What multipliers don't tell you: A spatial analysis of farm household linkages

Kate Pangbourne[1] and Deborah Roberts[2]

[1]Department of Geography, University of Aberdeen
[2] University of Aberdeen Business School, University of Aberdeen

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* Corresponding author: Deb Roberts, University of Aberdeen Business School. Edward Wright Building, Old Aberdeen, Scotland. AB24 3QY. Tel: +44 (0) 1224 273690. Email deb.roberts@abdn.ac.uk

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Abstract

Agricultural policy and farm lobby groups often stress the role of farm production in sustaining local economies. This paper considers the spatial pattern of the upstream and downstream agricultural transactions of farms in North East Scotland and, in particular, the extent to which they take place within the locality of the farm holding. Three alternative definitions of "local" are considered: a distance based measure; a measure which takes into account the location of the farm in relation to the nearest town; and finally a measure which takes into account the location of input suppliers/output purchasers. The results are shown to vary qualitatively according to the definition of local adopted, highlighting the importance of allowing for context as well as demand-side factors when explaining purchasing and sales decisions. A highly complex pattern of production-related linkages in the region is revealed. Certain towns are found to dominate agriculture-related transactions in the region reflecting the spatial concentration of upstream and downstream agribusinesses. Probit analysis suggests that farm size, farm type and risk attitudes influence output sales patterns. The policy implications of the findings are considered.

Keywords local transactions, spatial tracking, farm households, agribusiness

JEL codes R12, Q12, Q13.

1. Introduction

Farms and farm households contribute to local economies in multiple ways. Apart from their links through agricultural production processes, farm businesses may have diversification activities, members of farm households may undertake off-farm work, and there is also farm household consumption expenditure in the local economy. However the discourse of both farmer lobby groups and EU communications on the CAP tend to stress the role of production-related links in maintaining local economies (see, for example, National Farmers Union of Scotland, 2009).

There is a substantial body of rural sociology literature concerned with farm households and local economic development. This stems largely from Goldschmidt's hypothesis on the socially detrimental effects of large scale farms and industrial agriculture (Goldschmidt, 1978; Hoggart, 1987; Lobao and Stofferahn, 2008). Far less work has been done by economists on the local economic impact of agriculture. Instead, research has tended to focus on the "rural" as opposed to "local" economic impacts of farm household transactions and is based on multiplier or general equilibrium models (Midmore and Harrison-Mayfield, 1996; Psaltopoulos et al., 2006; Kilkenny, 1993). Apart from the issue of geographic scale, such models are aspatial with even the bi-regional rural-urban models treating each sub-area as point economies. As a consequence, they fail to provide any indication of the spatial distribution of impacts within the area they are studying.

Those studies which have focussed at the local level have, arguably, failed to give sufficient attention to how local context influences farmer behaviour. Purchasing and sales patterns have been explained by farm characteristics (farm type, size and distance to urban settlements) and farmer and farm household characteristics (demographic profile, engagement in off farm work, community attachment). A farmer can only buy inputs and sell output locally if local input sellers and output purchasers are present. However, previous analyses have paid little or no attention to the structure of the agribusiness sector in the locality. Given the significant market concentration of upstream and downstream sectors in recent years (Busch and Bain, 2004) this issue is of growing relevance.

Against this background, this paper considers the spatial distribution of direct or "first-stage" farm business transactions of a sample of 224 farmers in North East Scotland. Building on a critique of previous studies in the area, empirical analysis compares the findings from three

alternative definitions of a "local" transaction: A simple distance-based measure; a measure which takes into account the distance of the farm to the nearest settlement of a certain minimum population; and a measure which takes into account the location of input suppliers/output purchasers.

The results show a highly complex pattern of farm production-related linkages in the region. The proportion of farmers dealing with their nearest input supplier or output purchaser is far higher than would be anticipated from the simple distance based measures of local integration. However a significant proportion of farmers bypass their most local input-suppliers and output purchasers. Such complex patterns are masked by the more simple definitions of a local transaction. Further, location analysis shows that certain towns in the case study region dominate agriculture related transactions, reflecting a long term trend of market concentration in upstream and downstream sectors. Multivariate probit analysis is used to test whether there are factors which systematically influence the buying and selling behaviour of farmers.

The remainder of the paper is structured as follows. Section 2 reviews relevant background literature. Section 3 gives a brief introduction to the study area and the characteristics of the sample. The results are presented in Section 4. Finally, Section 5 concludes with a discussion of the implications for conceptualising the local economy, the policy implications of the findings, and areas for further research.

