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# The Factors Influencing the Profitability of Leased Land on Dairy Farms in Ireland

## Abstract

The Republic of Ireland possesses a land market that is constrained by minimal sales each year, less than 1%. In an effort to capitalise on milk quota abolition and to increase dairy production, a suite of tax incentives has recently been introduced in the Republic of Ireland to encourage land mobility and long-term leasing among Irish dairy farmers. Using Irish Farm Accountancy Database Network (FADN) data from 2011 to 2017 to examine this, a Heckman sample selection model explores two aspects; (i) the factors that influence a farmer's decision to rent, or continue renting, land and (ii) the profitability of dairy farmers renting in land. We find self-selection into the rental market is driven by farm traits that include a high level of hired labour, the presence of a successor, intensive farming practices and dairy discussion group membership. The results show that rental agreements assist farms in achieving economies of scale. The findings provide evidence to support government intervention such as tax incentives for renting out land and knowledge sharing discussion groups.

**Keywords:** agricultural rented land; land policy; performance; dairy

## 1. Introduction

Land is a vital factor of production that plays a more significant role in agriculture than in other production sectors (Marks-Bielska, 2013; Poczta, 1994). An efficient agricultural land market contributes to economic growth in many ways. It provides access to land for farmers who own less land than they require, it allows the exchange of land from those who wish to work in the off-farm economy, and it facilitates the use of land as collateral to access credit markets (Swinnen and Vranken, 2009). Farmers use the rental market to increase their access to this production factor and the portion of leased farmland typically increases with the size of the farm (Vranken and Swinnen, 2006; Ciaian and Swinnen, 2006).

The land rental market allows for more effective use of potentially idle land, making it an effective choice to overcome inefficiency. Empirical evidence shows that the decision to rent land can have favourable outcomes for the renting farmer. Marks-Bielska (2013) find that the efficiency of leased land in Poland is comparable to the efficiency of owned land when stable long-term agreements are in place. Wästfelt and Zhang (2018) find that farms in Sweden with more leased land produce food more intensively

compared to farms with a greater portion of owned land. This may be because renters have stronger incentives to become efficient farmers or, equally, more motivated farmers seek out land to rent. Wästfelt and Zhang (2018) argue that by converting farmers into leaseholders, agriculture has been sustained in Sweden. However, this may also be understood as a need for leaseholders to be more productive to reap the benefits of opportunity cost. Another benefit of leasing is the fact that it can become a first step in negotiating a purchase agreement (Marks-Bielska et al., 2006).

The agricultural land market in Ireland is notable for its lack of fluidity. The main method by which land is transferred is through inheritance with farmers generally exhibiting a desire to keep land in the family name (Hennessy and Rehman, 2007; Bogue, 2013). As noted by Ricardo (1817), scarcity of land, as a factor of production, gives rise to rent. Ireland has the lowest rate of agricultural land rental in Europe and less than 1% of farmland is transferred by sale or inheritance each year (Geoghegan and O'Donoghue, 2018). The share of farmland that is rented, rather than owned, has increased from 12.7% to 17.6% between 1996 and 2011 (Geoghegan and O'Donoghue, 2018), but this figure remains well below the European average of approximately 55% (European Commission, 2018).

In advance of milk quota removal, the Irish government set a target to increase milk production in order to stimulate economic activity in rural areas and to boost foreign earnings through increased exports. This initiative, referred to as Food Harvest 2020 (DAFF, 2010), set a target to increase national milk production by 50% by 2020 relative to the average position in the 2007-2009 period. Läßle and Hennessy (2012) note that increased farmland is required to increase milk production. To facilitate this expansion a number of incentive schemes were introduced including tax incentives for farmers leasing out land. In the aftermath of EU milk quota abolition, milk production in Ireland has increased considerably, by 29% from 2014 to 2017 (People in Dairy Stakeholder Group, 2018). This was achieved through increased cow numbers, higher milk yields and an increase in average dairy forage area (including leased land). It is now an apt time to consider the impact of these policies on land use and farming in Ireland. An added benefit of the increase in milk production is its impact on the local economy. Hennessy et al. (2018) calculates an output multiplier of 1.44 for the agriculture, forestry and fishing sector in Ireland. This figure suggests that each additional euro of output produced in this sector generates €1.44 of output in the economy overall. This comprises of a direct effect of €1.19 and an indirect effect of €0.25. The employment multiplier implies

that for an increase of 1 million euro in output, 16.23 extra jobs are created (Hennessy et al., 2018). This contributes to the income multiplier effect of rural Ireland with Hennessy et al. (2018) highlighting the importance of agriculture to regions outside Dublin in particular. Along the border region with Northern Ireland, 11.5 percent of employment is in agriculture, forestry and fishing. In addition, the value of dairy exports has doubled from €2 to €4 billion since EU quotas were removed in 2015. Of every €1 of exports of dairy products, 91 cent is spent within the Irish economy (CSO.ie, 2019a), making the prosperity of the dairy sector of significance to the overall macro-economy.

Using farm-level data from the National Farm Survey (NFS), the Irish component of the Farm Accountancy Data Network, key farm and production characteristics for the period 2011 to 2017 are discussed. This study adds to the existing body of research, which is under-developed in a European context, by examining the factors which affect self-selection and farm profitability on dairy farms with rental agreements, when the land market is inelastic due to high degrees of sentiment. The paper is organised as follows. In Section 2 the theoretical framework is discussed. This includes a discussion on Ireland's agricultural and rental market. Section 3 details the empirical model and Section 4 describes the data. This is followed by the empirical results in Section 5 and the conclusion in Section 6.

## **2. Theoretical Framework**

### **2.1 Background**

The theoretical background for this paper is embedded in Ricardo's theory of rent (1817), which highlights that the payment of rent is represented by the intersection of a downward sloping demand curve for land and a perfectly inelastic supply curve. This highlights that scarcity of land, as a factor of production, gives rise to rent. Kellerman and Jones (1979) state that Ricardo presented his production and income distribution theory, but he failed to consider any shift in the supply schedule of land. By nature, land is a finite resource on an aggregate market level, but policy aims to increase the elasticity of individual farmers' supply curves through land transfers.

The current lack of fluidity within the Irish agricultural land market is due to a high degree of sentiment. A reasoning for this is the wish to honour the hard work and sacrifices of previous generations

(Cassidy and McGrath, 2014). The longer individuals perceive a family's history to be embedded within a farm, the more likely they are to feel a sense of commitment to preserve it (Bjørkhaug and Wiborg, 2010). Farms often also serve more than purely economic functions. Quinn and Halfacre (2014) find that farmers report their attachment to farmland as due to their want for security, by developing a thriving economic business and leaving a family legacy. Land also provides a place to live and a way to own a means of supply (Sikorska, 2008). These characteristics are important concepts to note while studying land markets, as much more than market dynamics are at play.

Ireland shares many of the same issues facing other EU countries in terms of land mobility: the inability of young farmers to access land (Hennessy, 2014; Zondag et al., 2015); increased concentration of land ownership (van der Ploeg et al., 2015) and increased competition for land use (Rounsevell et al., 2006). Land rental markets are a means to overcome these issues. However, the market in Ireland is small by European standards with only 18% of agricultural land being rented each year with farmland rental rates in the EU vary significantly from 17% in Romania to 89% in Slovakia (Geoghegan, 2018; Ciaian et al., 2012c). The reason for this high percentage in Slovakia, as well as many parts of Eastern Europe, is that the majority of agricultural land is used by large corporate farms as opposed to family-run farms in Ireland (Ciaian et al., 2012a). Renting land for at least five years is one of the requirements put in place by European funds for Slovakia, which motivates farmers to sign contracts with a longer duration of up to ten years (Swinnen and Vranken, 2009).

