The Local Impact of Cattle Farming

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Abstract.

A motivation provided for the provision of substantial agricultural subsidies to low income farmers is that it is an effective mechanisms to transfer resources into poorer rural areas. In this study we look at the local impact of a low income farming sector, cattle farming in a typical cattle farming county in the West of Ireland, County Clare. The input-output analysis reveals that cattle farmers in the county purchase and sell approximately 80 per cent of their livestock within the county and rely upon Clare suppliers for almost 90 per cent of their inputs and overheads. We have examined the impact in particular of a reduction in the size of the herd as a direct consequence of requirements to meet national level greenhouse gas emissions targets. The overall impact of such policies is capable of reducing household income within Clare by €9.5 million.

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The Local Impact of Cattle Farming

1. Introduction

Rural endogenous development, that is economic development based on the utilisation of local natural, physical and human assets, is a central tenant underpinning rural development policies and rural economic development strategies. Marsden and Sonnino (2008) conclude that endogenous development encourages farmers and the broader food industry 'to reconnect with markets, consumers and the environment' in advancing sustainable rural development. Van der Ploeg (2000) contends that 'rural development is more than the new, innovative and sometimes almost exotic activities we increasingly encounter in the European countryside' and that a more economical style of farming, with an emphasis on local ecosystems and local innovativeness can offer alternatives to the modernization project. The relationship between farming activity and the local economy and environment has an extensive literature with the various development agendas forming an important part of the discussion.

There is a relatively large literature on local multipliers for many sectors including Tourism (Frechtling and Horvath, 1999), recreation (Cordell et al, 1990), natural resource extraction (Cust and Poelhekke, 2015), mining (Fleming, D. A., & Measham, 2014), sporting events (Gelan (2003), cultural events (Tohmo, 2005) health services (McDermott et al., 1991) and universities (Armstrong et al., 1999) amongst others.

Moretto (2010) highlights the impact of changes in tradeable sectors on jobs in non-tradeable sectors. The agri-food sector is an example of a sector with potentially large local impacts in terms of local feed, animal and service inputs, but part of a major globally traded sector. Linkages can be relatively complicated for example as Harriss (1987a) finds that in addition to production impacts, consumption impacts can be even higher if a stronger agriculture reduces outward migration from a rural area. There is a particularly significant literature in development economics (Harriss, 1987a, Harrissb; Delgado et al., 1994; Hazell and Haggbade, 1990). In OECD countries much of the Agricultural literature on local impacts relates to local sustainable value chains, relating to the concept of food miles (Connor et al., 2008).

Agricultual productivity can have impacts through different mechanisms (capital, labour, demand) on non-agricultural sectors (Marden, 2015). Marden (1015) argues that Agriculture has been argued to provide linkages to industry through several channels. If agricultural productivity can impact on other sectors by increasing the labour supply, suppressing other wages through the labour channel. Increased savings may increase wider productivity through the savings channel. If agricultural productivity improvements increase the demand for other goods, when imports are not easily available, increasing the price and output of other goods through the demand channel. The greater the impediments to the movement of these factors, labour, capital or goods (Matsuyama, 1992), the greater the impact.

Local spillovers from Agriculture are relatively mixed in the literature. Santangelo (2016) finds positive spillovers from Agriculture on the wider local economy in both the Agriculture and non-Agricultural areas, while Hornbeck and Keskin (2012) find local gains within the Agricultural sector but limited gains elsewhere from an exogenous change on the sector via improved irrigation.

In this paper, we are interested in the local impact of an internationally traded sector in terms of the demand channel in the Cattle Sector in Ireland. The cattle sector is particularly interesting. On the face of it, cattle farming is loss making with subsidies on average exceeding family farm income (Connolly et al., 2010). As agricultural subsidies have been decoupled from production since 2005, it would seem that it would be rational for farmers to exit production. Yet, although cattle numbers have fallen in recent years, it has not been due to the impact of decoupled subsidies, but rather a reduction in cattle o dairy farms that have specialised after milk quotas have been abolished. Cattle numbers on specialist cattle farms have not fallen substantially even if they are in theory loss making.

One potential explanation is that although farmers are loss making in total market income, most farmers in fact make a cash profit from the market (O'Donoghue and Howley, 2012). What makes total costs greater than market income is the fact that depreciation and interest payments, which are part of total costs are sunk costs and must be borne regardless of the production decision. Thus a farmer makes a return on holding animals. It is less clear cut however in relation to the incentive to borrow to invest on farms, where the return may indeed be negative.

A sector that has such a high share of input costs relative to income has the capacity to have quite a high multiplier as much of the income gets transmitted into input supplies. The question we ask in this paper, where do these inputs come from, to gauge the impact on the local economy. Much of the literature when focusing on the local impact, focus on a regional or even a national scale. However at an individual scale, local has a much smaller scale than this. In this paper, we look at an intra-county level, so quite a granular look at local impact.

We focus on Ireland in this paper as a country with an extensive pastoral based cattle sector and with a proportionally large local economy. Assessing the local impact, we consider a typical rural county with a significant cattle farming population, County Clare in the mid-west of Ireland.

The purpose of this paper is to evaluate the local economic impact of the cattle beef sector to a rural economy in Ireland, in this case County Clare, and to assess the spatial extent of these economic activities. In many respects, farming activity in County Clare is typical of many parts of Ireland with the average farm size in the county (32.6 hectares) close to the national average (CSO, 2012). Cattle farming is the main form of agricultural activity in the county as is the case in many other parts of Ireland. Cattle farming in Ireland consists of many relatively smallholdings with an average farm size of approximately 29 hectares (Eurostat 2015). In general, farming in the county is not considered suitable for intensive production with 94 per cent of the agricultural area classified as severely disadvantaged (DOAFM, 2015). One may therefore conclude that the rural endogenous development approach has more relevance to farming in the county than modernization development. Tourism is also an important part of the local economy and rural areas with a relatively high dependence on tourism are less associated with full-time intensive farming and more towards extensive agriculture in combination with off-farm employment (Van Berkel and Verburg 2011).

Shucksmith and Ronningen (2011) conclude that policy can too often be "geared towards an ideal of full-time agricultural holdings treating smallholdings as obstacles to productivist agriculture, rather than recognising their potential role in terms of rural sustainability." The contribution of farms, with varying scale, towards wider rural sustainability can take many forms with the economic connections between farmers, local suppliers and retailers being just one particular aspect. The analysis in this paper concentrates on examining the location of livestock purchases and sales and the degree to which farmers in County Clare are reliant upon local suppliers for their farm inputs. This allows us to establish estimates regarding the local monetary impact of particular economic and policy changes for cattle farming and the wider

Clare economy. In particular, we estimate the impact of a reduced size of cattle herd as a product of meeting national level requirements for greenhouse gas emissions.