2. Background Literature and research methods

Perhaps the most well known study of the spatial distribution of first-stage agricultural linkages within the UK was conducted by Harrison (1993). Harrison used the postcode origin (destination) of farm invoices (receipts) of a sample of farms in the Reading Farm Business Survey to assess the distance over which transactions took place and calssified each source/destination as either rural or urban. Amongst other findings, the mean value of transactions was found to increase with distance from the farm and farm size while smaller farms were found to have more transactions with rural-based businesses. More recently, Lobley et al. (2009) adapted Harrison's approach to consider differences in the direct or "first stage" transactions of organic and non-organic farms in England. Based on survey data, transactions were classified according to whether they occurred a set distance from the farm

(10 miles) or, for those beyond this distance, according to administrative boundaries of ascending scale. While both studies provide useful new insights into the nature of farm business transactions, they fail to take into account local context. For example, the shorter transaction distance of small farmers found by Harrison (1993) may be due to more input suppliers and output buyers in localities where small farms predominate. Similarly, the lack of differences found by Lobley et al. (2009) between organic and non-organic businesses may be because the distance they adopt to indicate of a local transaction is of insufficient magnitude to capture differences in the distribution of agribusinesses used by the two farm types.

Within a US context, the USDA's Agricultural Resource Management Survey (ARMS) requires respondents to reveal the distance over which particular transactions occur as well as the distance of the farm holding to the nearest town of 10,000 people or more. As a consequence the USDA regularly report on the extent of farm household integration with local economies with transactions within the market reach of the town defined as local while transactions made beyond the distance to the town are classified as non local, Findings suggest that the pattern of linkages (in terms of local and non-local transactions) vary by farm size, type and ownership structure of the farm business (USDA, 2008). This approach to measuring local integration avoids the (arbitrary) choice of a single distance to define a local transaction but again fails to take into account the structure of the agribusiness sector. Indeed, the distance and ARMS approaches will produce very similar results in situations where the economic geography (in terms of distance between conurbations) coincides with the choice of distance used to categorise local transactions.

Cleary, it is not just the existence or otherwise of local agribusinesses which will affect purchasing and sales decisions but also their relative competiveness. Lawrence et al.'s study of the purchasing pattern of hog producers in the 1990s showed that those most likely to bypass a local input suppler had large scale operations, higher levels of education, and fewer years of experience (Lawrence et al., 1997). However the authors also found that producers of all sizes indicated a willingness to purchase inputs over considerable distances if price or non-price attributes were sufficiently attractive.

Building on this, Folz and Zeuli (2005) showed how local context as well as demand side factors influence farm input-purchasing patterns of dairy farmers in Wisconsin. Their findings suggested that purchasing patterns vary by type of input but, contrary to expectations

are not systematically determined by particular farm or farmer characteristics. Rather the authors highlighted the importance of allowing for community characteristics (including the diversity of market outlets) in explaining farmer purchasing behaviour.

The issue of context is particularly important given changes in the nature of the agribusinesses. In particular, globalisation and integration processes have changed the structure and the interrelationships in the agri-food chain, creating a new economic environment for production agriculture (Busch and Bain, 2004). Upstream, the supply chain has been affected by the movement away from production growth and increase in environmental concern, the latter affecting the range of farm inputs that can be offered. The result has been vertical integration and greater horizontal integration across businesses (Bijman and Joly, 2001). Downstream, the market for agricultural output has been substantially internationalised as a consequence of successive agreements on tariffs and trade, but also as a result of new food manufacturing technologies and changes in long distance transportation (Nadvi, 2004; Henson and Reardon, 2005). The consequence has been an increase in both vertical and horizontal integration to mirror that occurring upstream in the agri-food chain.

Such market consolidation has a spatial dimension globally but also at the local level. In particular, in many regions the choice of farm input suppliers and output purchasers will have declined as outlets and distributors undergo an allied consolidation process. Concomitantly the extent to which farmers can and do have transactions with businesses based within their immediate local economy will have declined.

From the above, a key methodological issue which emerges is how to fine a "local" farm transaction while allowing for the structural characteristics of the region and, in particular, the structure of the upstream and downstream agribusiness sectors. This paper builds on previous analyses by comparing and contrasting findings based on three alternative measures:

1) A simple distance-based measure where a transaction is defined as local if it occurs within 10 miles of the location of the holding. This is the approach taken by Lobley et al. (2009).
2) A relative measure of "local" which takes into account the location of the farm and the location of the nearest town with a minimum population of 3,000. This is the approach taken by the USDA (2008).