Over the last 30 years the leasing of agricultural land has increased in Western European, particularly among countries with well-developed agricultural systems such as Germany, France and Belgium. Marks-Bielska (2013) notes that the prevalence of land leasing results from the high purchase prices of agricultural land in Europe. The lease of agricultural land is regarded as a rational land management policy and it is managed by solid legal regulations. In Western Europe, this form of land government is considered an apt means to meet socio-economic needs. To encourage its development, solutions were introduced to make agricultural leasing one of the simplest forms of land management (Marks-Bielska, 2013; Tanska-Hus, 2009). Ireland faces a similar limitation, combined with the lack of supply of land becoming available to buy each year. The rental market in Ireland is characterised by short-term rental contracts typically lasting for eleven months at a time (Geoghegan, 2018; Ciaian et al., 2010).

Leasing land has previously raised issues in relation to a change in policy relating to agricultural direct payments in Ireland. When direct payments accrue to the land user rather than the landowner, farmland owners may be hesitant to lease out land, as any further policy change within the term of the lease may reduce the level of future direct payments they receive. Such a situation arose following the 2013 re-negotiation of the Common Agricultural Policy (CAP). Irish farmers who had leased out all their land were not classified as active farmers and were, therefore, not eligible for new entitlements under the new system (Geoghegan et al., 2017). It is assumed that part leasing of land will be a more common option going forward, which data currently shows to be the case.

In support of the goal to expand dairy output, improved tax incentives were introduced by the Irish Government in 2015 to promote land mobility. The policy provides an incentive to encourage land mobility and provide an incentive for landowners to lease out land for a period of fifteen years. Since 1st January 2015, farmers can obtain tax relief of €30,000 from a 10 year lease and €40,000 from a 15 year lease. These amounts are double those of previous years ("Leasing farm land", 2018).<sup>1</sup> It should be noted that Ireland currently has no regulation in place that directly controls land rental prices.<sup>2</sup>

Although generally welcomed, farmers have also been shown to be hesitant with regards to taking advantage of such initiatives themselves (Banovic et al., 2014; Bogue, 2013). Work by Bogue (2013) highlights relatively limited understanding of economic policies amongst farmers, as well as a lack of trust on the part of farmers in relation to these types of schemes. However, between 2011 and 2017, the number of long-term land leases rose from 3,590 to 9,790 (Teagasc, 2019).

This paper adds to the existing literature by increasing knowledge in the area of self-selection into the agricultural rental market and the profitability benefits it can achieve. This is in the context of low land sales due to high degree of family which is applicable in an international setting.

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<sup>1</sup> The land must be leased for the purpose of agriculture and a farmer cannot lease the land to a close relative, for the tax relief to be obtained (Revenue.ie, 2019).

<sup>2</sup> Regulations affecting the price of land, such as minimum and maximum prices for land rental, can limit the mobility of land between users since the market cannot easily match supply and demand by freely adjusting prices. Land market regulations can also have the effect of unethical market practice where extra undeclared payments are added to the purchase or rental price in order to secure a plot of land, which has occurred in Belgium (Ciaian et al., 2012b, 2012c).

## 2.2 Farm Demographics

Previous research, as reviewed below, has explored characteristics that affect the decision to rent land and its profitability.

**Land.** If a firm is profit-maximising, it will add units of a factor of production until the price of the factor equals the value of its marginal product. This assumes that farms act as profit maximising firms, adding units of land up to the point where the price paid for it is equal to the sum of the present value of the expected marginal value product of the land and the present value of the expected depreciation in the value of the land, over the period for which the land is held.

As previously noted, Ireland experiences low levels of land transfers per annum. Therefore, the effect of leases on productivity is important as, for most farmers in Ireland, this is the most feasible means of increasing their land area. From the literature, the existing findings are inconclusive and there are two schools of thought. The first being that performance differences between owned and rented land supports the basic theory that owning the means of production incentivises maximum effort and, therefore, yields (Michler and Shively, 2014). On the other hand, higher technical efficiency amongst renting farmers can be a result of self-selection (Lawin and Tamini, 2019). Profit maximising farmers will only expand their farm through rental contracts if they believe themselves to be efficient farmers (Michler and Shively, 2014), in order to benefit from the high opportunity costs incurred. This self-selection encourages the market to operate efficiently where supply and demand meet at market rate. Ireland's tax incentives are simply a means of encouraging the market to operate efficiently by incentivising long-term leases as a compromise for sentiment hindering land sales. The significant heterogeneity in the results of the empirical literature may be due to the local context and the conditions within which tenure systems operate (Lawin and Tamini, 2019; Place, 2009). The existing literature is also predominately based on the developing world.

The presence of a land rental market can be advantageous in that it allows farmers to alter farm size to achieve an optimal level of production. Vranken and Swinnen (2006) find no relationship between initial land endowment and land rented in. This study adds further knowledge by also assessing the relationship between farm size and dairy net margin to assess if allocative efficiency is being achieved on

renting dairy farms in Ireland. When assessing the decision to rent land, the overall size of the farm is analysed prior to any rental agreement. This is to include farms that may have hectares available under alternative farming systems, which could potentially become dairy forage area. If land rental markets are allocatively efficient, we expect to find diseconomies of scale.

**Human Resources and Demographic Factors.** Vranken and Swinnen (2006) note that a higher portion of family labour, relative to hired labour, can have a positive effect on the decision to rent agricultural land. Benefits of family labour include a reduction in moral hazard (Vranken and Swinnen, 2006), as external employees require supervision which is costly to the farm's productivity. It is important to assess whether this is evident in the dairy industry which remains relatively labour intensive in a country with a very competitive labour market. Vrankan and Swinnen (2006) also highlight the effect of off-farm employment plays in the decision to rent land. The greater its availability, the lower the probability of increased land rental.

Vranken and Swinnen (2006) find that renting farmers are better educated. To control for heterogeneous farmer characteristics that might affect farm output, several variables are included to act as proxies for farmer ability. This study looks at the effect of formal agricultural training and discussion group membership on the decision to rent land and profitability. Discussion group membership can be considered as a form of continued education as it aims to help farmers share their experiences with others, gain skills and discuss current farming topics. It is hypothesized that such education increases farmers' awareness of policies regarding land leasing and helps farmers identify the benefits they may gain from increasing their land area.

**Farm Inputs.** Vranken and Swinnen (2006) find that high transaction costs and poor liquidity affect the decision to rent land. Highly liquid resources indicate financial flexibility that can affect investment decisions, such as land rental. Liquidity is assessed, within this study, by examining the dairy net margin in the previous year and direct payments received. Bojnec and Latruffe (2013) find that the ratio of subsidies to total output has a negative relationship with technical efficiency. This presents the argument that farmers in receipt of direct payments have a tendency to assert lower effort, reflecting the findings of Zhu and



Lansink (2010) and Emvalomatis et al. (2008). Interestingly, Bojnec and Latruffe (2013) find that heavily subsidised farms have a positive relationship with profitability. The presence of subsidies, especially decoupled ones, aids allocative efficiency. Dairy farmers may receive financial support under the Basic Payments Scheme which acts as a financial safety net for farmers by supplementing their main farm income.

In Ireland the percentage of cows grazing is estimated to be up to 100%, with low levels of concentrate feed use (Reijs et al., 2019). Ireland is noted as a country that will experience increased grazing due to potential rising grain prices and the country's low productivity per hectare, compared to its European counterparts such as the Netherlands and Denmark (Reijs et al., 2019). It is our hypothesis that rented land will be demanded by farms currently utilising a high level of concentrate feed, as they transition to increased grazing. The quality of farmland may also be influential. In the absence of a variable measuring land quality, a regional variable (NUTSIII level disaggregation) is used as a proxy.<sup>3</sup> The regional variable also accounts for differences in rental prices. Based on Von Thünen's (1826) model of agricultural use, land prices decrease and land use changes from intensive to extensive practices as the distance from Central Business Districts increases. Vranken and Swinnen (2009) find that renting is significantly higher in areas with high sales price as it's a cheaper alternative to buying the land.