This is a relatively novel piece of research in an Irish or European context. While previous studies such as (Miller et al 2014) have examined the multiplier effects of agricultural output changes at a national level, few studies have examined the multiplier effects of output changes at a local level. Roberts et al (2013) have identified a gap in the literature with relatively little research focused on the interactions between farm households and the local economy. Moreover, this research applies a microsimulation approach to modelling the local economic impact. Microsimulation models have previously been applied in a spatial context to examine the multiplier effects of major job losses or gains at a local level (Ballas et al 2006a), the implications of CAP reform for the national spatial strategy (Ballas et al 2006b) and the local impact of the marine sector in Ireland (Morrissey et al 2014).

While some of our research draws from the rural endogenous development agenda, alternative agendas have their relevance to other circumstances. For instance, in line with a modernization approach, Rickard (2015) argues that accelerating the consolidation of small farms has desirable properties, as larger scale farms have "an inherent advantage" in delivering the investment considered necessary for global food security. This line of argument may have a stronger foundation in geographical areas suitable for production intensification and specialist dairy farming but this is unlikely to be the case for farms in the vast majority of County Clare. In addition, many authors, have for various reasons, concluded that researchers should avoid a productivist/post-productivist dualism (Bjørkhaug and Richards 2008; Evans et al 2002; Wilson 2014).

In the next section, we describe the background regarding the local economic impact of agriculture and the related literature. The methodology is described in section 3 followed by a description of the data sources. This is followed by three separate results sections, the first dealing with the spatial distribution of farms and farm income in the county, the second set of results dealing with the spatial distribution of livestock sales and the source location of inputs and the final results section dealing with the local multipliers. This is followed finally by the conclusions.

2. Background

Cattle farmers in Ireland are highly dependent on publicly-funded subsidies (Hennessy et al 2008) and have become increasingly vulnerable to a cost-price squeeze with declining margins per volume of beef (O'Donoghue 2013). Recent evidence suggests that many cattle farmers use subsidies to support loss-making production (Howley et al 2012). Some of the larger farms use the direct payments to support investments in rented land and additional livestock but this tends to have mixed outcomes (Finneran and Crossan 2013). In combination with off-farm income, publicly funded subsidies allow many cattle farms to maintain a reasonable standard of living and be economically sustainable (Hynes and Hennessy 2012). The retention of these farm households in rural areas supports the relevant local economies via the farm and non-farm expenditures attributed to these households.

The economic position of Irish cattle farmers is therefore well treated in the economic literature but there is something of a void in relation to the treatment of the local economic effects of cattle farming production. Cattle farmers may not enjoy the profitability of their dairy farming counterparts but they do contribute indirectly towards other economic activity in rural Ireland. As in the case of (Sutherland and Burton 2011), we argue that the notion of 'good farmers' should account for the local social and economic outputs that farmers provide. Miller et al (2014) have developed a social accounting matrix to examine the wider economy effects of a decline in the beef sector and show that significant employment losses in the wider economy would result. The analysis is focused however, at a national rather than local or regional level.

The inadequate treatment of the wider local economic effects of agriculture in Ireland contrasts with the United States where numerous studies have examined these effects. Foltz and Zeuli (2005) found that small farms were more likely to purchase inputs locally in communities where an array of marketing outlets existed. The authors suggest that the attachment to community appears to result from "the procompetitive effects of local market diversity". In a study of Wisconsin dairy farmers, (Foltz, Jackson-Smith and Chen 2002) found that larger dairy operations were more likely to purchase feed and other inputs outside of the local communities. Lambert et al (2009) found that farmers located in areas with relatively large farm populations appear to be better served by local input suppliers implying "that farm-community linkages are strongest where farms are numerous and where the sector is large enough to anchor a regional farm supply center".

In addressing the local economic effects of agriculture, researchers have tended to focus their analysis on a relatively small geographical area e.g. Jablonski and Schmit (2014) which focused on a particular district within New York State. Foltz, Jackson-Smith and Chen (2002) focused their analysis on three communities in Wisconsin. This approach can be justified on the basis of the costs associated with data collection and the desire for a relatively homogenous sample of farms. Our analysis is focused on the cattle sector in a particular county in Ireland, in this case County Clare. This county is chosen as cattle farming is overwhelmingly the most important agricultural enterprise in the county. According to the 2010 Census of Agriculture, approximately 78 per cent of farms in County Clare are classified as specialist beef production which far exceeds the national average of 56 per cent.

Quite apart from their farming activities, Irish cattle farmers contribute directly to local economies through off-farm employment. A relatively high proportion of Irish cattle farmers engage in off-farm employment with 43 per cent of cattle rearing farm operators and 33 per cent of operators of other cattle farms engaging in off-farm employment (Hennessy et al 2014). Pluriactivity is therefore likely to play an important role in determining the economic welfare of farm households in County Clare. Shucksmith and Ronningen (2011) argue that "small farm holdings provide a base from which rural households are able to sustain their livelihoods through pluriactivity, keeping 'lights in the windows' and retaining populations in areas from which they would surely have been lost if farm amalgamation had proceeded." The direct payments are particularly important to the beef and sheep farms where relatively few enterprises are profitable. This raises further questions as to their long term viability and the potential implications for rural economies should they be consolidated.

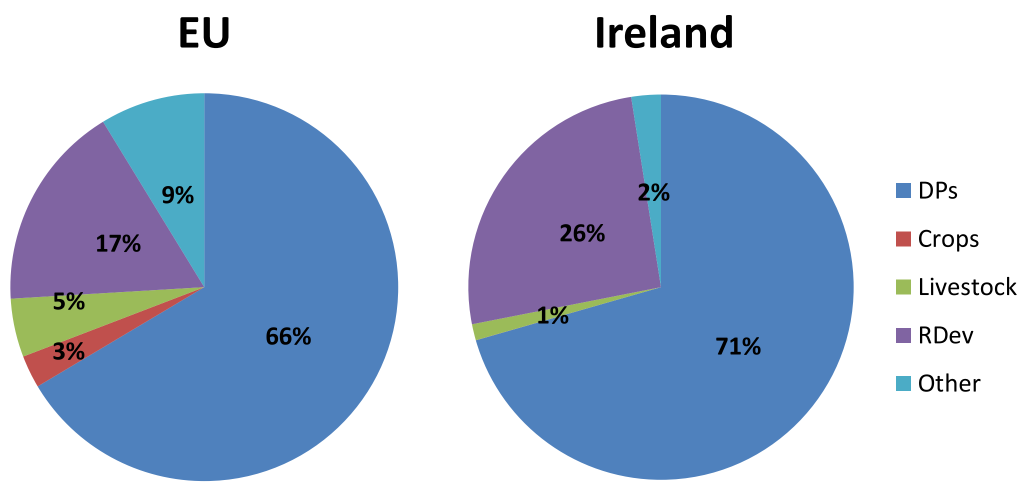
EU subsidies play an essential role in maintaining agriculture throughout Europe in its current form. Data from the Farm Accountancy Network Data (FADN) show that the average gross income for EU farms in 2012 was €38,559[2] and average total subsidies (excluding on investment) was €11,125. In other words, over 28% of farm income in the EU is derived from CAP subsidies. Figure 1 shows a breakdown of the source of subsidies on EU, and Irish, farms, respectively. It is clear that farmers in Ireland are almost entirely awarded subsidies in the form of decoupled payments, e.g. as part of their single payment scheme (SPS), or as support for Rural Development. Receipt of DPs and subsidies for Rural Development is usually conditional

[2] Average net income for EU farms was €19,582 (FADN, 2015).

on meeting certain criteria. For example, in the case of the SPS, Irish farmers are required to follow a variety of rules on the environment, public health, animal health, plant health, animal welfare and land maintenance in return for their subsidy (DAFM, 2015).

