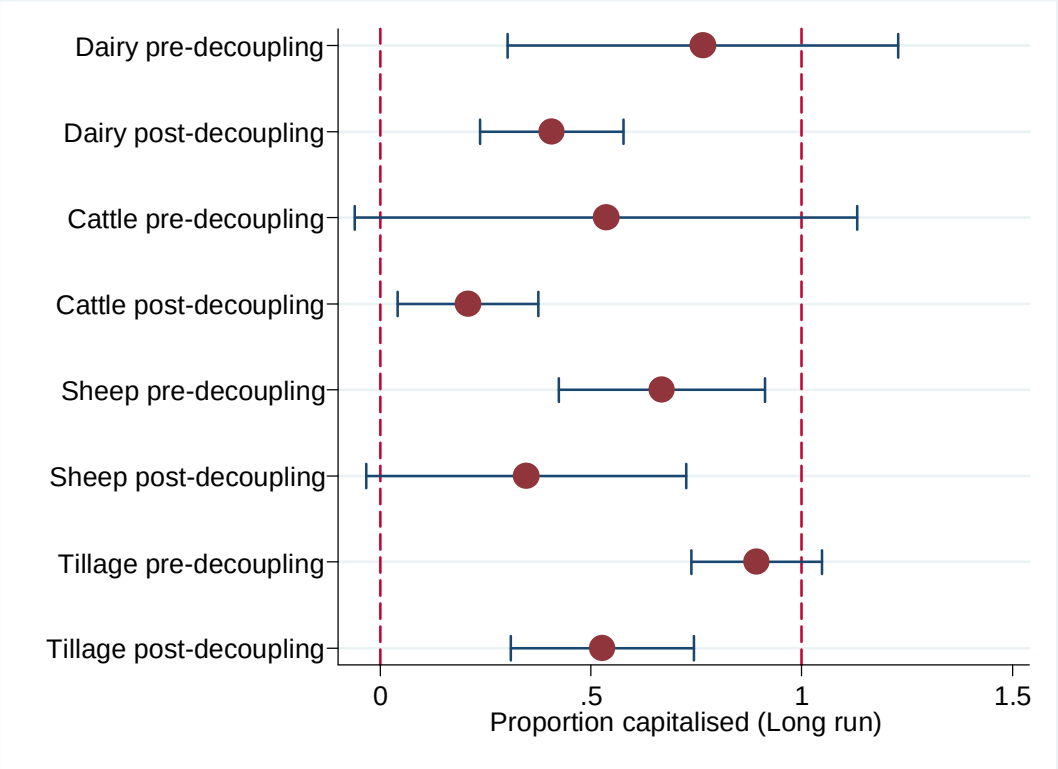
All models include a full set of Year dummies and are estimated using the two step System GMM estimator with robust standard errors using the 2nd lag as instrumental variables (similar results are obtained if deeper lags are included).

Lagged rents are strongly related to current rents albeit slightly less so following decoupling (in line with the inertia indicated in Figure 3). In the pre-decoupling period, approximately 6 cents per euro of market income is capitalised into land rents for dairy farms in the short term which corresponds to approximately 30 cents per euro in the long run. Positive effects of market income on agricultural rent levels are found for the other systems but these coefficients are not found to be statistically significant. Turning to Pillar 1 payments, area aid payments, such as those to tillage farmers, act as a land cost subsidy and hence are expected to lead to greater capitalisation than output subsidies such as those for cattle and sheep (Kilian et al, 2012; Alston and James, 2001; Guyomard et al., 2004). Our findings for the pre-decoupling period are consistent with this hypothesis, for dairy farms 15 cents (77 cents) of each euro of payments are capitalised into land rents in the short (long) run. For sheep and tillage farms the corresponding figures are 25 cents (67 cents) and 32 cents (89 cents). For cattle farms, Pillar 1 payments do not appear to be capitalised into rents in the pre-decoupling period although this can be attributed to the imprecision of the estimate. Figure 4 which graphically presents the estimated long run capitalisation and its corresponding 95% confidence interval. We cannot reject the null hypothesis that Pillar 1 payments are fully capitalised into land rents. While Pillar 1 payments are heavily capitalised into rents, we can reject the null of full capitalisation. Again the imprecision of our estimate for cattle farms is apparent with the confidence interval spanning both full capitalisation and also zero capitalisation. In the pre-decoupling period, Pillar 2 payments are not capitalised into land rents which may in part be due to nature of these payments and the relatively small contribution they make to total income per hectare (see Figure 2). For instance one of the major components of Pillar 2 payments in Ireland are made under the agri-environmental