**Price of Farm Inputs.** The average price of rented land, milk price and direct dairy enterprise costs are considered. It is assumed that farm decision-making is based on the rationality of a profit-maximising firm. Vranken and Swinnen (2009) find that rental prices have a negative effect on the decision to rent in land. This is rational as any cost to the farm negatively affects revenue which is assumed to reduce motivations to rent in land. As milk prices increase milk receipts, it is hypothesized that high current milk prices encourage land rental.

**Fixed Productive Assets.** Under the auspices of the EU's Young Farmers Scheme, direct payments are in place for farmers up to the age of 40 years to encourage generational renewal. Forbord,

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<sup>3</sup> The Nomenclature of Territorial Units for Statistics (NUTS) were created by Eurostat in order to outline territorial units for the production of regional statistics across the European Union (CSO.ie,2019b).

Bjørkhaug and Burton (2014) highlight that, in Norway, farmers expand their farm size through rental agreements when a farmer is unsure if a successor will wish to work the farm. The presence of a successor can also affect the financial performance of the farm. Ma et al. (2017) find that land security can lower technical efficiency due to the migration effect of less productive farmers and practices. This may be likely when there is a family successor who has the security of family ownership of land.

**Policy Influences.** A farmer's decision to rent land may be motivated by policy. Given the abolishment of the milk quota in 2015, farmers have a new opportunity to expand their farms. In the same year, tax incentives to promote land rental were enhanced. Such initiatives encourage idle or under-utilised land to transfer from farms with excess supply to those with a shortage, creating mutual benefits. This study uses data from before and after 2015 to determine if these policies are motivators to rent in land.

A limitation of the study is the inability to assess whether farmers are increasing their land resources to reduce their level of nitrates per hectare to abide by regulations that require levels to be below 170kg per hectare. Farmers may also be concerned about future regulation limiting methane emissions which might limit herd sizes. At this point, no methane emissions restriction is in place and no data is available to measure the concerns it raises among farmers.

### **3. Empirical Model**

Using a simple OLS regression model containing 1,986 farms, and controlling for years, it is found that renting farms generate significantly higher total dairy net margin compared to farms with no rented land. This tells us that allocatively efficiency is not occurring. If land is allocated efficiently, the effect of tenure on the dairy net margin would not be significant. However, the use of an OLS regression model is flawed due to its inability to capture self-selection. The Heckman (1979) sample selection model can be used to solve the self-selection problem by adding  $\lambda$  to the regression; if  $\lambda$  is not equal to zero, then there is a self-selection problem (Wang, Li, Xin, Tan and Jiang, 2018). The Heckman model is used to examine the decision to rent land and to determine the factors affecting dairy net margin within the group of farmers who choose to rent in land.

The Heckman (1979) sample selection model assesses two latent dependent variables models: the independent variables influencing the decision to rent land (1) and the independent variables of renting farms that affect dairy net margin (2). The decision to rent land is binary. Dairy net margin, or profit, is used as the performance measure as it is assumed to be the motivator for farmers' decision making. The log of dairy net margin is used in order to reduce the effect of outliers to ensure the results are robust.

$$E[I|X] = P(R_i = 1) = (R > 0) - B'X \quad (1)$$

where  $P(R_i = 1)$  is the probability of  $R_i = 1$ , that is participation in the renting in of land is certain, which occurs if the portion of farmed land that is rented exceeds 0. The probability of renting in land is a function of a vector of exogenous variables  $X$ .

Profit is derived by subtracting dairy farming costs ( $C$ ) from the dairy income received ( $Y$ ). The profitability of dairy farms with rented land is determined by the optimal levels of land ( $L$ ), human resources and demographic factors ( $H$ ), inputs ( $X$ ), the price of inputs ( $pX$ ) and fixed productive assets ( $Z$ ).

$$\pi = Y - C = f(L, H, X, pX, Z) \quad (2)$$

The Heckman (1979) model allows the two latent models to contain some common variables. The estimated parameters from the first stage model are used to derive the Inverse Mills Ratio, ( $\lambda_i$ ) by dividing the probability density function by the cumulative density function where  $\phi$  and  $\Phi$  denote the density and distribution function for a standard normal variable, respectively. 'A' denotes the estimated values of the parameters in equation 1.

$$\lambda_i = \frac{\phi(A)}{\Phi(A)} \quad (3)$$

A  $\lambda_i$  coefficient that is not equal to 0 means that some unobserved variable is influencing both decisions. The existence of the sample selection bias is therefore established, and the estimates of the decision must be corrected. The decision to use this model is justified by the occurrence of zero observations on the dependent variable of renting land. These observations account for 30 percent of the sample. If the correlation coefficient had shown no correlation between the error terms of the two latent models, the total dairy net margin equation could be estimated by an OLS regression model.

As this paper uses a maximum likelihood estimation of Heckman's sample selection model, coefficients represent the estimated marginal effects of the regressors in the underlying regression equation.<sup>4</sup> Note that total dairy net margin was chosen as a dependent variable with farm size included as an independent variable. As previously mentioned, profit is identified as the motivator for farmers' decision to increase farm sizes through rental agreements. The prior year's dairy net margin, current milk prices and stocking rates are included in Step 1 of the Heckman model only, as restriction variables for the model.<sup>5</sup> It is not assumed that the continuous explanatory variables display a linear relationship with the dependent variables and, thus the square term of all continuous variables is included in the model. Before these square terms are included, correlation tests are also carried out on a Probit model using the same variables that are included in step 1 of the Heckman model. A VIF test is carried out on all nominal variables within an OLS regression model. Those with an individual VIF score of 10 or greater are omitted from the model. These included farmers' age, degree of specialisation and stocking rate. No issues of multi-collinearity are evident in the existing model. The Huber/White/sandwich estimator of variance is used to eliminate heteroskedasticity in the data. This is a feature of the maximum likelihood estimates that is not possible in the alternative limited information two-step Heckman model. Due to the censored nature of the data, the variance estimates obtained within the limited information two-step Heckman model would be smaller than the true population variance (Bushway et al., 2007).

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<sup>4</sup> The alternative two-step estimator is a limited information maximum likelihood estimator. In finite samples, as evidenced by Monte Carlo simulations, the full information maximum likelihood estimator used in this study displays better statistical properties (Puhani, 2000).

<sup>5</sup> Both variables presented multi-collinearity when included in Step 2 of the Heckman model.

#### 4. Data

This study uses data from the Irish Teagasc National Farm Survey (NFS) which includes approximately 900 farms annually. The survey is operated as part of the FADN. It includes a representative sample of farms in the Republic of Ireland with a standard output of greater than €8,000, selected in conjunction with the Central Statistics Office.<sup>6</sup> This paper focuses on dairy farms in the period from 2011–2017 in order to analyse data from before, and since, the introduction of increased tax incentives for long term leasing and the abolitions of the milk quota on April 1<sup>st</sup> 2015. Details of the tax incentives are outlined in Table 4.1.

The Teagasc NFS collects data from a stratified random sample of farms annually with each farm assigned a weighting factor. Weighting the data is the basis for calculating estimates for all dairy farms in the Republic of Ireland, of which there is an aggregate total of 17,000 dairy farms. The NFS contains information on the business activities of farmers as well as other socio-demographic and environmental data. The survey records information provided by individual farms but does not capture informal rental agreements or cash transfers that a farmer may choose not to disclose. In order to examine the role of the prior year's financial performance on the decision to rent within the Heckman sample selection model, only dairy farms that are surveyed in two consecutive years are included in the dataset, yielding total number of observations of 1,630 farms.

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<sup>6</sup> The CSO classifies farms into size groups on the basis of their standard output by applying a standard output coefficient to each animal on the farm. Only farms with a standard output of €8,000 or more, the equivalent of 6 dairy cows, are included in the sample (Dillon et al., 2019).