The most recent reform of CAP in the area of rural development sets out 6 priority areas for Member States. The two that are most pertinent to this study are enhancing the viability/competiveness of farms and all types of agriculture and promoting social inclusion, poverty reduction and economic development in rural areas (DAFM, 2014). In essence, these aims highlight the role that subsidies are supposed to play in retaining rural viability. This paper aims to assess whether a substantial proportion of the 26% of Irish subsidies intended for Rural Development (Figure 1) are, indeed, fulfilling this role.

Figure 1: Average Sources of Subsidies for EU and Irish farms in 2012



Source: FADN (2015). DPs: Decoupled Payments, RDev: Rural Development

In particular, this paper examines the flow of expenditure from Irish beef farms into the local economy. We focus on the Irish beef industry for two reasons. Firstly, Ireland is one the most important producers of beef worldwide. For example, in 2012, the beef trade between Ireland and the UK was one of the 10 single biggest beef trade flows internationally (Agri Benchmark, 2013). Secondly, at a national level, the beef industry in Ireland is second to dairy alone in terms of agricultural value; however, as Table 1 shows, the importance of support for Rural Development is substantially higher for Irish cattle specialists than milk specialists.

Table 1. Support for Rural Development and Outputs for Milk and Cattle Specialists

	RDev	Outputs	%
Milk specialist	4681	153214	3.1
Cattle specialist	6132	37498	16.4

Source: FADN (2015). RDev: Rural Development, %: (RDev/Outputs)x100

3. Methodology

The objective of this study is to model the impact on the local economy of cattle farming. This objective however has a number of methodological challenges. While there exists good micro farm level data containing incomes, costs and technical attributes at national level and while there exists spatial Census information in relation to small area statistics of farm structures, no dataset exists containing both detailed income sources and fine spatial attributes. It is therefore necessary first to utilise a methodology to synthetically generate spatially differentiated micro data.

Spatial microsimulation (Clarke, 1996) is a potential methodology achieving both of these dimensions within its data enhancement process. There is an extensive literature described in O'Donoghue et al (2014) covering many different policy areas, utilising various methodologies described in (Hermes and Poulsen 2012).

The methodology has been applied in a number of instances within agriculture and rural development. (Ballas et al., 2006) utilised iterative proportional fitting to examine CAP reform as part of the Luxembourg agreement. Hynes et al. (2009b) developed a model of spatial farm incomes utilising simulated annealing, which has been used to examine the impact of EU Common Agricultural Policy Changes (Shrestha et al., 2007). This forms part of the Simulation Model of the Irish Local Economy (SMILE) (O'Donoghue et al., 2013). O'Donoghue (2013) extended the farm focused models to include wider household income sources to be able to assess the wider economic sustainability of farm households. Clancy et al. (2013) utilised the model in Ireland to assess the optimal spatial location for the growth of willow and miscanthus for biomass production. Lindgren and Elmquist (2005) linked natural sciences and economics in their Systems AnaLysis for Sustainable Agricultural production (SALSA) model to evaluate the economic and environmental impact of alternative farm management practices on a site specific arable farm in Sweden.

A variant of the agricultural dimension of SMILE (Hynes et al., 2009b), focuses on recreational activity in forests within a single city (Cullinan et al., 2008). Also with a small area focus (a number of municipalities), van Leeuwen et al. (2008) have developed a model exploring the linkages between on and off-farm employment, which is becoming an increasing part of farmer's incomes in the EU. While there have been many examples of aspatial static microsimulation models that have simulated greenhouse gas emissions, the spatial models that have modelled these emissions tend to be those where spatial context is relevant such as agricultural models (Hynes et al., 2009a), land use (Moeckel et al., 2007) or transportation issues (Mavoa, 2007). In terms of environmental and biodiversity related issues, microsimulation models were used to look at a range of issues including wildlife-recreation interaction (Bennett et al., 2009) and the non-market value of wild bird conservation (Hynes et al., 2010), landscape services from Agriculture (Pfeiffer et al., 2012) and participation in Rural Environmental Protection Schemes, (Hynes et al., 2008).

In order to undertake a spatial impact analysis of the CAP reform, we need to statistically combine farm level survey data, Teagasc National Farm Survey (NFS), the Irish version of the Farm Accountancy Data Network with spatial Census of Agriculture data. The most recent Census of Agriculture was collected in 2010 and released for research purposes in 2013 (CSO 2010). We wish to combine this with the 2010 Teagasc National Farm Survey.

O'Donoghue et al. (forthcoming) and Hermes and Poulsen (2012) describes a number of potential methodologies to do this. Potential options include

- Iterative Proportional Fitting
- Deterministic Reweighting
- Combinatorial Optimisation
- Quota Sampling

In determining the methodology to use for the creation of a farm level spatial microsimulation model, we faced a number of issues. While Iterative Proportional Fitting (Ballas et al., 2006) could potentially be used to produce small area weights, it struggles to deal with the issue of heterogeneous stocking rates. As the survey has a greater sample size than the cell size for most districts, resulting in weights of less than 1, it is likely that this approach will smooth the heterogeneity of farm incomes. Similarly given how many districts have small numbers of farms in Ireland, the GREGWT reweighting method (see Tanton et al, 2011) used in household analysis Australia is potentially challenging and may smooth incomes. Simulated Annealing (SA) was used to generate an earlier version of the model (Hynes et al, 2009) but has significant computational costs and also struggles with the heterogeneous stocking rate issue.

Thus we were motivated to develop a methodology that was sample based to avoid the income smoothing concern of the weighting methodology, was computationally efficient and could be adjusted to improve the spatial heterogeneity of stocking rates.