measure applied in Ireland known as the Rural Environment Protection Scheme (REPS) and can only be received on rented land if the farmer can prove that they have rented the land for a period in excess of the subsidy program contract period. Given the prevalence of short-term "conacre" rental contracts this effectively restricts these payments to owned land in Ireland.

In the post-decoupling period, we find that market returns for dairy and tillage farms are not capitalised into rents but that surprisingly for cattle and sheep farms higher market incomes are associated with lower rental rates, albeit insignificantly so in the case of sheep farms. Pillar 1 payments remain capitalised into land rents, albeit in most cases slightly less so although for Cattle farms capitalisation increases to 7 cents (21 cents) per euro of support in the short (long) run. For dairy farms 12 cents (41 cents) per euro of support and for tillage farms 25 cents (53 cents) per euro of support were capitalised in the short (long) run. For sheep farms the capitalisation fell to 9 cents (35 cents) and is not significantly different from zero. From Figure 4 it can be seen that post-decoupling pillar 1 subsidies are not fully capitalised into rents. The results suggest that capitalisation of Pillar 1 subsidies has fallen post-decoupling, however, since the confidence intervals pre- and post-decoupling overlap for all systems except Tillage we cannot conclusively say that this is the case. This uncertainty is primarily to the imprecision of pre-decoupling estimates.

Figure 4. Long run capitalisation of subsidies pre- and post-decoupling



6. Conclusions

The influence of subsidies on land prices has attracted considerable attention in the literature (Phipps, 1984; Featherstone and Baker, 1987; Barnard, et al., 1997; Weersink et al., 1999; Shaik et al., 2005 *inter alia*). More recently attention has focussed on land rental rates (see Lence and Mishra, 2003; Roberts et al. 2003; Kirwan, 2009a, 2009b *inter alia*). This paper adds to the burgeoning literature by exploring the extent to which coupled and decoupled subsidy payments have been capitalised into land rental rates in Ireland using panel data from the Teagasc National Farm Survey for the years 2000 through to 2008, and presents evidence that following the Fischler reforms to CAP, the degree to which pillar 1 subsidies are

bid into agricultural land rents has declined. This may be explained by the interaction between the reforms themselves and the prevailing agricultural rental market custom in Ireland, i.e. the conacre short term rental model. The freedom to consolidate entitlement values accorded to farmers who in the reference period farmed rented in land would appear to reduce the extent to which agricultural subsidies are capitalised into agricultural rents. However, this effect was not as dramatic as one might anticipate, in line with the conclusions of O'Neill and Hanrahan (2012) who found that the reform did not dramatically influence the area rented by farms in Ireland.

In contrast to existing studies on land rents in the EU, we apply a dynamic model for land rents to account for inertia in the land rental market, while also taking account of expectation error through the use of a two-step GMM estimation approach. *A priori*, given the short term nature of agricultural land rental contracts in Ireland, one would expect to observe less inertia in Irish agricultural rents than in other European countries where longer term rental contracts are the norm (Ciaian et al., 2010). However, the estimated coefficient on the lagged rents variable ranged from 0.532 to 0.886. These results reveal the importance of accounting for inertia in the agricultural land rent-setting process. This inertia may indicate the presence of significant search costs when seeking alternative plots to rent or significant transaction costs associated with renegotiating existing contracts or those for alternative plots. In Ireland land is often rented within the locality of the farm, limiting competition and increasing the importance of social relations between the landlord and tenant.