3) An alternative relative measure of "local" which takes into account whether the farm buys from the nearest available input supplier/output purchaser.

As far as the authors are aware, this is the first time the third approach has been used to assess the extent of local economic integration of farmers. The measure allows for situations where a farmer may buy, for example, fertilizer from the local supplier but that supplier may be a considerable distance from the farm and beyond the reach of the nearest town. The measure relies on the availability of information on the postcode of each farm and the place name (either the origin or destination) of all transactions in addition to information on the distance over which these transactions take place. Comparing the location of each farm with all named sources (destinations) of particular inputs (outputs) provides a means of differentiating between cases where i) a transaction took place over a long distance but still with the most local supplier (buyer) to that farm as identified within the sample, to ii) a case where a farmer chose to by-pass a certain (potential) supplier (buyer) in preference for another located further away. In the former case the transaction is classified as local, in the latter, non local.

A key decision was to restrict the focus of the paper on the pattern as opposed to value of the direct economic transactions. As the majority of direct economic transactions will involve market intermediaries (wholesalers, merchants, and retailers) rather than manufactures or processors, only a portion of the value of the exchange will be retained locally and therefore it is incorrect to infer that the value of each transaction represents the injection of income into the local economy. However, the insights gained from an analysis of the spatial pattern of transactions will add significantly to existing understanding of the local integration of farmers and provides a basis for further research in the topic area.

3. Study area, data and sample characteristics

The North East of Scotland case study area (NUTS 3 area UKM50) comprises the two unitary authorities of Aberdeen City and Aberdeenshire. Nearly half the region's 457,320 population (9% of Scotland's total population) lives in the region's one city, Aberdeen (General Register Office for Scotland, 2010). The region has the third highest Gross Value Added (GVA) in the UK, underpinned by activity within the Oil and Gas sector (ACSEF, 2009).

Historically North East Scotland has been an important agricultural region, however, in line with national and international trends, the number of farms and employment within agriculture has declined over the last two decades and part-time employees and part-time farmers have increased in significance (Aberdeenshire Council, 2009). Farms are predominantly mixed, with beef and sheep production important (Aberdeen Consortium, 2008).

Data were collected through a telephone survey of farm businesses conducted during November 2009. The questionnaire included sections covering individual and household characteristics, holding details, output, on-farm diversification, labour, inputs and off-farm work. Particular emphasis was given in the questionnaire to spatial aspects of input and output-related transactions. Three hundred businesses were contacted, drawn from a sampling frame of 2,900 Single Farm Payment (SFP) recipients in 2008. Of these, 75% willingly participated in the survey while around 25% refused to participate due to a variety of reasons including pressure of work, survey fatigue and unwillingness to share information. Due to an incomplete questionnaire, the final sample used in the analysis comprised 224 farm businesses.

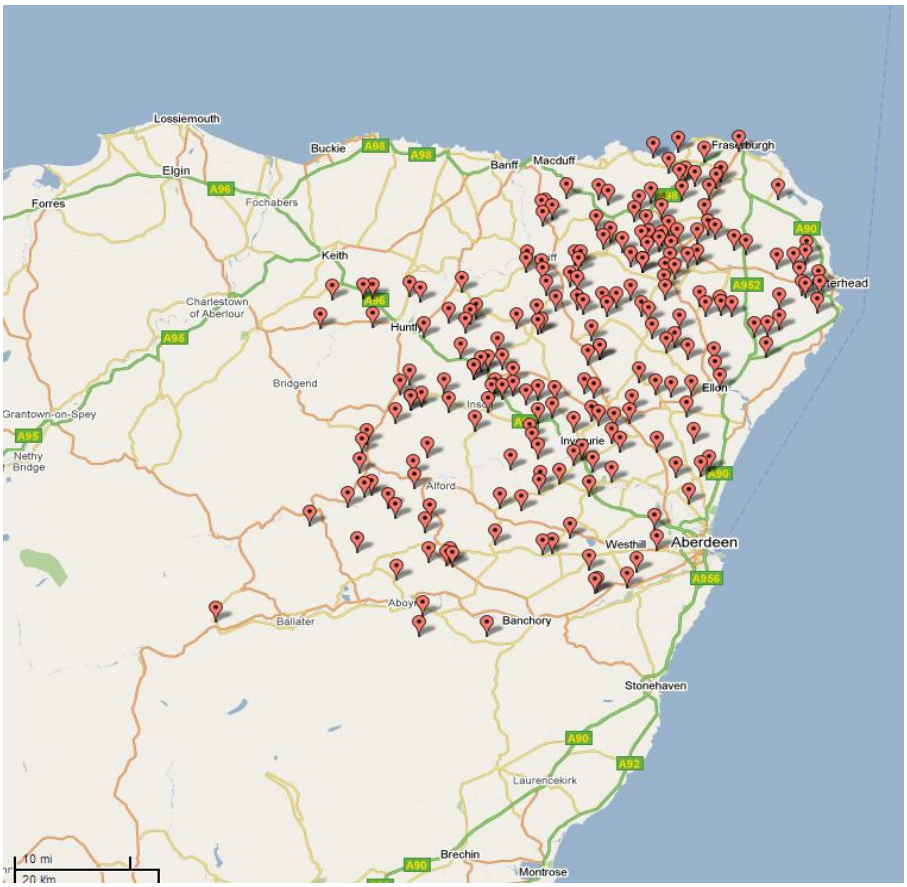
Table 1 indicates the farm types represented in the sample. Data on characteristics of SFP recipients is not available, thus it is impossible to formally check how representative the sample is of the population of SFP recipients. However, in terms of farm type, the sample reflects well the distribution of farms in the region. In relation to geographical representativeness (see Figure 1), there were fewer respondents from the southern part of the study area than expected but at a general level, the spatial coverage is sufficient to be able to draw insights into the distribution of input and output flows.