We have thus developed in parallel with Farrell et al. (2013) a method known as Quota Sampling (QS) which is a probabilistic reweighting methodology developed which operates in a similar fashion to Simulated Annealing (SA) (Wu and Wang, 1998), whereby survey data are reweighted according to key constraining totals for each small area, with amendments made in the sampling procedure in order to improve computational efficiency. We call the resulting model SMILE-FARM[3]. The basic sampling procedure, and its implementation in the overall simulation process, is now outlined.

Similar to SA, quota sampling selects observations at random and considers whether they are suitable for selection for a given small area based on conformance with aggregate totals for each small area characteristic. Unlike SA, Quota Sampling only assigns units (in this case farms) that conform to aggregate constraint totals and once a unit is deemed selected, it is not replaced; the main computational improvement.

The quota sampling process involves the following steps

- Thus for each unit *i*, we draw a random number *v*
- Sort units by *v*.
- Select the unit for spatial sample if $x_{j,s}^{acc} + x_{j,i} \leq x_{j,s}^{total} \forall j$, where $x_{j,i}$ is the value of the variable j for the unit i, $x_{j,s}^{total}$ is the target total for district s for variable j and $x_{j,s}^{acc}$ is the running total for variable j for district s.
- If $x_{j,s}^{acc} + x_{j,i} > x_{j,s}^{total}$ for any j, then the we do not sample the unit i.

Thus, one can see that the variation of admitted units cumulates in a random sort which is consistent with aggregate constraint totals. This mechanism of sampling without replacement avoids the repeated sampling procedure of SA and is fundamental to the efficiency gains of the

[3] SMILE-FARM: Simulation Model of the Irish Local Economy, Farm Model

quota sampling procedure relative to other methods. One can see that the process is analogous to the type of quota sampling undertaken by market researchers, whereby only individuals considered relevant to concurrent quota counts are admitted to a sample.

This method of improving efficiency does present a number of convergence issues, however. Disparities in population distributions between census and survey totals may create a number of problems for unit-based microsimulation procedures. This is because survey microdata are representative at the national level, whereas small area census data are representative at the district level. This poses little difficulty in simulating small areas that have a population distribution similar to that of the national distribution, but areas that differ from the national distribution may lead to some demographic groups consistently being underrepresented in a given district. These differences may cause some districts to consistently fail in reaching adequate convergence.

Also, the use of sampling without replacement in quota sampling results in quota counts becoming increasingly more restrictive as the simulation progresses. As quota counts reach their target, the search space is continuously refined in accordance with concurrent quotas, whereby all units no longer eligible given updated quota totals are removed from the subset and the procedure is repeated[4]. When each constraint allocation reaches its target quota, all individuals of that characteristic are removed from the candidate search space. These mechanisms cumulate to offer a continuously diminishing search space and may prohibit convergence, whereby no unit is able to satisfy all concurrent quota counts.

Improving the fit of the Spatial Stocking Rate

Hynes et al. (2009) utilised farm size, farm speciality and soil code to generate the spatial distribution of agriculture. This however ignores differences in stocking rate, which given that that Irish Agriculture is largely animal based is likely to be a significant driver of farm income heterogeneity not accounted for by farm system, size and soil type. In addition to economic considerations, it is also likely to be an important driver of the environmental impact of agriculture.

While we know the average stocking rate in each spatial district and we know the stocking rate of each farm, we are unable to utilise this variable within the quota sampling process or the Simulated Annealing process, which requires the number of farms with a particular characteristic to be sampled. These methods cannot handle spatial averages.

Thus the objective of this new methodology is to improve the spatial heterogeneity of the stocking rate. In devising a method, consider the following relationship between match variable (soil, system, size) dummies and stocking rate

$$stocking\_rate_s = \sum_j match\mathrm{var}\_share_j \beta_j + u_s \quad (1)$$

Where the stocking rate of the district s is a function of the share of farms by system, farms by size and farms by soil type, with unobserved heterogeneity being accounted for by a stochastic term u_s

[4] e.g. with a remaining quota count of *n* individuals of class *k* to be filled, the search space is refined to exclude households containing *n+1* individuals of class *k*.

Consider now the stocking rate for farm i

$$stocking\_rate_i = \sum_j match\text{var}\_share_j \beta_j + u_s + \varepsilon_i \quad (2)$$

where the stocking rate of the farm i is a function of the share of farms by system, farms by size and farms by soil type, with spatial unobserved heterogeneity u_s and farm level unobserved heterogeneity being accounted for by a stochastic term ε_i.

Thus if we believe in the consistency of our spatial and survey data, where by the underlying relationship between the stocking rate and match variables are the same, then rather than randomly selecting farms for selection, we would like to select farms where the unobserved heterogeneity is similar.

We can partially identify this by estimating β_j using our spatial data and deriving an area effect u_s, applying the coefficients β_j to the micro data and deriving farm level unobserved heterogeneity $u_s + \varepsilon_i$. A selection of farms that can result in a similar spatial stocking rate from sampling to the actual spatial stocking rate are farms farm level unobserved heterogeneity $u_s + \varepsilon_i$ is closest to the spatial unobserved heterogeneity u_s.

To improve the fit, therefore rather than sorting randomly, we sort on the difference between the two residuals. Thus, before selection commences, farms are ranked by the smallest absolute difference between the stocking rate residual for the current district and the stocking rate residual contribution reported for the sample farms. This step means that farms with residuals which most closely resemble the residual stocking rate of the target district are more likely to be selected first. The SMILE-FARM model then considers each ranked farm in the micro data file for inclusion in target district. The application of this ranking is designed so that each target Districts residual stocking rate, unexplained by the linear regression model, can be somewhat preserved.

This assumption rests on the basis that if spatial unobserved heterogeneity is important then u_s is high as a share of $u_s + \varepsilon_i$ in which the approximation of the absolute difference between the residuals will largely account for the spatial effect. On the other hand if unobserved spatial heterogeneity is small, then the absolute difference will be largely driven by the aspatial stochastic term which is assumed to be random.

4. Data

In this section, we discuss the data required for our analysis and provide some summary statistics.

Choice of County Clare as a Case Study

The survey used for this study was undertaken in County Clare, in the West of Ireland. Clare is bordered to the north by Galway, to the east by Tipperary and to the west by the Atlantic Ocean, as is demonstrated in Figure 2 below.

Figure 2. Map showing the location of County Clare in Ireland

County Clare was chosen as the study area for this paper for two specific reasons. Firstly, over 7% (2467/33538) of the working population in County Clare are employed in agriculture (Table 2 below). This is substantially higher than the number employed in agriculture for the entire country, which is just over 3% (76,975/2,232,203).