Given the importance of past rents in determining current rents, it is not surprising that other variables are found to play a lesser role. While market income and Pillar 2 payments tends to have a weak impact on rental rates, in the pre-decoupling period Pillar 1 subsidies for dairy, sheep and tillage farms are found to be heavily capitalised into agricultural land rents, with Pillar I subsidy capitalisation rates ranging from 67 to 90 cents per euro of subsidies. Long run capitalisation of agricultural subsidies into agricultural rents is highest amongst tillage farms. This system is also in an Irish context the system where the greatest proportion of agricultural area farmed is rented-in land. Post-decoupling, we find that Pillar 1 payments remain capitalised into land rents, albeit in most cases slightly less so than in the pre-decoupling period. The estimate long run captialisation rates for each farm type tend to be approximately half the rate observed for the pre-decoupling periods.We attribute this result to the option for Irish farmers to consolidate their entitlements from rented land where the rental contract has expired to other plots of land, reducing the ability of landowners to capture these payments.

The freedom to consolidate SPS entitlements would appear from our results to have, in an Irish context, reduced the extent to which subsidies are capitalised into rents. This outcome may be peculiar to Ireland, the conacre rental model is only widely used in one other region of the EU, Northern Ireland. The prevalence of long term agricultural land rental contracts in most EU Member States (Ciaian et al., 2010) means that the ability of farmers (as opposed to landlords) in other Member States to capture more of the decoupled agricultural subsidy may not have been similarly enhanced by the Fischler reforms. In an Irish context our results suggest that the transfer efficiency of agricultural policy has been improved by the implementation of the Fischler reforms and particularly the freedom to consolidate SPS entitlements that, in the reference period, were "earned" on rented-in land. In an Irish context owned, as opposed to rented, land is the dominant form of land tenure. The relative unimportance of rented land in total agricultural land use (see Ciaian et al., for comparative EU statistics) and very slow rate of structural change in Irish agricultural suggest that in the future structural change in Irish agriculture may depend on growth in the share of agricultural area that is rented-in. In the context of the recently agreed reforms to the CAP (EC, 2013) that link entitlement to direct income support to control of agricultural land, the future transfer efficiency of agricultural policy may be reduced if a mechanism that allows farmers to circumvent the capitalisation of subsidies into agricultural rents, such as the freedom to consolidate entitlements, is not present.