Table 4.1. Maximum tax relief allowed each year

Lease length	Leases entered before 01 January 2015	Leases entered after 01 January 2015
5 to 7 years	€12,000	€18,000
7 to 10 years	€15,000	€22,500
10 years or more	€20,000	€30,000
15 years or more	N/A	€40,000

Source: Revenue.ie (2019)

The definitions of variables examined are listed in Table 4.2 with summary statistics detailing the changes to land and dairy performance from 2011 to 2017.

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*Table 4.2. Variable Definitions*

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*Dependent Variables*

Decision to rent in land (Heckman Step 1) = 1 if a farm rents in land, 0 otherwise

Dairy net margin (Heckman Step 2) Dairy gross output less dairy direct costs and dairy overheads divided by the number of forage hectares designated to dairy farming

*Independent Variables*

U.A.A. size The size of a farm, in hectares

Dairy forage hectares The total area under grass (including rough grazing) plus adjusted commonage for dairy enterprise, that is rented or owned.

Basic Payment Scheme to farm Previously known as the Single Farm Payment. Calculated as the value of the payment received, divided by the total family farm income. Family farm income

Capital Represents the total return to family labour, management and capital investment in the farm business.

Hired to family labour ratio The value of hired labour and casual labour divided by the value of family labour

Off-farm employment = 1 if the farm holder engages in off-farm employment, 0 otherwise

Concentrates per cow The value of home produced and purchased concentrates fed to the dairy herd, divided by the number of cows

Stocking rate The number of cows per hectare

Successor = 1 if the farm holder is > 40 years old and a younger individual, as a proxy potential successor, is present in the household. 0 if no younger individual is present. Marital partners are not regarded as successors

Formal agricultural Training = 1 if a member of the household has obtained agricultural training, 0 otherwise

Discussion group Membership = 1 if a member of the household is a member of a discussion group, 0 otherwise

Prior year's dairy net margin Dairy gross output less dairy direct costs and dairy overheads from the previous financial year

Output per cow The litres of milk produced divided by the number of cows

Specialisation The portion of farm output that is from the dairy enterprise.

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*Table 4.3. Selected Descriptive Statistics of Farm Averages (All Dairy Farms)*

Variable Selected	2011	2012	2013	2014	2015	2016	2017
U.A.A Size (ha)	56	58	58	58	58	60	60
Rented Hectares (%)	22	22	22	22	21	22	23
Land for Dairy Use (ha)	31	32	32	32	34	36	37
No. of Cows	58	58	61	62	65	73	74
Milk Production (litres)	304,943	299,873	320,587	329,512	363,110	401,352	417,190
Output per Cow (litres)	5,267	5,135	5,227	5,294	5,571	5,528	5,627
Dairy Net Margin per hectare(€) <sup>7</sup>	1,329	1,329	1,328	1,402	1,149	888	1,814

Source: NFS (2011-2017)

Following the removal of the milk quota, the area of land dedicated to dairy farming has increased as has the average herd size 4.3). For the average farm, milk production increased by 37% from 2011 to 2017, achieved by a 19% increase in the average amount of land used for dairy farming and a 28% increase in average herd size. This has resulted in the average dairy net margin per hectare increasing by 36% for the same period. The average percentage of land farmed by dairy farmers has increased by 1% between 2011 and 2017 equating to an increase in aggregate rented land from 252,125 to 260,244 hectares.

*Table 4.4. Selected Descriptive Statistics for Renting and Non-Renting Farmers*

Variable	Non-Renting Farmer			Renting Farmer		
	2011 (n=108)	2014 (n=89)	2017 (n=84)	2011 (n=240)	2014 (n=261)	2017 (n=244)
UAA Size (ha)	47	51	50	61	61	64
Land Rented (ha)	-	-	-	20	19	21
Dairy Forage Hectares	27	28	31	33	34	39
Herd Size	49	55	58	62	65	80
Milk Production (lt)	258,399	285,818	315,260	328,190	346,156	456,163
Output Per Cow (lt)	5,273	5,197	5,435	5,293	5,326	5,702
Dairy Net Margin (€)	34,271	38,077	50,038	37,821	41,481	67,820

Source: NFS (2011-2017)

<sup>7</sup> The fluctuations in yearly performances are due to volatility in milk prices and weather conditions. A 20 percent year-on-year fall in the price for milk occurred in 2015 (Hennessy and Moran, 2016), followed by a further 10% decrease in 2016 (Dillon, Moran and Donnellan, 2017). Ireland is a net exporter of milk which means it is susceptible to changes in global milk prices.



Table 4.4 highlights the farm size differences between renting and non-renting farmers. In 2017, farms with rented land were 28% larger, on average. Renting farmers are using rental agreements to increase their supply of land which is resulting in larger herd sizes and a substantial increase in milk production, up 45% between 2011 and 2017. The higher output per cow among renting farmers may suggest that either they are keeping breeds with higher yields or they are milking cows more often. Profits also increase by a greater proportion on renting versus non-renting farms, thus highlighting the economic benefits of farm expansion achieved through rental agreements.

Figure 4.5. The Breakdown of Rented Land of Dairy Farms

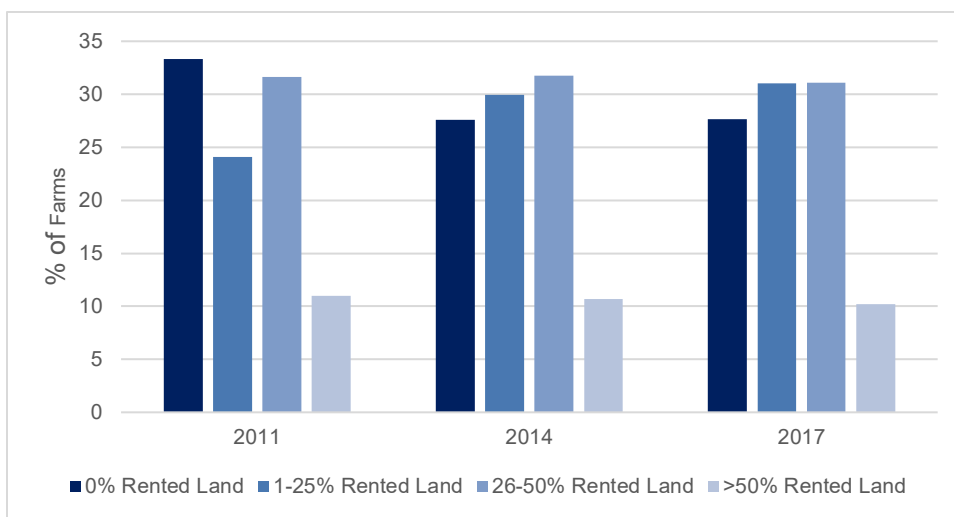


Figure 3.5 highlights the decline in the portion of farms that rent in no land.<sup>8</sup> No significant change is noted in the share of farms that consist of twenty six percent or more rented land. Instead, farmers choosing to rent in land are choosing to do so at minimal levels. Over the seven years studied, 71 percent of farms in the South are renting in land, 74 percent of farms in the North and West and 81 percent of farms in the East and Midlands are renting in land. Dairy farms are most plentiful in the South. This results in 70 percent of renting farms being in the South, 16 percent are in the East and Midlands and the remaining 14 percent are in the North and Western region.

<sup>8</sup> The portion of farms with 0% rented land fell by 2.5% between 2011 and 2012 and by 2.5% between 2013 and 2014 which may have been incentivised by the strong financial performances of dairy farms in 2011 and 2013. The positive performance in 2011 was due to an increase in demand for dairy output and reduced production costs (Hennessy, Kinsella, Moran and Quinlan, 2012). 2013 experienced strong growth in output value (Hanrahan, Hennessy, Kinsella and Moran, 2014).