Table 2. A Comparison of an average farm in Clare versus the State in 2010

	Clare	National
Population	117,196	4,588,252
Daytime working population	33,538	2,232,203
People in agriculture	2,467	76,975
Number of Farms	6,551	139,829
Specialist Beef Farms	4,722	72,141

Source: Census of Agriculture 2010 and Census of Population 2011

Secondly, Table 2 shows that, of the 6,551 farms located in County Clare, over 72% of them are beef specialists. Again, this value is much higher than the national average, which is 52% (72,141/139,829). Hence cattle-farming is a relatively important source of employment in Clare. In this paper, we hypothesise that cattle farmers' earnings, a large proportion of which are assumed to have derived from subsidies for Rural Development, feed into the wider Clare community, thus meeting one of the primary goals of the CAP's Rural Development Plan: rural viability. We then estimate how changes to the local beef sector in Clare would hypothetically influence rural viability in the county.

Data Description

While the SMILE-FARM model provides the spatial distribution of farms with their incomes, costs and technical attributes, we also need to collect data in relation to the location of purchases and sales by type of good. In this section, we provide a brief description of the data sources used for this paper and the methodology used to collect the data from Clare farmers.

This data provided us with the necessary information about the source location for inputs and the output destination for cattle outputs among cattle farmers in the county. The resulting sample of Clare farms was matched with the Teagasc SMILE-FARM model so that spatial analysis could be carried out with reference to the activities of all cattle farms in the county. We provide here under various headings, a description of the methods used to collect the Clare farm data.

Data Collection

Identifying the sample of farmers to be surveyed

An application was made to undertake a series of queries on the Teagasc Client Information Management System (CMIS). This request was granted subject to a number of conditions associated with ensuring the confidentiality of the data and agreement that the data extracted could not be used for any purpose other than the survey. A series of queries were run to i. identify all Teagasc clients in Co. Clare; ii. identify all Teagasc clients with a beef enterprise from this subset of data; iii. identify those enterprise where beef production was the primary type of farming undertaken on the farm.

Selecting the sample

Using spatial analytical techniques, Co. Clare was divided into four sub-regions by applying a horizontal and vertical transept that bisected Ennis. (i.e. Clare was divided into four sub-regions with Ennis at the centre). Each of the farms selected from the CIMS was allocated a sub-region identification number based on their address. These data were incorporated into a statistical analysis package and a random sample of 100 farms was identified from each sub-region.

Completing the survey

The survey instrument (questionnaire) was implemented by contacting those farmers selected by telephone and either collecting the data at that time of organising another time to call back to do so. If a farmer did not wish to participate in the survey or did not have to time to do so, the next farmer on the list was contacted until 13 farms in each of the sub-regions had been surveyed. This resulted in a population of 52 farms being surveyed.

Processing the Survey

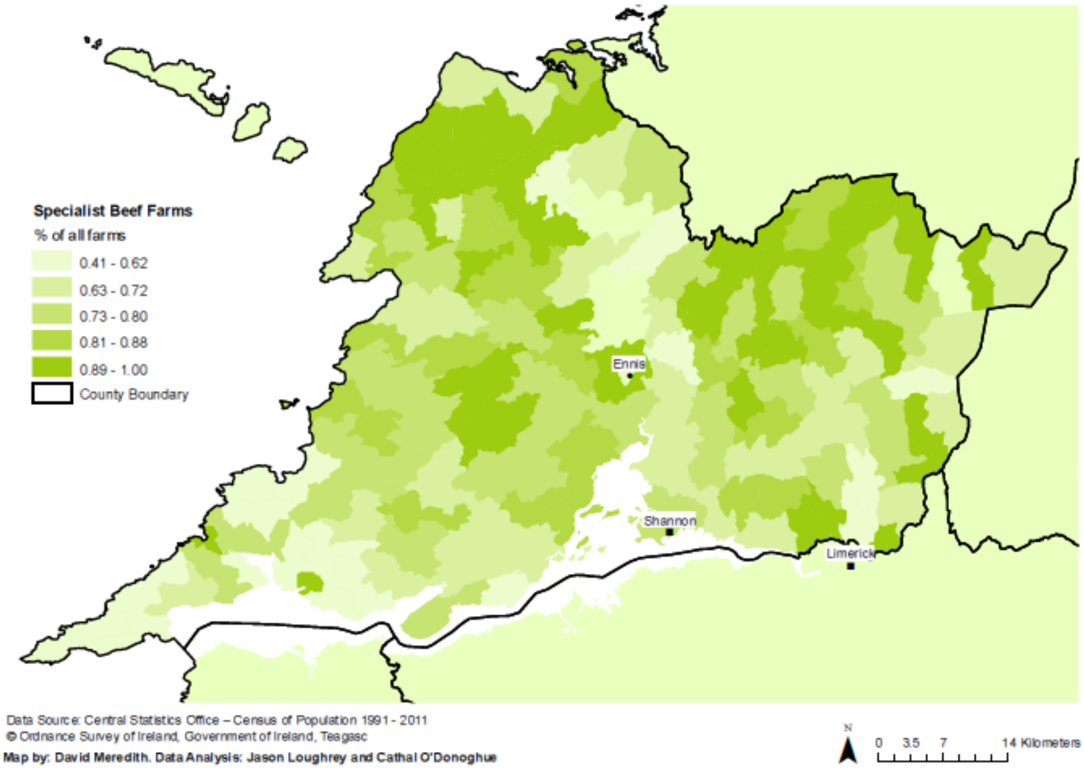
Once complete, the questionnaires were entered into a spreadsheet and the data restructured to extract out four individual survey sections. These included i. the address of the farm; ii. the structure of the farm enterprise; iii. the source (address) of inputs to the farm; and iv. the destination (address) of outputs. All sections that incorporated address data, that is i, iii and iv, were geocoded to facilitate spatial analysis (location allocation) within the SMILE model. This involved matching the address of the farm or business address of input and output to its address in the An Post Geodirectory. For more information on the Geodirectory see this website: www.geodirectory.ie. Where it was not possible to identify an exact match for each address the farm or business was allocated the nearest address point in the dataset. Once the matching process was complete, the geographic coordinates associated with each farm and business were extracted.

The survey data was then matched to the Teagasc SMILE model using a statistical matching method known as the distance method. This method of matching records from the survey to the SMILE model involves a set of overlapping variables that are common to both the survey data and the SMILE model. These variables included the farm type (i.e. dairy, specialist beef, crops etc.), some demographic variables such as age and marital status and the size of the single farm payment. This allowed us to match farms of similar type from the farm survey data to the SMILE model and therefore achieve the necessary scale for spatial analysis.