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Appendix

Figure A1. Boxplot of market income per hectare by system

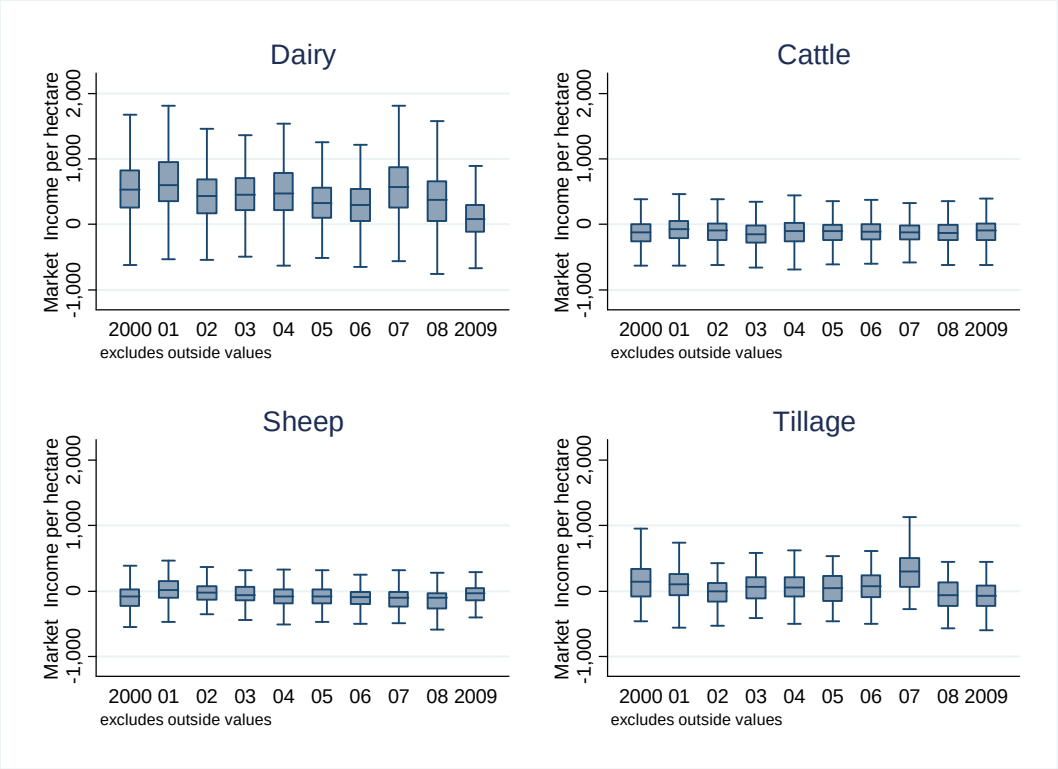