Table 1 Sample Characteristics: Farm type

	Sample			Population[1]	
	n	%	Mean	n	%
Farm Type			Ha		
Cattle	135	60	193	2,547	29
Crops	48	21	179	2,023	23
Dairy	3	1	n/a	53	1
Mixed	34	15	183	3,715	42
Granivores	4	2	n/a	456	5
Total	224	100	191	8,794	100

[1]Scottish Government (2010).

Figure 1 Distribution of farms in the sample



So as to set the context for the spatial analysis, each respondent was asked the distance to various services and urban settlements of certain minimum size. The results are shown in Table 2 below.

Table 2 Distance from household to principal locations for household inputs (miles)

	Mean	**Standard Deviation**
Groceries	6.8	5.1
Major household items	17.2	10.9
Local primary school	2.9	1.8
Local secondary school	7.0	3.7
Nearest hospital	12.1	9.2
Nearest town >3,000	8.2	5.0
Nearest city >50,000	27.9	9.5

As expected, the mean distance travelled for major household items is larger than for groceries, and the mean distances to the services included in the table (primary schools, secondary schools and hospital) all follow the pattern expected consistent with central place theory. Across all respondents, the mean distances to nearest town and to the nearest city, Aberdeen, are 8 and 28 miles respectively.

Figures 2 and 3 below show the mean distances at which various farm input purchases are made and outputs sold. In terms of averages, all inputs are sourced at distances further than that to the nearest town with the distance to fertilizer suppliers beyond the distance of the nearest city. The average distance to output purchasers varied by type of output but again were well beyond the nearest town. However, the comparison of average distances ignores differences in the geographic and socio-economic contexts of individual farm households in the sample. To correct for this, attention turns to the proportion of transactions of different types that can be classified as local according to the three alternative measures described in section 2 above.

Figure 2 Average distances to farm input suppliers (miles)

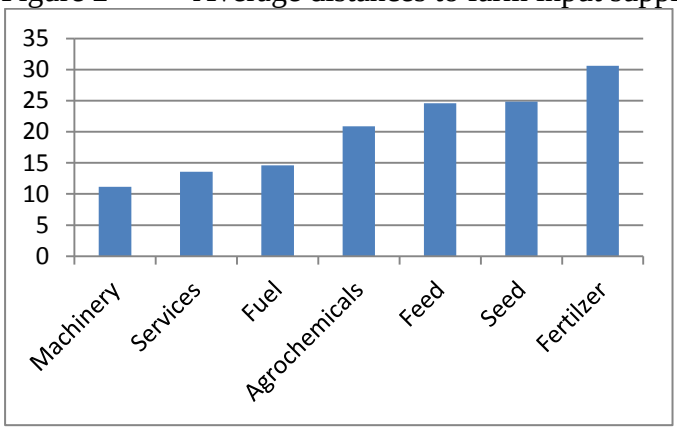
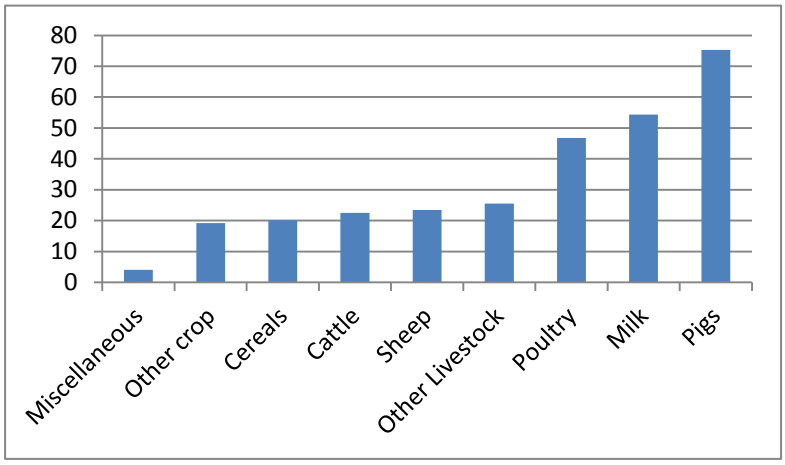