5. Results 1: Outputs from the SMILE model

Spatial Distribution of Agriculture in County Clare

Figure 3. The Share of Farmers classified as Specialist Beef Producers in Clare



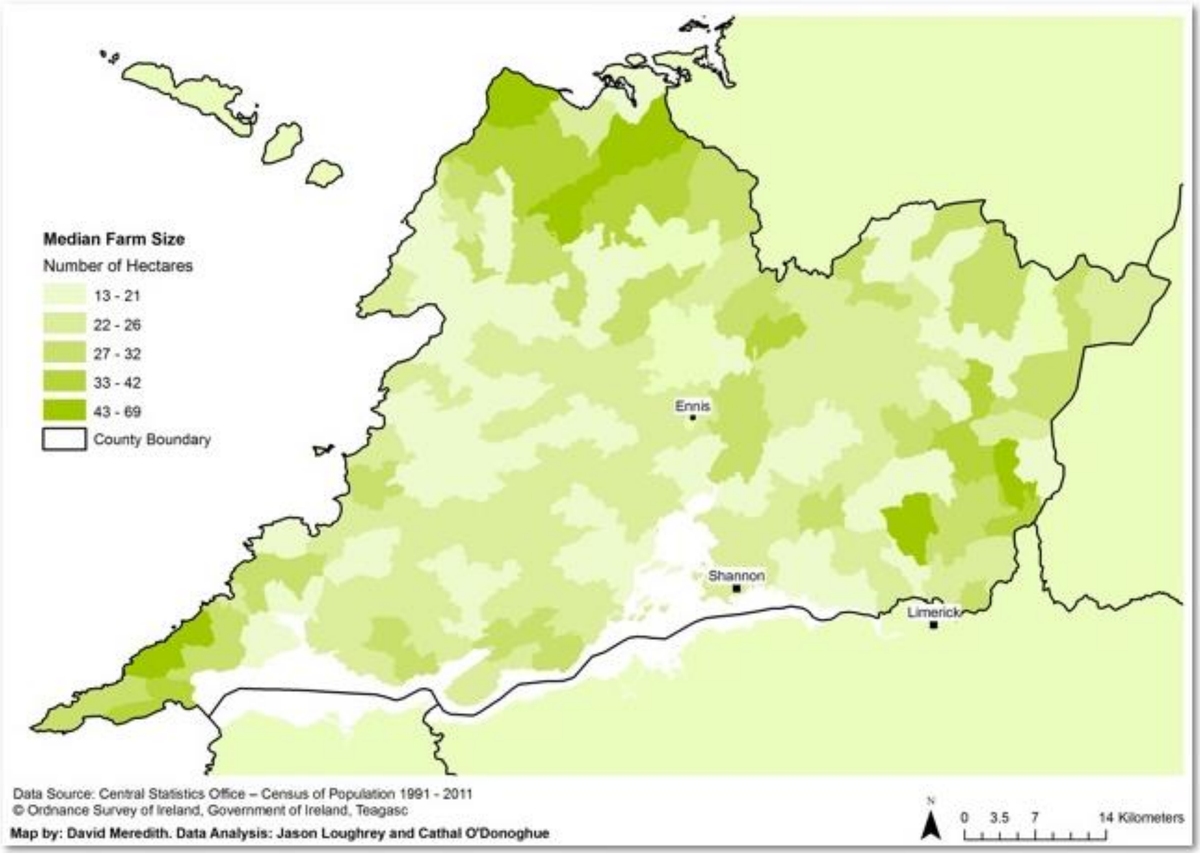
The census data indicates the importance of specialist beef production to farming in Clare with some variability within the county in terms of the reliance upon specialist beef production. In figure 3, we show the share of farmers engaged in specialist beef production and the picture indicates some variability between the north and south of the county. Farming in many parts of the north is almost exclusively dependent on specialist beef production. Many parts of the south have a relatively high share of farmers devoted to other activities such as dairying or mixed livestock grazing. This explains why the share engaged in specialist beef production is below 63 per cent in parts of the south.

In figure 4, we present the median farm size for each district.[5] The picture from figure 4 is that farm size is generally bigger in the very north of the county in comparison to elsewhere. This is an area where farming is particularly focused on specialist beef production. Median farm size appears to be below 32 hectares in many parts of the south where dairy farming is more popular. The lower farm size in the south is due however to the location of many relatively

[5] This is because the average value can be completely distorted in districts with a small number of farmers. The median value is therefore a more reliable indicator.

small sized specialist beef farms. Dairy farms in Clare are still approximately 12 hectares bigger on average than specialist beef producers according to the SMILE-FARM model.[6]

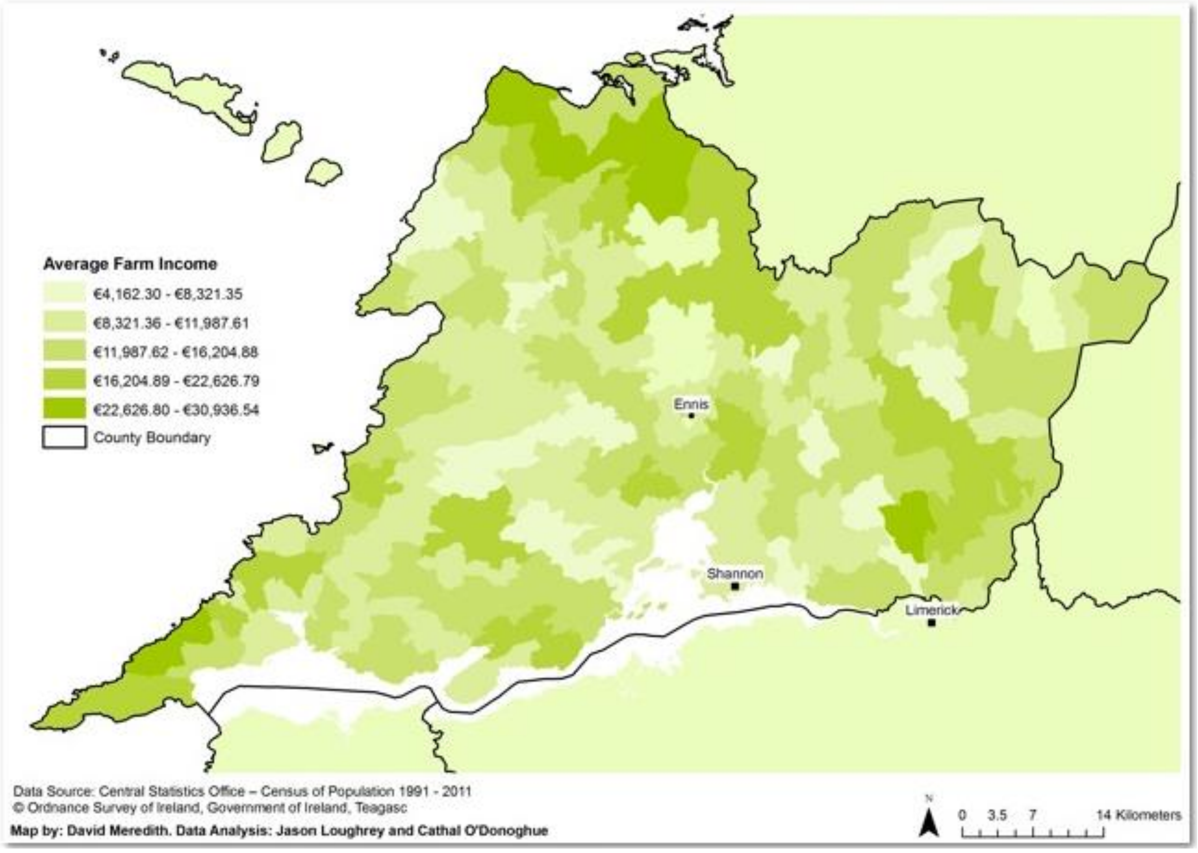
Figure 4. Spatial Distribution of Farm Size in County Clare