Figure A2. Boxplot of pillar 1 subsidies per hectare by system

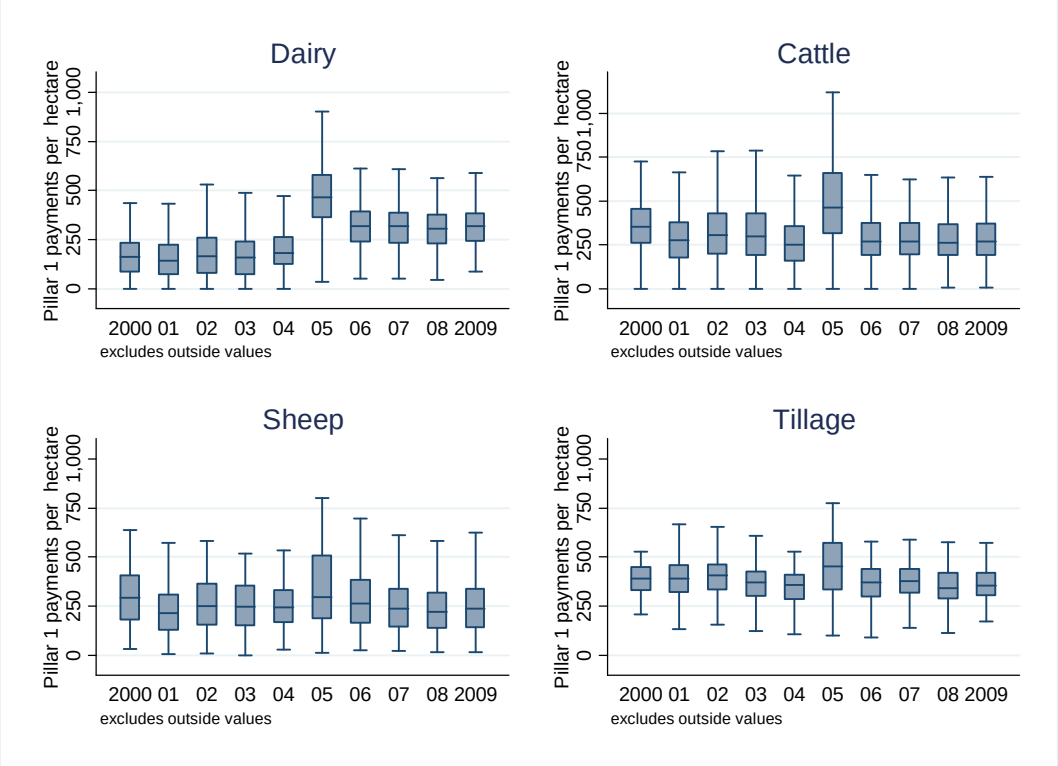


Figure A3. Boxplot of pillar 2 subsidies per hectare by system

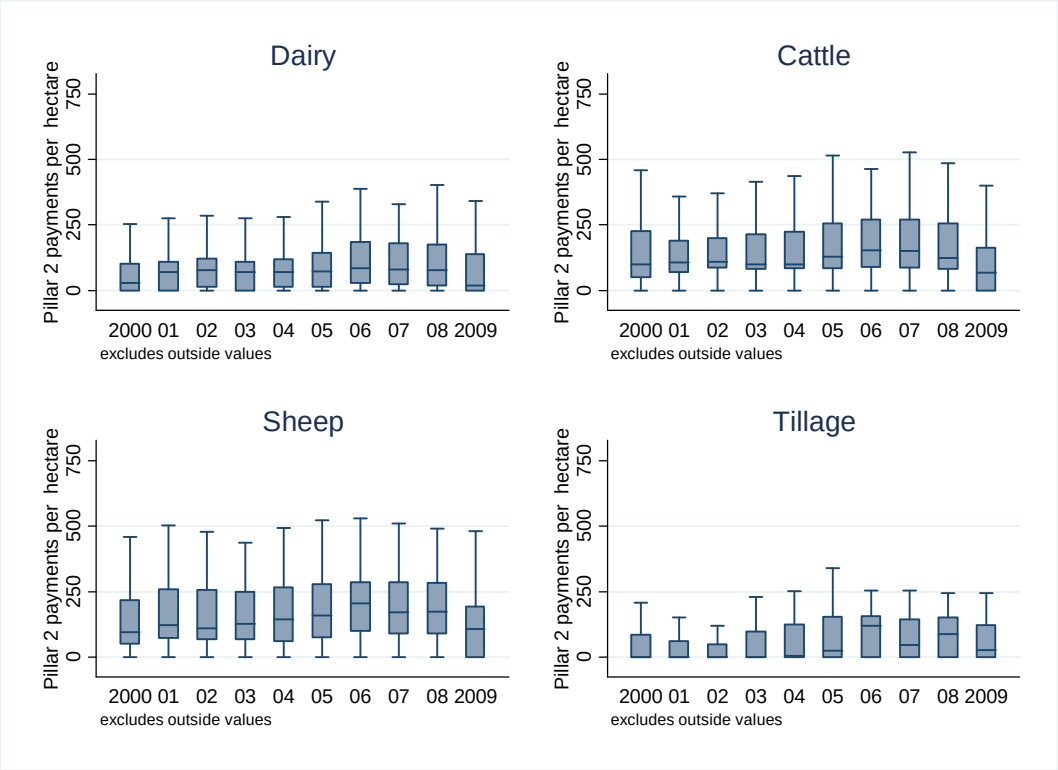