Figure 3 Average distance to (first-stage) output purchaser (miles)



4. Results

Comparison of locality measures

Table 3 indicates, by input type, the percentage of farms in the sample who had transactions which could be classified as local according to the three alternative definitions: within 10 miles of the farm, within reach of the nearest town to the farm or with the nearest supplier as identified using postcode based analysis.

Table 3 Percentage of farmers purchasing inputs by alternative definitions of a local transaction

	% within 10 miles	% within reach of town	% from nearest supplier
Fertilizer	22.4	19.3	41.7
Chemicals	34.0	30.1	47.9
Seed	37.8	35.5	58.3
Feed	38.8	30.5	65.8
Machinery services	40.0	56.1	82.7
Fuel	40.8	43.2	43.2
Other Services	50.6	53.9	72.7

Concentrating first on the distance based definition, the percentage of input purchased within 10 miles of the holding, varies by type of input. As expected, a higher percentage of farmers sourced inputs purchased on a frequent basis (such as fuel or services) from within 10 miles of the farm than was the case with more specialist, less frequent input purchases (such as fertilisers or agrichemicals). In general however, the percentage buying within the 10 mile limit is lower than might be expected, ranging from 22% in the case of fertilisers to 51% in case of services.

The percentages buying the same inputs within reach of their nearest town follow a very similar pattern reflecting the economic geography of this particular region. The fact that the within town reach percentage is slightly higher than the within 10 miles percentage for the more frequent low cost purchases is consistent with the less specialist nature of these services and the fact that they are more likely to be still available from the local town should the farmer chose to source locally. In contrast the lower percentage of farmers sourcing, in particular seed and chemicals, from the local town suggests that a) the suppliers of these products are more spatially dispersed (with the products not available from the local town) or

b) farmers are such that they are more likely to bypass local suppliers when purchasing these higher cost inputs, or c) a combination of these two factors.

The final column in Table 3 provides further insights into the underlying spatial pattern of transactions. The higher percentage of transactions occurring with the nearest available supplier across all input categories suggests that for many farmers, the lack of local integration suggested by the first two measures is due to the lack of a supplier geographically close to the farm. In particular, as indicated in Table 4 below which focuses on fertiliser transactions only, an additional 41 farms were found to purchase locally in terms of their market opportunities as compared to the simple distance based measures. However even allowing for the geographical distribution of agribusinesses, Table 3 indicates that there remain high proportions of farmers, particularly in relation to fertiliser and agrochemical sales but across all input categories, who chose not to purchase from their nearest input supplier. In the case of fertiliser and agrichemical transactions, over half farmers fall into this category.

Table 4 Cross tabulation of fertiliser purchasing patterns by alternative definitions of a local transaction

		Nearest purchaser		
		No	Yes	Total
Within 10 miles	No	100	39	139
	%	*71.94*	*28.06*	*100*
	Yes	5	36	41
	%	*12.20*	*87.80*	*100*
	Total	105	75	180
	%	*58.33*	*41.67*	*100*

Tables 5 and 6 replicate the same analyses as above but in this case focus on output sales. In particular, the tables relates to the sales of a farms main output where the latter is defined as accounting for 50% or more of the farm's total revenue.

Table 5 Percentage of main output sales

	% within 10 km	% within reach of town	% from nearest buyer
Main output	25.3	25.9	70.21

Table 6 Comparison of sales by alternative definitions of a local transaction

		Nearest purchaser		
		No	Yes	Total
Within 10 miles	No	55	87	142
	%	*38.73*	*61.27*	*100*
	Yes	1	45	46
	%	*2.17*	*97.83*	*100*
	Total	56	132	188
	%	*29.79*	*70.21*	*100*

The majority (almost 70%) of farmers sell to their most local buyer. However Table 5 indicates that often these buyers are often not geographically close to the farm holding: The equivalent percentages selling within 10 miles or reach of the local town are far less. Thus in the case of output sales patterns, even more than in the case of inputs, the results confirm how the agribusiness context within which the farmer is located will influence his or her ability to contribute to the local economy.