The spatial variations in farm size and system across the county may be expected to impact upon the spatial distribution of farm income. In figure 5, we present the spatial distribution of family farm income in 2006 using five income brackets. The definition of family farm income includes agricultural subsidies but excludes off-farm income. Figure 5 indicates that farm income is highest in the very north of the county. The relatively high farm income in this area may be attributed to the higher than average farm size. The relatively lower income in the south emerges despite the fact that dairy farms have higher incomes than specialist beef producers and dairy farms are more common in the south. The patterns suggest that there are many low income specialist beef producers in the south and north-east of the county. These farm households are economically vulnerable unless decent off-farm employment is available.

Figure 5. Spatial Distribution of Family Farm Income in 2006

[6] The average size of dairy farms is approximately 18 hectares greater than for specialist beef production at the national level Census of Agriculture (2000).



6. Results 2: Cattle farmer expenditure in County Clare

In this section, we present results regarding the flows of cattle farming inputs and outputs in the county as facilitated by the matching of the Clare survey data to the Teagasc SMILE model. The SMILE model indicates that annual gross cattle output in 2008 stood at approximately €97 million for farming in Clare.

For analytical purposes, we provide these results according to six regions i.e. North-West Clare, South-West Clare, North-East Clare, South-East Clare, Ennis and outside Clare. The inclusion of this latter category allows one to account for the share of inputs coming from outside the county and the share of farm output being sold to outside the county. The four within-Clare regions are defined roughly according to their position relative to the town of Ennis. As one can see from figures 1 to 3, the majority of the geographical area in the county is west of Ennis town. It is therefore unsurprising to find that the majority of farmers and agricultural output comes from that part of the county that lies west of Ennis town. This is clear from the results of table 3 below which shows that north-west and south-west Clare account for over 60 per cent of the value of farm output and cattle output in the county.

Table 3. Share of Farm Output coming from farmers in five Clare regions

Region of Farm	All Farm Output	Cattle Output
North-west	28.6	30.4
South-west	35.5	31.1
North-east	16.5	18.5
South-east	18.5	19.0

Ennis	0.8	0.9
Total	100	100

Table 3 excludes information regarding the geographical point of sale. Cattle marts are located throughout the county including the town of Ennis where sales are held two to three times per week and more frequently than other marts in the county (see www.claremarts.ie). It does not therefore follow that the west of the county will be the point of sale for over 60 per cent of output. In a study of agricultural transactions in North-East Scotland, Pangbourne and Roberts (2015) found that certain towns are found to dominate agriculture-related transactions. In this study, it will be interesting to identify the relative importance of Ennis town as a place of agricultural-related transactions.

In table 4, we provide the share of output for each of the six regions based on the geographical point of sale. This includes the share of output sold to outside the county. Table 4 shows that 44.5 per cent of farm output goes outside of the county. This high figure is primarily driven by the exit of milk output to creameries in Limerick and Cork. Confining this to cattle output, we find that approximately 20 per cent of cattle output goes outside of the county. We find that the west of the county is the point of sale for only approximately 30 per cent of cattle output. Almost one quarter of cattle output is sold in Ennis town and approximately 26 per cent is sold in the east of the county. A reduction in the size and value of the cattle herd in Clare will therefore be associated with a decline in the local economy in Ennis town and further outside of the county. Farmers from the west of the county are clearly purchasing and selling a large proportion of their livestock in Ennis mart. This is true of farmers in the east of the county but to a lesser extent. In addition, we have examined results according to different groups of cattle.[7]

Table 4. Share of Output sold in six regions according to Geographical Point of Sale

Region	All Farm Output	Farm Output Excluding Dairy	Cattle Output Only
Outside	44.5	20.3	20.1
North-west	14.2	20.3	20.4
South-west	6.7	9.6	9.7
North-east	7.7	11.0	10.9
South-east	10.1	14.6	14.6
Ennis	16.8	24.1	24.4
Total	100	100	100

Inputs and Overheads

We have now established some important findings about the point of sale for livestock sales. In table 5, we present the share of direct inputs and overheads purchased from each of the six regions. Direct inputs include feed, machinery hire, casual labour and fertiliser. Overheads include electricity, telephone costs, interest payments and depreciation of assets. We find that almost 9 per cent of expenditures are sourced from Ennis town and over 11 per cent from outside of the county. Among specialist beef farms, we find that almost half of all overheads and inputs are sourced from the west of the county. Approximately 32 per cent are sourced from the east of the county. We find that the share of overheads sourced from outside of the county is greater than the share of direct inputs from outside of the county.

[7] We find that there is little variation between regions in terms of the reliance upon cattle at different stages of production or between breeding and non-breeding cattle.

Further analysis indicates that the majority of inputs are purchased within the same regional area. This is particularly strong in the western part of the county, where the road infrastructure is probably less advanced than in the east of the county. Pangbourne and Roberts (2015) found that a relatively high percentage of farmers choose to purchase inputs from a supplier located outside of their immediate area. The results in table 5 suggest that this sample of Clare farmers are inclined to purchase most of their inputs from within their local hinterland so there may be some contrasting results with (Pangbourne and Roberts 2015). The findings have much in common with those of (Pritchard et al 2010) where there is clear evidence that farm households and businesses make extensive use of their local towns for maintenance purchases and a range of other supplies. Pritchard et al (2010) label this tendency to buy local as the 'local-if-possible principle'.

Overall, the findings suggest that a change in the volume and value of the cattle herd in Clare will clearly lead to output changes for those companies supplying the specialist beef farmers with inputs. The information supplied in table 5 suggests that over 90 per cent of these output changes would come from within the county. The multiplier effects at the county level are therefore likely to be more important than in the case of most other industries.

Table 5. Share of Farm Inputs and Overheads coming from six regions

Region	All Farms	Specialist Beef Production Farms Only
Outside	9.3	11.2
North-west	27.7	28.3
South-west	25.0	19.8
North-east	12.4	13.4
South-east	18.5	18.4
Ennis	7.0	8.9
Total	100	100

We can conclude from this section that changes in cattle output will produce secondary economic effects outside of the farm gate. Under changes in cattle output, in the region of 40 per cent of the downstream impact is likely to be felt in the area west of Ennis. The share of livestock sold in the area may be relatively low at approximately 30 per cent but almost half of all overheads and inputs are sourced from there. In addition, the majority of specialist beef farmers reside in the area west of Ennis town therefore indicating that a majority of the farm income change will emerge from there.