## 5. Empirical Results

The results of the Heckman sample selection model are presented in Table 5.1 and Table 5.2. The  $\rho$ , which represents the estimated correlation coefficient between the error terms in the two equations, is significant and not equal to zero. These result shows that self-selection bias does exist. Therefore, the Heckman model is required for analysis of the factors driving total dairy net margin. The negative co-efficient of  $\rho$  means that some unobserved variable that is decreasing the likelihood of renting is is making profit generation more likely, or vice versa.

Table 5.1. Heckman Sample Selection model – Decision to Rent Land

Decision to Rent Land	Coef.	Std. Err.
East and Midlands (reference)		
North and West	0.218	0.114
South	-0.225**	0.114
Farm Size (excl. rented land)	-0.009***	0.002
Farm Size (excl. rented land) (sq)	0.000	0.000
Milk Price	5.933***	1.184
Milk Price (sq)	-0.008	0.014
Hired to Family Labour Ratio	0.212**	0.086
Hired to Family Labour Ratio (sq)	-0.020***	0.006
No Off-Farm Employment (reference)		
Off-Farm Employment	0.103	0.118
No Formal Agri. Training (reference)		
Formal Agri. Training	0.047	0.080
Discussion Group Membership (reference)		
Discussion Group Membership	0.147**	0.067
Previous Year's Dairy Net Margin (€,000)	0.012***	0.002
Previous Year's Dairy Net Margin (€,000) (sq)	-0.000***	0.000
Basic Payments/Farm Income Ratio	0.100	0.087
Basic Payments/Farm Income Ratio (sq)	0.005	0.004
Direct Dairy Costs (€,000)	-1.138***	0.191
Direct Dairy Costs (€,000) (sq)	0.168***	0.036
Concentrate Use per Cow (€,000)	1.570***	0.375
Concentrate Use per Cow (€,000) (sq)	-0.680***	0.204
Stocking Rate	1.468***	0.177
Stocking Rate (sq)	-0.232***	0.034
No Successor ( <i>reference</i> )		
Successor	0.235***	0.077
2012 ( <i>reference</i> )		
2013	-0.127	0.153
2014	-0.285**	0.125
2015	0.130	0.114
2016	0.428***	0.130
2017	-0.131	0.128
_cons	-2.932***	0.458

Statistically significant: \*\*\*at 1% level; \*\*at 5% level; \*at 10% level.

Observations: 1,158 in total. 472 censored.

Prob > chi2 = 0.000

Table 5.2. Heckman Sample Selection model – Determination of Dairy Net Margin

Dairy Net Margin (log)	Coef.	Std. Err.
Portion of Land Rented	-1.763***	0.305
Portion of Land Rented (sq)	1.691***	0.415
East and Midlands (reference)		
North and West	-0.342***	0.115
South	0.179**	0.071
Dairy Forage Hectares	0.042***	0.003
Dairy Forage Hectares	-0.000***	0.000
Land Rental Price per Hectare (€,000)	0.033	0.255
Land Rental Price per Hectare (€,000) (sq)	0.000	0.000
Hired to Family Labour Ratio	-0.261**	0.083
Hired to Family Labour Ratio (sq)	0.019*	0.010
No Non-Farm Employment (reference)		
Off-Farm Employment	-0.143	0.095
No Formal Agri. Training (reference)		
Formal Agri. Training	-0.012	0.071
Discussion Group Membership (reference)		
Discussion Group Membership	-0.053	0.056
Basic Payment/Farm Income Ratio	-0.199**	0.086
Basic Payment/Farm Income Ratio (sq)	-0.018***	0.004
Direct Dairy Costs per Hectare (€,000)	0.859***	0.131
Direct Dairy Costs per Hectare (€,000) (sq)	-0.123***	0.027
Concentrates per Cow (€,000)	-1.476***	0.312
Concentrates per Cow (€,000) (sq)	0.611***	0.179
2012 (reference)		
2013	0.225*	0.118
2014	0.258**	0.098
2015	0.136	0.095
2016	-0.215**	0.103
2017	0.643***	0.091
_cons	9.028***	0.218
Inverse Mills Ratio		
Lambda	-0.922***	0.056
Rho	-0.992***	0.004

Statistically significant: \*\*\*at 1% level; \*\*at 5% level; \*at 10% level.

Observations: 1,158 in total. 472 censored.

Prob > chi2 = 0.000

### **5.1. The Decision to Rent Land**

From a policy perspective, an increase in leasing agreements from 2015 is expected. However, when other factors are controlled for, farmers are no more likely to decide to rent land in 2015 than in 2012. An increase in uptake is shown in 2016 but this does not continue in 2017. This highlights a lower than expected utilisation of tax incentives that are in place to encourage land mobility over the long-term. This may be due to a lack of trust by farmers with excess land supply in allowing their land to be farmed by another farmer. It may also be due to a shortage of knowledge or understanding of the scheme by either potential renting in or renting out farmers.

The existing level of land farmed plays a significant role in the decision to rent additional land. The results show that a negative relationship exists between the number of owned hectares and the decision to rent additional land. This means that land rental agreements allow small-scale farmers, constrained by their land resources, to increase their land supply. This result is in keeping with the finding of Rahman (2010), who also found a negative relationship between farm size and hectares rented. Vranken and Swinnen (2006) find no relationship between the two variables. Therefore, the differences in results shown by existing literature suggests that findings are very much location specific. In an Irish context, the model indicates that land is more likely to be rented in the Eastern and Midland region, the area of the Central Business District, than the South. The time period examined may be a factor here as, since the abolition of EU milk quota in 2015, an expansion in dairy production has been experienced with some having occurred in the Eastern and Midland region. This is a region that traditionally was dominated by tillage farming but there has been a general decline in land area utilised for this purpose which makes land more freely available to facilitate dairy farm expansion there relative to the South (Dillon et al., 2018). Farms in the Northern and Western region are predominantly drystock with generally less demand for land rental.

The results show that a positive relationship exists between the decision to rent land and the portion of hired labour on the farm, albeit at a declining rate. When farms are constrained by their labour resources, they employ hired labour. This is rational given the added labour required by farms expanding following the milk quota abolishment in 2015. It is assumed that rental agreements encourage the renting out of idle or under-utilised land. Therefore, this result highlights the positive role land rental can play in enhancing employment in the dairy sector, when land is transferred to farmers who wish to maximum its output. The

presence of off-farm employment throughout the year has no effect on the decision to rent land. This is to be expected as only 7 percent of farmers in the sample engaged in off-farm employment. Farmers aged more than 40 years with a younger non-marital householder member (a proxy for succession) are more likely to rent land which supports generation renewal. This finding is similar to research from Poland where young farmers demand rented land as they do not have the ability to buy their own land (Marks-Bielska, 2013). Farm expansion is also a means to encourage farm succession. Following the abolishment of EU milk quotas in 2015, opportunities arose for dairy farmers in the EU to expand. This increased the possibility of higher profits in the sector, which contributed to a higher likelihood of dairy farms being able to generate sufficient income for two generations (Leonard et al., 2017). A positive relationship between stocking rates and the decision to rent highlights the intensive farming practices of these farmers. This supports the findings of Wästfelt and Zhang (2018) who find that farms with a greater proportion of leased land produce food more intensively compared to farms higher proportions of owned land. However, a point is reached where the relationship becomes negative which is a result of some farms having high stocking rates but not wishing to expand their land resources. It may be a case that some farmers, within Ireland's inelastic land market, are unable to obtain additional land in their area and increased stocking rates is their sole means of expansion.

Formal agricultural training does not significantly affect the decision to rent land. This is likely due to the fact that dairy farmers in Ireland generally engage with agricultural education, with 75% of farmers having completed such training. Discussion group membership/participatory extension acts as a proxy for continued education and membership of such organised groups increases rental participation. Advantages lie in the social networks participants develop with other farmers resulting in both knowledge and resource sharing. From this, farmers learn about rental schemes and may agree with other participants to enter such an agreement for mutual benefits. This furthers the conclusion that education plays a role in increasing rental agreements. This finding supports Vranken and Swinnen's (2006) finding that renting farmers are better educated, albeit it in a less formalised manner.