Location Analyses

To provide further insights, the (named) locations associated with each type of transaction were mapped and compared to the centre of the postcode sector of the farm holding(s) from which the transaction(s) emanates. This provides a means of showing graphically cases where transactions took place over long distances but still with the most local supplier/ buyer to other cases where farmers chose to by-pass certain (potential) suppliers/buyers in preference for others, located further away. It also indicated the degree of complexity of transaction patterns and revealed that both upstream and downstream agribusinesses in the study area had become concentrated in certain towns in the region.

The spatial pull of two such towns – Turriff and Inverurie - are demonstrated in Figures 4 and 5 below. Figure 4 concentrates on the spatial pattern of fertilizer transactions (the most widely used input), Figure 5 the spatial pattern of cattle sales. In both cases, only locations identified by more than 10 farms in the sample are shown. The origin of the arrows represents the postcode sector of the farms involved in the transaction, the end of the arrow where the transaction takes place, and the thickness of the arrows indicates the number of farms involved in the transaction.

Figure 4 Fertiliser purchases, main locations

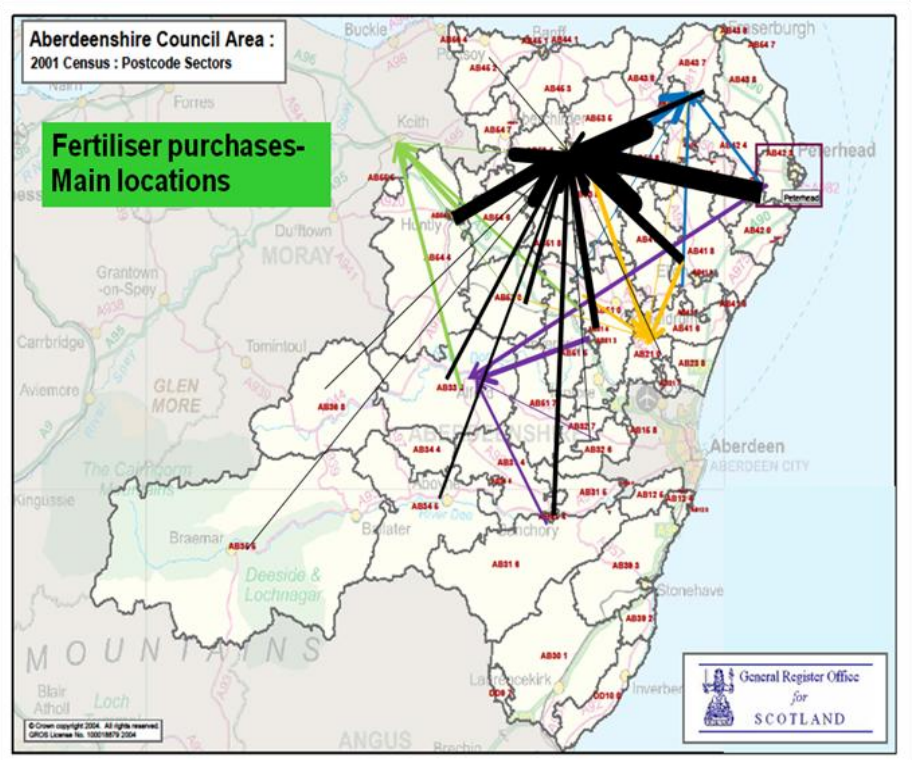


Figure 5 Cattle Sales, main locations

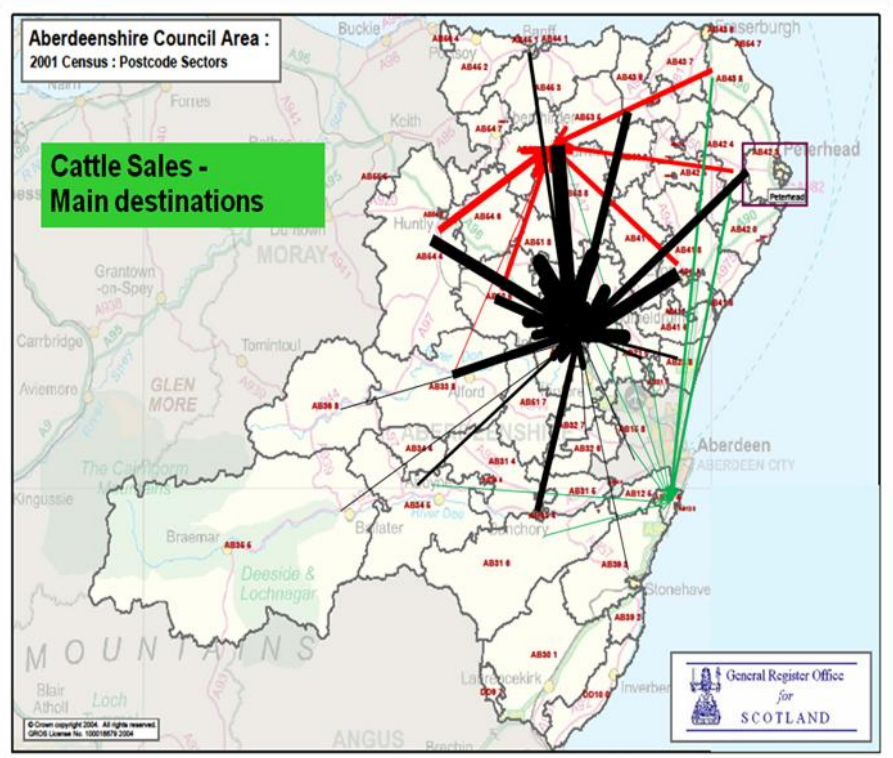


Figure 4 reveals that there are five towns which sell fertilizer to more than 10 farms in the region but one, Turriff, dominates, being the source of fertilizers for 40% of farm households in the region. There is a noticeable number of distant farms purchasing their fertilizer from suppliers located in Turriff, potentially bypassing more local sources. Turriff was also found to be the major source of all other input categories apart from general services accounting for between 18% (machinery services) and 35% (agrichemicals) respectively.

Figure 5 demonstrates the same pull effect for cattle sales. These are seen to be heavily focused on one town, Inverurie, the location of the major regional auction mart, with farms from throughout the region converging here to sell livestock. Inverurie was found to be the destination of 63% of cattle sales in the sample.

Probit analysis

To explore, in more depth input purchasing and output sales patterns, each farmer's decision on whether or not to buy or sell locally was characterised as a dichotomous (yes or no) variable and a probit model was applied to explain the probability of a "Yes" response. Formally,