Figure A4. Evidence of inertia in market income by system

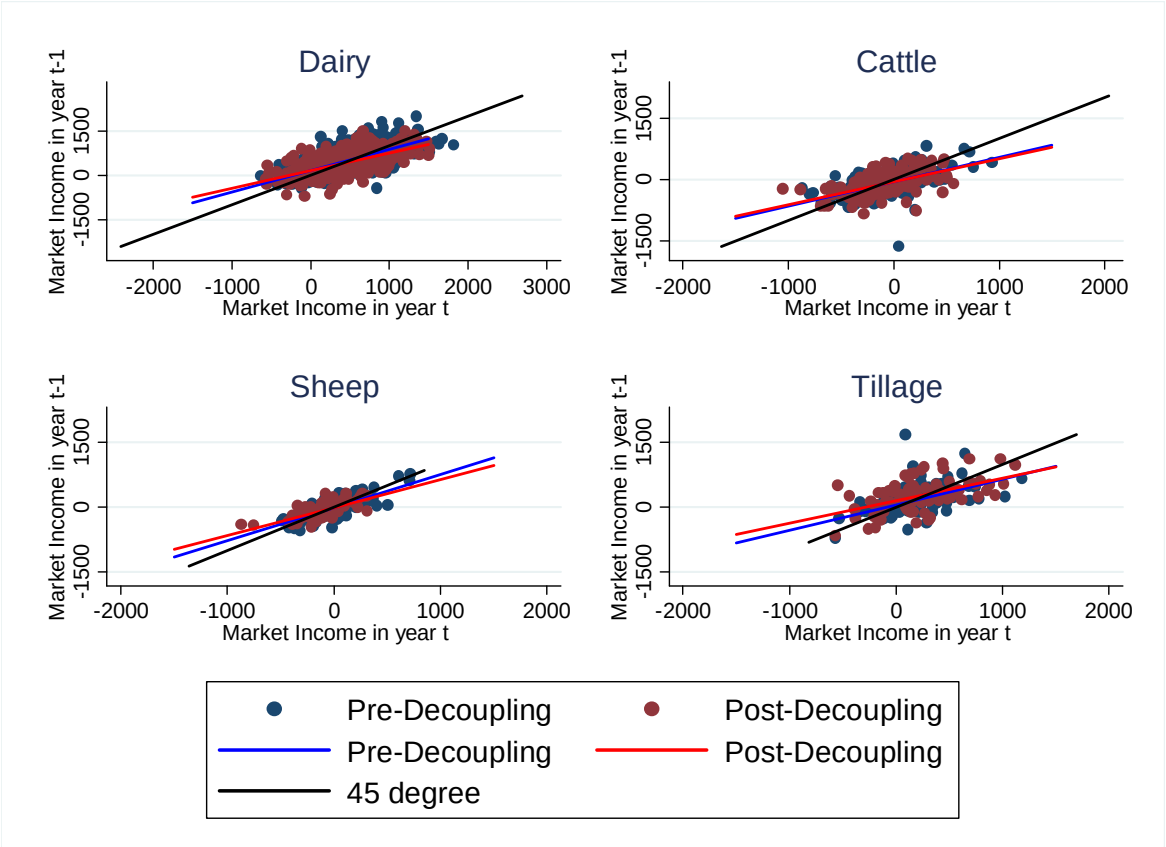


Figure A5. Evidence of inertia in Pillar 1 payments by system