Concentrate use per cow positively affects the decision to rent land. This may be due to a desire by farmers with a high reliance on concentrates to gain additional grassland for grazing. Unsurprisingly, current milk prices have a significant and positive effect on the decision to rent land due to its direct effect

on revenue. Direct dairy costs per hectare negatively affect the decision to rent land as it is a considerable cost for farmers. Profit achieved in the previous year has a positive effect on the decision to rent land. A positive relationship is expected as a strong performance in the previous year achieves two aims; it increases liquidity and acts as a signal in terms of future performance. This follows the work of Vranken and Swinnen (2006) who highlight that poor liquidity negatively affects the decision to rent land. To estimate the effect of the Basic Payment Scheme on the decision to rent land, the direct payment received is calculated as a ratio of total farm income, reflecting a farmer's reliance on the payments as opposed to the nominal figure that may also reflect farm size. No significant relationship is found which adds to the argument that the payment scheme is supporting farms appropriately and not generating surplus cash reserves.

Average land prices were omitted from this step of the model due to its high correlation with the time variable. Fiscal incentives such as abolishment of the milk quota and increased tax relief for the renting out of land, both imposed in 2015, increase the value of land rents with the data showing the average price paid per hectare increasing each year from 2012 and 2017. It is likely this is also due to increased rental in the East and Midlands which has higher land values due to proximity to Ireland's Central Business District. The time variable represents the weather, economic climate and changes in policy, as well as land prices. For this reason, the time variable was included and not the average land price variable.

## **5.2 The Profitability of Rented Land**

The model indicates that profits initially decrease when the percent of land that is rented increases. However, a point is reached where this relationship becomes positive. This is due to the role self-selection plays in entering rental agreements with innate high opportunity costs, as previously highlighted by Lawin and Tamini (2019) and Wästfelt and Zhang (2018). To self-select into the market, farmers are assumed, as profit maximisers, to believe that they have the management skills and resources to be financially successful in farming the extra land. The results show that additional land aids farms in reaching their optimum size. A marginal negative co-efficient for the square of dairy forage hectares shows that minimal diseconomies of scale are beginning to occur. This follows Ricardo's (1817) assumption of diminishing marginal returns. It is a favourable outcome as optimal scale is being achieved and it highlights the benefit

of tax incentives currently in place to encourage farmers to rent out their idle or under-utilised land. When studying the same variables, existing literature shows both positive and negative results. This proves that allocative efficiency is based, again, on the local context. It is also likely that farmers will use land leasing agreements to reduce the negative effects of having a fragmented farm.

The total dairy net margin earned by farmers renting in land is lowest in the Northern and Western region. Farms located in this region are faced with challenging structural conditions which hamper their financial performance. The majority of these farms operate on poor soil conditions, resulting in a shorter grazing season (Dillon et al., 2018). The average rental price per hectare has no bearing on profit which is explained by the high portion of farms in one region, the East and Midlands, which rent in land.

Dependency on Basic Payments has a significant and negative effect on profit. This is a favourable finding as the work of Bojnec, and Latruffe (2013) suggests financial support can hinder effort which would contradict the aims of the support scheme. Direct dairy costs per hectare increases profits. This suggests that high costs incurred by renting farmers are successful in profit generation. Concentrate use lowers profit, at a declining rate, which can be explained by its necessity in times of poor weather conditions. Some years are significant in terms of dairy net margin performance which highlights the yearly volatility farmers experience with renting land being a rational decision in some years, but not in others. This finding questions the desirability of entering a long-term leasing agreement when a farm's income is so susceptible to yearly performance changes. However, pricing negotiations should reflect this variability.

The portion of hired to family labour has a negative effect on profit. Vranken and Swinnen (2006) highlight the issue of moral hazard when external employees are hired on a farm, as opposed to family members. While added labour should increase productivity, Vranken and Swinnen (2006) note that the effective labour supplied by hired workers should be appropriate for the amount of family labour on the farm, for supervision purposes. The results suggest that moral hazard is at play. As details of these employees' contracts and incentives is not known, their motivations or work ethics cannot be determined. The results for the proxy of a successor shows no effect on profitability. However, it is not known whether the successor is either currently working on the farms or anticipates doing so in the future.



## 6. Conclusion

The results reveal a number of interesting factors that motivate dairy farmers in Ireland to rent land, which subsequently affects profit levels. The findings provide valuable insight into the role played by policy initiatives which promote rental agreements, allocative efficiency, increased industry employment and knowledge sharing.

A minor increase in rental agreements since 2015 is evident. It is probable that rental agreements will gain popularity over time as they continue to be encouraged by initiatives such as discussion groups that have a proven ability to increase both rental arrangements and profits. Their importance is highlighted by demand for rented land by small farms constrained by their current land resources. Land rental is shown to be successful among renting farms as farm size and profit have a positive relationship before diseconomies of scale begin to occur. Therefore, farms restricted by their land resources are utilising rental agreements effectively to achieve optimal farm size. The strong positive relationship between stocking rate and the decision to rent land also highlights the desire of farmers to expand their output. Rented land allows farmers to further their output expansion, while meeting environmental restrictions. The squared variable shows that some farmers are increasing their herd size without expanding their land resources. For some, a lack of availability may be driving this relationship. This strengthens the argument for tax incentives to be in place to encourage farmers to rent out their land.

An additional benefit to both the farmer and wider economy is the role rental agreements play in increasing hired labour. A positive relationship exists between the portion of labour that is hired and the decision to rent land. At a farm level, farms are using hired labour when family labour is not sufficient. The results suggest that high levels of hired labour decreases profitability due to moral hazard. This strengthens the importance of the need for policy to support succession. However, further assessment of this area of research is required to determine the work contracts and incentives in place for employees. On an aggregate level, increased overall employment for the agricultural sector, when the land was previously idle or under-utilised, benefits the rural and national economy. Employment is an issue of particular concern as the agriculture, forestry and fishing workforce decreased by 9,000 persons, or 8%, between the first quarter of 2018 and 2019 (CSO.ie, 2019c). Increased employment is a temporary gain for the economy. However, long term benefits lie in the development of skills and the desire of young farmers to farm family land

ensures that the farmland does not become idle or under-utilised when the current lead farmer retires. An added gain for the dairy industry is the beneficial role rental agreements can play in supporting farm succession as the results show that the presence of a successor has a positive influence on the decision to rent land, with additional land provides a successor with immediate employment and skill development. These benefits are in addition to the 1.44 multiplier effect (Hennessy et al., 2018), previously discussed, which represents the invaluable stimulus agriculture adds to Ireland's rural regions and national economy.

An analysis of taxation measures found that the benefit-cost ratio of agricultural taxation measures is 1.16 (Dept. of Finance, 2019). Although this analysis uses an aggregate of a number of schemes,<sup>9</sup> it is clear that the land leasing tax incentives are improving resource allocation from an economic perspective, given the farm profitability findings from this study. Leases are effective in increasing farm performance but given the relatively low uptake, the new initiatives have not been sufficient to stimulate rental activity. Greater publicity of the benefits of the tax incentives and renting would increase uptake. Education and discussion groups are two means to achieve this. The results show that both increase participation in rental agreements and profits, showing their clear benefit to the farmer and the economy. Policies should be in place to make these schemes more widespread to encourage increased participation, as their benefits can be compared to continued professional development that is formalised in many industries. Such an initiative could be adopted by other countries with similar benefits to be expected.