$$\Pr(Y = 1|X_1, X_2, X_3, \ldots . X_k,) = \emptyset\ (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots\ \beta_k X_k)$$

where Y is a binary variable indicating if the input (output) was purchased (sold) locally, ø is the cumulative standard normal distribution and X_1 to X_k are explanatory factors.[1] In terms of inputs, fertiliser purchases were focussed on as fertilisers had the highest response rate of all inputs while, as in the analysis above, the dependent variable in the case of output sales was the farm's main output.

The variables included as explanatory variables in the model were selected to be consistent with underlying theory and the findings of previous studies. In particular, farm characteristics (farm type and size), and farm household characteristics (demographic structure, whether or not the farmer is involved in a community group, and attitudes to risk) were included along with participation in off farm work and distance from the holding to urban settlements.

Regardless of which definition of local was selected, including that based on nearest supplier, the analyses of fertiliser sales failed to produce any statistically significant results. In

[1] For a more detailed explanation of probit models, see Greene (2007).

particular, there was no evidence that farm or farm household characteristic systematically influence the decision to purchase fertiliser either within a set distance from the farm, within reach of the nearest town, or from the most local vendor.

Similarly, the analyses of sales patterns found no significant results when the dependant variables was either sales of main output within 10 miles or within reach of the nearest town. However, there was some evidence of significant influences on the sales decisions of farmers when the spatial spread of buyers is recognised, that is when the nearest buyer definition of local transactions is analysed rather than the distance based measures.

In particular, Table 7 presents the results from the probit model where the dependent variable is the probability of the farmer selling the main output of the farm to the nearest buyer and marginal changes are reported. In this case, cropping farms, no membership of a community group low attachment and risk-averse farmers are the omitted dummy variables for farm type, attachment level and risk attitude respectively. Farm size is captured by the magnitude of SFP received by the farmer. This variable, rather than the value of output sales, was selected on the basis that, given the manner of data collection, SFP receipts is more reliable indicator of farm size.