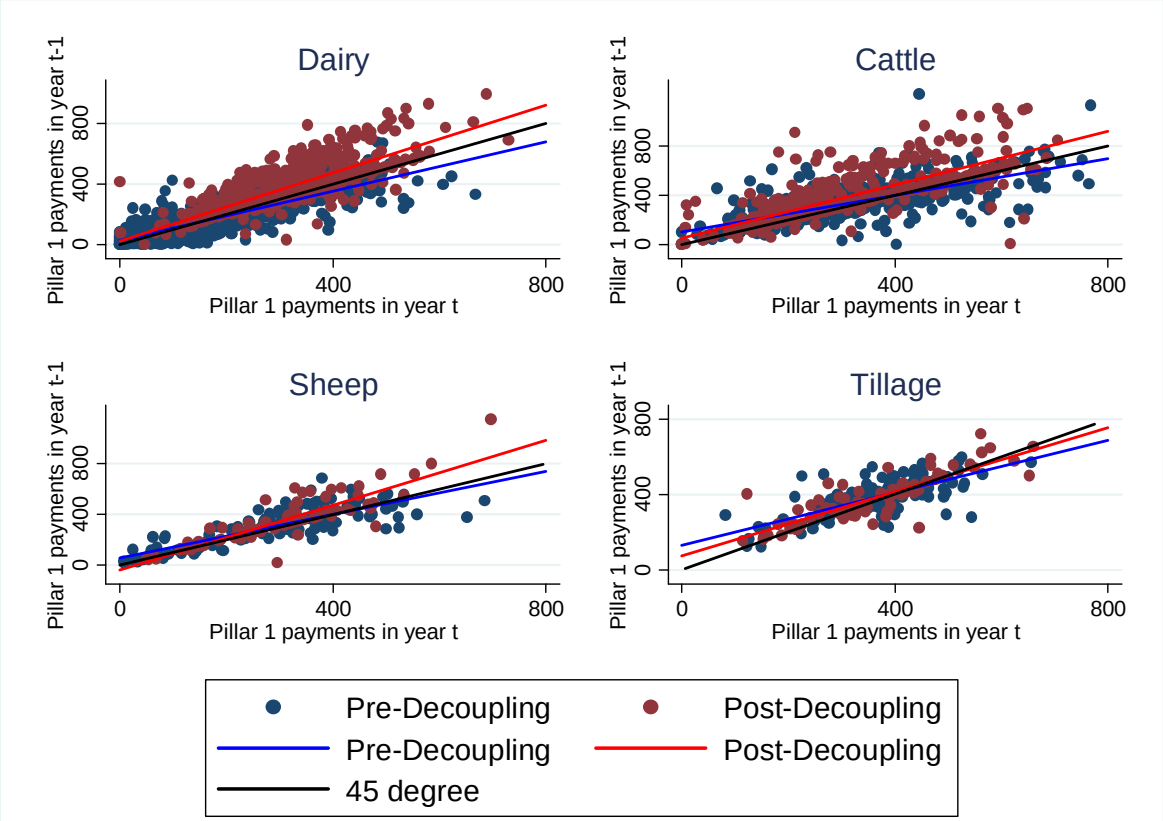


Figure A6. Evidence of inertia in Pillar 2 payments by system

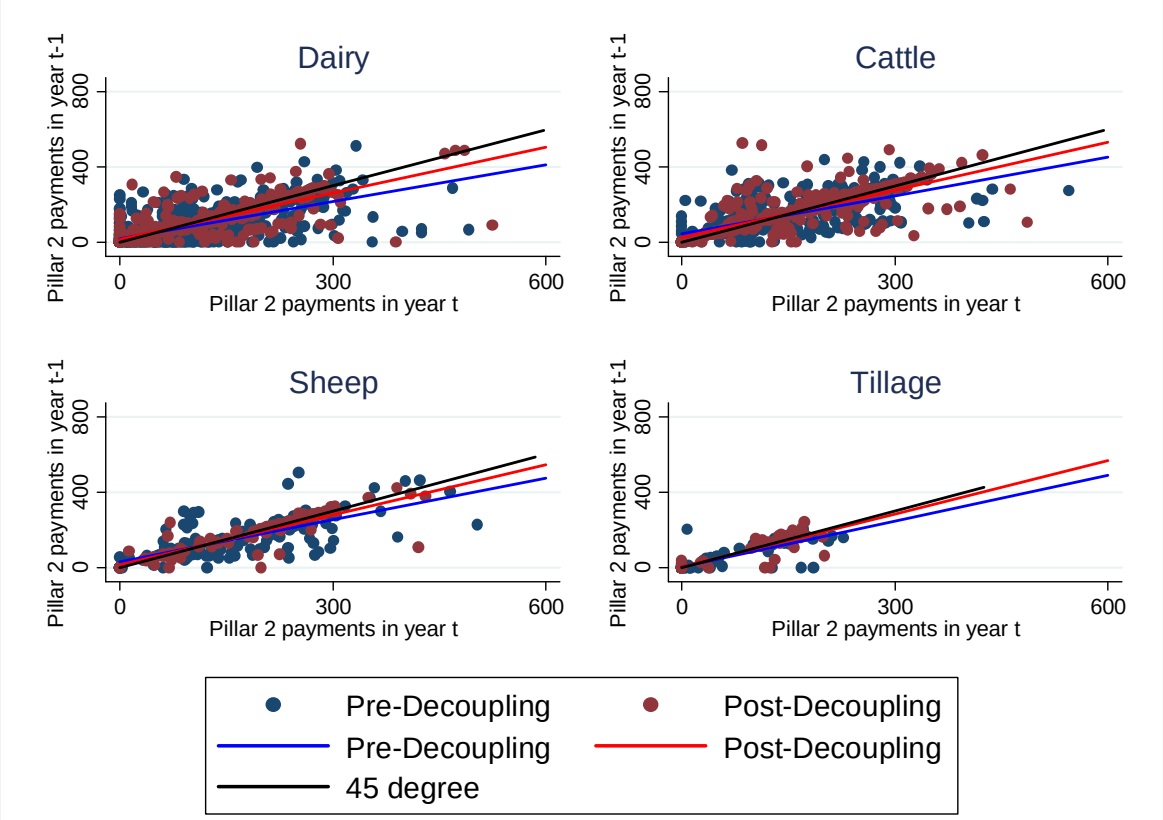
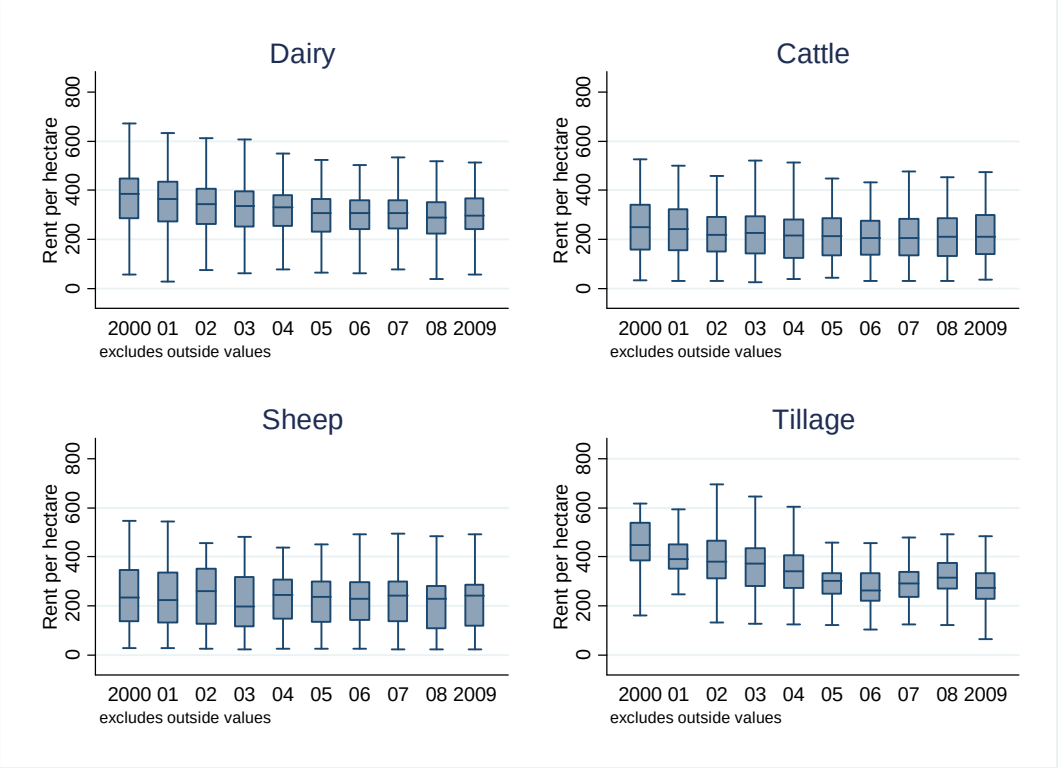