From a national perspective, land is best utilised while in the hands of those who have capacity to increase their economies of scale. Land rental agreements, although still under-developed in Ireland, are helping to achieve this aim. The increased financial performance facilitated helps to further Ireland on its way to achieve the aims of post-quota production targets. However, further assessment is required in order to determine the quality and location of land that is available for rent, as well as the role of hired labour on family farms. As previously mentioned, soil quality and farming systems vary between regions but differences may lie in the quality of the land farmed by owners and the land farmed by renters, which has a direct effect on output. Nonetheless, the findings remain informative with regards to the need for additional

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<sup>9</sup> The agricultural taxation measures assessed are Income Averaging, Capital Allowances, Stock Reliefs, Income Tax exemptions for land leasing, Income Tax exemptions for profits from woodlands, Capital Gains Tax measures, Capital Acquisitions Tax measures, and Stamp Duty measures (Dept. of Finance, 2019).

land among small farms in order to achieve economies of scale, increased industry employment, the benefit to intergenerational renewal and the highlighted advantages of discussion groups. These attributes can be applied in an international context to countries, such as Poland, which share similar attributes as Ireland. These include a high degree of sentiment towards family land resulting in minimal sales and a reliance on increasing rental participation in order to add fluidity to the currently inelastic agricultural land market. Leases are effective in increasing farm performance but, given the relatively low uptake, the new initiatives have not been sufficient to stimulate rental activity. Greater publicity of the benefits of the tax incentives and renting would aid an increase in uptake.

## References

1. Banovic, M., Duesberg, S., Renwick, A., Keane, M. T., and Bogue, P. 2014. The Field: land mobility measures as seen through the eyes of Irish farmers. Paper presented at the Agricultural Economics Society's 89th Annual Conference, University of Warwick, United Kingdom.
2. Bojnec, Š., and Latruffe, L. 2013. Farm size, agricultural subsidies and farm performance in Slovenia. *Land Use Policy*, 32, 207-217. doi: 10.1016/j.landusepol.2012.09.016
3. Bogue, P. .2013. Land mobility and succession in Ireland. Dublin: Macra na Feirme.
4. Bjørkhaug, H., and Wiborg, A. 2010. Challenges for succession in family farming-perspectives and research questions. Norway: Nordland Research Institute.
5. Bushway, S., Johnson, B.D. and Slocum, L.A. 2007. Is the Magic Still There? The Use of the Heckman Two-Step Correction for Selection Bias in Criminology. *J Quant Criminol* 23, 151–178.
6. Cassidy, A., and McGrath, B. .2014. The Relationship between 'Non-successor' Farm Offspring and the Continuity of the Irish Family Farm. *Sociologia Ruralis*, 54(4), 399-416. doi: 10.1111/soru.12054
7. Ciaian, P., Swinnen, J., 2006. Land Market Imperfections and Agricultural Policy Impacts in the New EU Member States: A Partial Equilibrium Analysis. *Am. J. Agric. Econ.* 88 (4), 799–815.
8. Ciaian, P., Kancs, A., Swinnen, J., van Herck, K. and Vranken, L. 2012a. Key Issues and Developments in Farmland Rental Markets in EU Member States and Candidate Countries. Factor Market Working Paper No 13. Centre for European Policy Studies (CEPS).
9. Ciaian, P., Kancs, D. A., Swinnen, J., Van Herck, K., and Vranken, L. 2012b. Sales market regulations for agricultural land in EU and candidate countries (Factor Markets Working Paper No. 14). Brussels: Centre for European Policy Studies.
10. Ciaian, P., Kancs, D. A., Swinnen, J., Van Herck, K., and Vranken, L. .2012c. Rental market regulations for agricultural land in EU and candidate countries .Factor Markets (Working Paper No. 15). Brussels: Centre for European Policy Studies.
11. CSO.ie. 2019a. Census of Industrial Production - CSO - Central Statistics Office. [online] Available at: <https://www.cso.ie/en/methods/industry/censusofindustrialproduction/> [Accessed 16 Dec. 2019].
12. CSO.ie. 2019b. Information Note for Data Users: revision to the Irish NUTS 2 and NUTS 3 Regions. Retrieved from <https://www.cso.ie/en/methods/revnuts23/>
13. CSO.ie .2019c. Labour Force Survey Quarter 1 2019. Retrieved from <https://www.cso.ie/en/releasesandpublications/er/lfs/labourforcesurveyquarter12019/>
14. Ciaian, P., Kancs, d'A., and Swinnen, J. .2010. EU land markets and the common agricultural policy. Brussels: Centre for European Policy Studies.
15. DAFF. 2010. "The Food Harvest 2020: A Vision for Irish Agri-food and Fisheries". Department of Agriculture, Fisheries and Food, Dublin, Ireland
16. Dept. of Finance. 2019. Budget 2019 Report on Tax Expenditures Incorporating outcomes of certain Tax Expenditure and Tax Related Reviews completed since October 2017 .pp. 15-16). Dublin: Dept. of Finance, Government of Ireland. Retrieved from [http://www.budget.gov.ie/Budgets/2019/Documents/Tax%20Expenditures%20Report%202018%20FINAL%202017.10.18%20\(002\).pdf](http://www.budget.gov.ie/Budgets/2019/Documents/Tax%20Expenditures%20Report%202018%20FINAL%202017.10.18%20(002).pdf)
17. Dillon, E., Hennessy, T., Moran, B., Lennon, J., Lynch, J., Brennan, M., and Donnellan, T. 2019. Teagasc National Farm Survey: The Sustainability of Small Farming in Ireland. Teagasc.
18. Dillon, E., Moran, B. and Donnellan, T. (2017). Teagasc National Farm Survey 2015 Results (p. 8). Galway: Teagasc.
19. Dillon, E., Moran, B., Lennon, J., and Donnellan, T. 2018. Teagasc National Farm Survey 2017 Results. Galway: Teagasc Agricultural Economics and Farm Surveys Department.
20. Emvalomatis, Grigorios and Oude Lansink, Alfons G.J.M. and Stefanou, Spiro E. 2008. "An Examination of the Relationship Between Subsidies on Production and Technical Efficiency in Agriculture: The Case of Cotton Producers in Greece," 107th Seminar, January 30-February 1, 2008, Sevilla, Spain 6673, European Association of Agricultural Economists.