Table 7 Marginal effects from the Probit model of sales decisions: Dependent variable: Probability of selling the farms main output to the nearest purchaser

	Coeff.	Std. Err.	
Livestock_LFA	0.201	0.088	**
Livestock_non_LFA	0.169	0.086	*
Other_farm_type	0.062	0.105	
Ln SFP	-0.062	0.033	*
No. of Retired	0.003	0.049	
Community group	-0.081	0.074	
Risk Neutral	0.146	0.078	*
Risk Loving	-0.002	0.095	
Nearest_city	-0.004	0.004	
Number of obs = 186	Prob > chi2 =	0.0357**	
Pseudo R2 = 0.078	LR chi2(9) =	-107.97	

** and * are used to denote coefficients that are significant at the 5% and 10% level respectively.

Overall the model has a significant chi-squared indicating that all variables are jointly different from zero. The results suggest that livestock farms are more likely to selling output to the nearest supplier than cropping farms. Further, consistent with the argument that larger

farms are more likely to be selling under contract to distant buyers and/or have more potential to bargain for discounted prices, the results find that the probability of selling to the nearest buyer declines with farm size. In contrast, the demographic profile of the household (in terms of number of retirees) or attachment to the local community (as reflected in the membership of community groups) does not significantly influence purchasing patterns. However there is some evidence that attitude towards risk influences sales behaviour with risk neutral farmers having a greater likelihood of selling locally than risk adverse farmers.

5. Conclusion

The aim of this paper was to provide new insights into the spatial distribution of farm production-related transactions. Research was motivated on the basis that agricultural policy documents and farm lobby groups often argue that such transactions help sustain local economies (particularly where other production activities are limited).

Previous methods for measuring the spatial distribution of farm linkages were criticised for paying insufficient attention to local context and, in particular the spatial distribution of agribusinesses. In particular, it was argued that market concentration in upstream and downstream agri-food sectors may have reduced the opportunities for farmers to buy and sell locally. At the same time, it was noted that farmers will only chose to use local agribusinesses to the extent that they remain competitive: Other factors such as farm size, type and farmer characteristics are thus likely to influence purchasing and sales decisions.

Empirical analysis was based on data collected from a sample of 224 farm businesses in North East Scotland. To assess the extent to which local context influences findings, a new definition of a local transaction, based on a post code analysis of transactions for the whole sample was developed. In particular, to supplement measures based on a distance from the holding and distance to the local town, a measure based on whether or not the transaction was with the nearest buyers or seller was proposed and used in the analysis.

The results confirmed the important of context with far higher proportions of farmers carrying out transactions with their local businesses than suggested by the distance based measures. In other words, the results showed that a key issue determining local integration is the spatial concentration of agribusinesses. At the same time, a high proportion of farmers,

particularly in the case of infrequent high cost input purchases were found to bypass local suppliers.

A striking finding from the analysis was the extent to which certain towns in the region have come to dominate agriculture related transactions. This suggests that the impacts of changes in agricultural activity (arising, for example, from CAP reform) will be spatially concentrated as opposed to being dissipated across rural space. While rural development policy makers often have to deal with problems that are spatially constrained, the insight that agricultural production which is spread evenly across rural space may also result in spatially concentrated rural development problems is important. The results also support Folz and Zeuli's argument that, given the endogenous relationship between the competiveness of farms and their local upstream and downstream businesses, there may be a case for switching policy attention away from agriculture itself to supporting agribusinesses in the local economy.

From a methodological perspective, the analysis has several weaknesses. First, the focus on the spatial pattern of transactions rather than value of these transactions is a limitation which could be overcome by supplementing the analysis with a survey of agribusinesses. Second, the focus on direct transactions while ignoring the indirect and indirect effects arising from those transactions could be criticised. In the absence of reliable information on value-related flows and on the extent to which these are locally retained, measuring such "knock-on" effects is problematic. The New Economics Foundation's Local Multiplier 3 (LM3) technique has some potential in this respect but several methodological shortcomings (Thatcher and Sharp, 2008). Third, the multivariate probit analyses provided fewer significant findings than expected suggesting a need to further develop underlying theory. Thus there is potential for exploring farmer purchasing and sales decisions using alternative approaches including in-depth qualitative methods.

Finally, farm households have multiple links with wider local economy. Apart from the agriculture-related links which are the focus of this paper, there are labour market links (through employees and the off-farm work of farm household members), other production-related links (through farm diversification strategies), and farm household consumption links, not to mention the cultural and social contributions to made by farm households to local communities. Analysis of the spatial characteristics of these other linkages is required to provide a fuller understanding of the role farm households play in sustaining their local economies.

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