Figure A7. Boxplot of rent per hectare by system



Comparative Analysis of Factor Markets for Agriculture across the Member States

245123-FP7-KBBE-2009-3

The Factor Markets project in a nutshell

Title	Comparative Analysis of Factor Markets for Agriculture across the Member States
Funding scheme	Collaborative Project (CP) / Small or medium scale focused research project
Coordinator	CEPS, Prof. Johan F.M. Swinnen
Duration	01/09/2010 – 31/08/2013 (36 months)
Short description	Well functioning factor markets are a crucial condition for the competitiveness and growth of agriculture and for rural development. At the same time, the functioning of the factor markets themselves are influenced by changes in agriculture and the rural economy, and in EU policies. Member state regulations and institutions affecting land, labour, and capital markets may cause important heterogeneity in the factor markets, which may have important effects on the functioning of the factor markets and on the interactions between factor markets and EU policies. The general objective of the FACTOR MARKETS project is to analyse the functioning of factor markets for agriculture in the EU-27, including the Candidate Countries. The FACTOR MARKETS project will compare the different markets, their institutional framework and their impact on agricultural development and structural change, as well as their impact on rural economies, for the Member States, Candidate Countries and the EU as a whole. The FACTOR MARKETS project will focus on capital, labour and land markets. The results of this study will contribute to a better understanding of the fundamental economic factors affecting EU agriculture, thus allowing better targeting of policies to improve the competitiveness of the sector.
Contact e-mail	info@factormarkets.eu
Website	www.factormarkets.eu
Partners	17 (13 countries)
EU funding	1,979,023 €
EC Scientific officer	Dr. Hans-Jörg Lutzeyer