Under changes in cattle output, approximately 15 per cent of the downstream impact will be experienced outside of the county as one-fifth of all livestock purchases are made outside the county and slightly over 11 per cent of inputs and overheads are sourced from outside the county. Approximately 30 per cent of the downstream impact is likely to be attributed to the east of the county. The secondary effects will reach the town of Ennis to some extent because approximately one-tenth of overheads and inputs are sourced from there and one quarter of livestock purchases are conducted within the mart in the town. It is worth noting that inputs and overheads account for much greater amounts than livestock purchases for the average farm as many farms rely upon their breeding cows to maintain the size of the herd rather than exclusively through livestock purchases.

7. Results 3: Effects of changes in beef industry to the local economy

In this section, we present results regarding the overall effect for the wider Clare economy of a hypothetical decline in the size of the cattle herd in the county. We perform this analysis while bearing in mind the recent volume and value trends for the cattle sector in Ireland and within County Clare. The AIM Bovine and the CMMS surveys have revealed that the cattle herd in County Clare declined in volume terms by an annual compound rate of 2.25 per cent between 2002 and 2011 and therefore close to the 2.1 per cent decline at the national level (DAFM, 2012). The monetary value of cattle output at the national level actually increased during this time. At a national level, the total value of cattle output increased from approximately €1.179 billion in 2002 to €1.502 billion in 2010 and €1.795 billion in 2011. This represented a compound annual growth rate of approximately 3.1 per cent up to 2010 and 4.8 per cent up to 2011 (CSO, 2012).

We use the Agrifood social accounting matrix developed by Miller et al (2011) to estimate the wider economic impact of a hypothetical decline in the size of the herd and the associated primary output values. Miller et al (2011) estimated the multiplier effects of a decline of 12.6 per cent in national output of cattle and a €183 million decline in the national-level primary cattle output value. The precise size of the decline is based on the expected level of decline required for Irish agriculture to deliver a 20 per reduction in greenhouse gas emissions (Donellan and Hanrahan 2011). This would entail a reduction in final demand of €326 million in the beef processing sector. In terms of the wider multiplier effects, Miller et al (2011) estimated a €945.83 million decline in overall economic output, a €457.45 million decline in GDP and a €332.8 million decline in household income.

Table 6. Multipliers for Cattle and Beef Processor Output

Monetary Variable	Multiplier from Euro of Cattle Output	Multiplier from Euro of Beef Processor Demand
Beef Processor Demand	1.78	1
National Output	5.17	2.90
GDP	2.50	1.40
Household and Enterprise Income	2.13	1.19
Household Income	1.82	1.02
Rural Non-Farm	0.20	0.35
Household Income- Rural Cattle Rearing Farm	0.05	0.09
Household Income- Rural Cattle and Other Farm	0.04	0.06
Enterprise Income	0.31	0.17

Source: Authors calculations based on Miller et al (2011)

In table 6, we provide the relevant multipliers to represent these findings. One can see that the initial change in cattle output generates a decline in overall national output that is over five times the size of the initial cattle output amount. Much of this change in output value can be attributed to the beef processing sector where the decline in the output value would far exceed the initial decline in primary output value. This is demonstrated by the multiplier value of 1.78. The overall multiplier effects for the cattle farm households appear quite small relative to the rural non-farm households. This is due to the number of cattle farm households being relatively small in number relative to the non-farm households and the low margin of profitability of cattle farming. This further underlines the importance of research that addresses the secondary local economic effects of cattle farming.

In the following, we apply the above multipliers to the scale of cattle farming in County Clare. This will provide us with estimates of the overall monetary impact from County Clare of a similar national-level decline in cattle output. The AIM bovine statistics show that the cattle herd in Clare accounts for 4.1 per cent of the national herd (DAFM, 2012). We may therefore expect that a decline in cattle output described in Miller et al (2011) would involve a decline in primary cattle output for County Clare in the region of €7.5 million, a further decline in final demand for the beef processing sector of €13.4 million and a decline in household income of approximately €13.65 million. The absolute decline in household income County Clare will be in this region. Given that cattle sales and beef processing crosses county boundaries, one can expect that the economic losses from farm households in neighbouring counties will impact on household income in County Clare just as the economic losses from farm households in Clare will impact on households in neighbouring counties. Miller et al (2011) estimated that each cattle enterprise farm household would lose approximately €927 on average under this decline scenario. This is a very significant amount of money given that average family farm income is below €16,000 in many parts of the county as shown in figure 5.

We should expect from these changes that approximately 60 per cent of the farm income change and 40 per cent of the downstream income change will come from the west of the county. We should also expect that the downstream income change will overwhelmingly dominate the farm income change. This is due to the low margin nature of specialist beef production.

8. Conclusion

In this paper, we have examined the importance of the cattle sector to the local economy of County Clare in Ireland and the potential impact of changes in this sector upon wider economic activity. Our findings suggest that farmers in this example are inclined to purchase most of their inputs from within their own immediate area thus indicating that the 'local-if-possible principle' is followed by many farmers in the county. The findings suggest that a substantial share of livestock sales (25 per cent) tend to take place in the main county town of Ennis and thus away from the immediate hinterland of many cattle farmers. This shows that farmers will travel longer distances for specific transactions but the overall results indicate that small towns and villages are deeply connected with the agricultural hinterlands. As in the case of (Pritchard et al 2010), the analysis suggests that a viable local farming sector supports local towns and the basic commercial functions demanded by farm households.

The empirical analysis has further examined the impact of a reduction in the size of the herd in County Clare to meet Greenhouse gas emission targets. The overall impact of such a decline is capable of reducing primary cattle output for County Clare in the region of €7.5 million and leading to a decline in household income of approximately €13.65 million. Efforts to meet greenhouse gas emission targets are not the only potential reason for a decline in the cattle herd. The total size of the cattle herd in the county declined significantly between 2002 and 2011 as the cost-price squeeze sharpened and the introduction of the Single Farm Payment incentivised farmers towards less intensive farming. Regardless of the cause for the decline in the cattle herd, the multiplier effects remain important. The potential losses to farm income further underline the importance of off-farm employment as an alternative income source. In addition, the Single Farm Payments, environmental and the rural development payments play an important role in sustaining these farming communities. While this paper has emphasised the local economic impact of cattle farming, it should be acknowledged that beef production has a strong export orientation and that a wider treatment of the contribution of cattle farming to the overall economy should reach beyond a local/global dualism.

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