21. European Commission. 2018. Agricultural capital and land value. Brussels: European Commission. Retrieved from: <https://ec.europa.eu/agriculture/sites/agriculture/files/statistics/facts-figures/agricultural-capital-land-value.pdf>
22. Forbord, M., Bjørkhaug, H., and Burton, R. 2014. Drivers of change in Norwegian agricultural land control and the emergence of rental farming. *Journal of Rural Studies*, 33, 9-19. doi: 10.1016/j.jrurstud.2013.10.009
23. Geoghegan, C. 2018. Understanding the Economics of Land Access in Ireland (Ph.D). National University of Ireland, Galway.
24. Geoghegan, C., and O'Donoghue, C. 2018. Socioeconomic drivers of land mobility in Irish agriculture. *International Journal of Agricultural Management*, 7(2), 26-34. doi: 10.5836/ijam/2018-07-26
25. Geoghegan, C., Kinsella, A., and O'Donoghue, C. 2017. Institutional drivers of land mobility: the impact of CAP rules and tax policy on land mobility incentives in Ireland. *Agricultural Finance Review*, 77(3), 376-392.
26. Hanrahan, K., Hennessy, T., Kinsella, A., Moran, B., and Quinlan, G. 2014. Teagasc National Farm Survey 2013. Galway: Teagasc.
27. Heckman J. 1979. Sample selection bias as a specification error, *Econometrica*, 47, pp. 153-61
28. Hennessy, T. 2014. CAP 2014–2020 Tools to enhance family farming: opportunities and limits (Directorate-General for Internal Policies. Policy Department B: Structural and Cohesion Policies). Brussels: European Parliament.
29. Hennessy, T., Doran, J., Bogue, J., and Repar, L. 2018. The Economic and Societal Importance of the Irish Suckler Beef Sector (pp. 36, 38). Irish Farmers' Association. Retrieved from <https://www.ifa.ie/wp-content/uploads/2018/08/The-Economic-and-Societal-Importance-of-the-Irish-Suckler-Beef-Sector-Aug-2018.pdf>
30. Hennessy, T., Kinsella, A., Moran, B., and Quinlan, G. 2012. Teagasc National Farm Survey 2011 (p. 2). Galway: Teagasc.
31. Hennessy, T., and Moran, B. 2016. Teagasc National Farm Survey 2015 Results (p. 8). Galway: Teagasc.
32. Hennessy, T., Rehman, T., 2007. An Investigation into Factors Affecting the Occupational Choices of Nominated Farm Heirs in Ireland. *J. Agric.Econ.*58(1),61–75.
33. Kellerman, A., and Jones, D. 1979. DOES VON THÜNEN MEET RICARDO?. *Annals Of The Association Of American Geographers*, 69(4), 639-641. doi: 10.1111/j.1467-8306.1979.tb01289.x
34. Läpple, D., and Hennessy, T. 2012. The capacity to expand milk production in Ireland following the removal of milk quotas. *Irish Journal of Agricultural and Food Research*, 51(1), 1-11.
35. Läpple, D., and Hennessy, T. 2015. Exploring the role of incentives in agricultural extension programmes. *Applied Economic Perspectives and Policy*. Vol 37. No. 3, pp 403-417
36. Lawin, K., and Tamini, L. 2019. Tenure Security and Farm Efficiency Analysis Correcting for Biases from Observed and Unobserved Variables: Evidence from Benin. *Journal of Agricultural Economics*. doi: 10.1111/1477-9552.12275
37. Leonard, B., Kinsella, A., O'Donoghue, C., Farrell, M., and Mahon, M. 2017. Policy drivers of farm succession and inheritance. *Land Use Policy*, 61, 147-159. doi: 10.1016/j.landusepol.2016.09.006
38. Ma, X., Heerink, N., Feng, S., and Shi, X. 2017. Land tenure security and technical efficiency: new insights from a case study in Northwest China. *Environment and Development Economics*, 22(03), 305-327. doi: 10.1017/s1355770x1600036x
39. Marks-Bielska, R. 2013. Factors shaping the agricultural land market in Poland. *Land Use Policy*, 30(1), 791-799. doi: 10.1016/j.landusepol.2012.06.003
40. Marks-Bielska, R., Kisiel, R., Danilczuk, J., (2006). Leasehold as the Prime Form of the Liquidated State-owned Farms Disposal. OBN, Olsztyn (in Polish)
41. Michler, J., and Shively, G. 2014. Land Tenure, Tenure Security and Farm Efficiency: Panel Evidence from the Philippines. *Journal of Agricultural Economics*, 66(1), 155-169. doi: 10.1111/1477-9552.12082
42. People in Dairy Stakeholder Group. 2018. People in Dairy Action Plan (p. 6). Dept. of Agriculture, Food and the Marine. Retrieved from <https://www.agriculture.gov.ie/media/migration/foodindustrydevelopmenttrademarkets/agri-foodandtheeconomy/foodwise2025/PeopleDairyActionPlan060618.pdf>

43. Place, F. 2009. Land Tenure and Agricultural Productivity in Africa: A Comparative Analysis of the Economics Literature and Recent Policy Strategies and Reforms. *World Development*, 37(8), 1326-1336. doi: 10.1016/j.worlddev.2008.08.020
44. Poczta, W. 1994. Polish Agriculture and Agriculture EEC vol. B.247 (Comparative Study). Poznań: University of Agriculture.
45. Puhani, P. 2000. "The Heckman Correction for sample selection and its critique". *Journal of Economic Surveys*. 14 (1): 53–68. doi:10.1111/1467-6419.00104.
46. Quinn, C., and Halfacre, A. 2014. Place Matters: An Investigation of Farmers' Attachment to Their Land. *Society For Human Ecology*, 20(2), 117-132.
47. Rahman, S. 2010. Determinants of agricultural land rental market transactions in Bangladesh. *Land Use Policy*, 27(3), 957-964. doi: 10.1016/j.landusepol.2009.12.009
48. Reijs, J.W. C.H.G. Daatselaar, J.F.M. Helming, J. Jager and A.C.G. 2019. Beldman Grazing dairy cows in North-West Europe; Economic farm performance and future developments with emphasis on the Dutch situation LEI Report 2013-001 ISBN/EAN: 978-90-8615-637-5
49. Revenue.ie (2019). Leasing farm land. Retrieved from <https://www.revenue.ie/en/personal-tax-credits-reliefs-and-exemptions/land-and-property/leasing-farm-land/index.aspx>
50. Ricardo, D. 1817. Principles of Political Economy and Taxation. London: John Murray.
51. Rounsevell, M.D.A., Reginster, I., Araújo, M.B., Carter, T.R., Dendoncker, N., Ewert, F., House, J.I., Kankaanpää, S., Leemans, R., Metzger, M.J.M., and Schmit, C. (2006). A coherent set of future land use change scenarios for Europe. *Agriculture, Ecosystems and Environment*, 114(1), 57-68.
52. Sikorska, A., (2008). Lease of agricultural land. In: *The Market of Agricultural Land—State and Perspectives. Market Analysis. IAFE, Warsaw, No.11*, pp.26–36 (in Polish).
53. Swinnen, J.F.M. and Vranken, L. 2009. Land and EU accession: Review of the transitional restrictions by new member states on the acquisition of agricultural real estate, CEPS, Brussels
54. Tánska-Hus, B. 2009. Agricultural Lease in Poland over the Centuries. Wydawnictwo Uniwersytetu Przyrodniczego Wrocławiu, Wrocław (in Polish).
55. Teagasc. 2018. National Farm Survey 2011-2017 Dataset. Galway: Teagasc Agricultural Economics and Farm Surveys Department.
56. Teagasc. 2019. Guidelines for Long-term Land Leasing. Carlow.
57. Wolini, M. and Andersson, C. 2014. 'Spatial patterns of organic agriculture adoption: Evidence from Honduras', *Ecological Economics*, Vol. 97, pp. 120–128.
58. Van Der Ploeg, J. D., Franco, J. C., and Borrás Jr, S. M. 2015. Land concentration and land grabbing in Europe: a preliminary analysis. *Canadian Journal of Development Studies*, 36(2), 147-162.
59. Verschelde, M., D'Haese, M., Rayp, G. and Vandamme, E. 2012. Challenging Small-Scale Farming: A Non-Parametric Analysis of the (Inverse) Relationship Between Farm Productivity and Farm Size in Burundi. *Journal of Agricultural Economics*, 64(2), pp.319-342.
60. Von Thünen, J. 1826. *The Isolated State*. Hamburg: Perthes.
61. Vranken, L., and Swinnen, J. 2006. Land rental markets in transition: Theory and evidence from Hungary. *World Development*, 34(3), 481-500. doi: 10.1016/j.worlddev.2005.07.017
62. Wang, Y., Li, X., Xin, L., Tan, M., and Jiang, M. 2018. Spatiotemporal changes in Chinese land circulation between 2003 and 2013. *Journal Of Geographical Sciences*, 28(6), 707-724. doi: 10.1007/s11442-018-1500-2
63. Wästfelt, A., and Zhang, Q. 2018. Keeping agriculture alive next to the city – The functions of the land tenure regime nearby Gothenburg, Sweden. *Land Use Policy*, 78, 447-459. doi: 10.1016/j.landusepol.2018.06.053
64. Zhu, X., and Lansink, A. 2010. Impact of CAP Subsidies on Technical Efficiency of Crop Farms in Germany, the Netherlands and Sweden. *Journal of Agricultural Economics*, 61(3), 545-564. doi: 10.1111/j.1477-9552.2010.00254.x
65. Zondag, M. J., Koppert, S., de Lauwere, C., Sloot, P., and Pauer, A. 2015. Needs of young farmers. Luxembourg: Publications Office of the European Union.

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