QMS

AN ASSESSMENT OF THE ECONOMIC CONTRIBUTION OF SCOTLAND'S RED MEAT SUPPLY CHAIN

2016

Evaluation and assessment of the economic contribution of Scotland's red meat supply chain (beef, sheepmeat and pigmeat) to Scotland's economy nationally and regionally.

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Quality Meat Scotland (QMS)

ISSN 2050-5205

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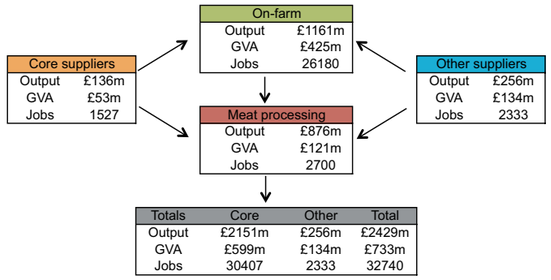
Executive Summary

1. Drawing on official government publications and databases (notably the June Agricultural Census, Farm Accounts Survey and Input-Output tables) plus other information available via Quality Meat Scotland (QMS), industry stakeholders and academic literature, this report presents estimates of the size and structure of the red meat supply chain in Scotland. This includes on-farm production of beef cattle, pigs and sheep but also upstream input supplies to farms and downstream processing of farm output.



2. Estimation results are summarised in the above diagram. “Core” suppliers include auction marts and the providers of animal feed, fertilisers, veterinary services and haulage. “Other” suppliers include construction, energy and financial services firms. The figures should be regarded as indicative rather than definitive but are sufficiently accurate to support some useful analysis.

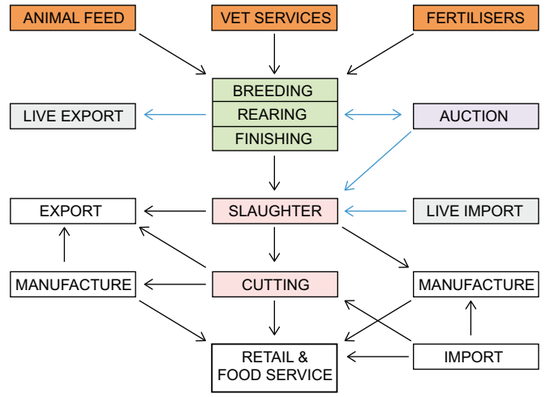
3. Although on-farm production accounts for the majority of jobs and the largest components of both output and Gross Value Added (GVA), other parts of the supply chain also make significant contributions. This highlights the importance of acknowledging linkages across the supply chain in the design of government policy and industry strategies. For example, to address the knock-on effects of changes to agricultural policy on the processing sector and on input suppliers.

4. Estimation of the relative contributions of different parts of the supply chain also adds further support to previous analysis of how overall sectoral performance could be enhanced. In particular, there is evidence of ample scope to increase sectoral GVA by at least 2–3% through either retaining more livestock within Scotland for processing and/or through raising the average efficiency of farms (because farms vary greatly in size and type, with accompanying variation in cost structures and profitability). There is also similar potential to improve performance through greater information sharing and co-ordination along the supply chain, provided that sufficient mutual trust and sharing of rewards can be established between different parties. However, the practical and organisational challenges of achieving any gains should not be under-estimated and require sustained commitment by all concerned.

Introduction

1. The red meat supply chain not only encompasses on-farm production but also upstream provision of farming inputs and downstream processing of farm products (see Figure 1). Evaluation of its economic contribution in terms of total output, value added and employment thus needs to consider the activities of, for example, animal feed suppliers, fertiliser (and other chemical) suppliers, vets, hauliers, auction marts and abattoirs alongside the farm level activities producing beef cattle, pigs and sheep.

Figure 1: Stylised representation of red meat supply chain



Source: modified from Thankappan & Flynn (2006), Safefood (2008) and Webb (2008)

2. An assessment of economic contribution requires information on the number and size of firms operating at particular points in the chain and the degree to which they are engaged primarily in red meat production or are also participating in other supply chains. For example, many farms have a mix of enterprises, some farm vets attend dairy as well as beef cattle or poultry as well as pigs, and some hauliers may transport other commodities. In addition, information on cost structures is also required if value added and income levels are to be estimated.

3. The Scottish Government produces a number of annual statistical publications and supporting databases containing relevant information on the red meat sector. On-farm production of livestock is covered in most detail, notably through the Agricultural Census and the Farm Accounts Survey (FAS), but some information on upstream and downstream parts of the supply chain is also available via Input-Output (I-O) analysis for the wider economy. Drawing on these publications and databases, plus other information available via QMS, industry stakeholders and academic literature, this report presents an overview of the size and structure of the red meat supply chain in Scotland.

4. Attention is restricted to the coloured portions of Figure 1, namely upstream suppliers (orange), livestock hauliers (blue arrows), farms (green), auction marts (purple) plus slaughterhouses and cutting plants (pink). This ignores the role of wholesalers and food manufacturers and stops short of the final delivery link of retail and food services to consumers, on the basis that these are less easily identifiable as part of a uniquely Scottish supply chain (e.g. retailers carry a range of products, not all of which are reliant on domestic supplies). Live imports and exports (grey) are considered to the extent that they affect the flow of domestic livestock through the Scottish supply chain. In addition, beyond the ‘core’ supply chain illustrated in Figure 1, red meat production draws upon other inputs such as energy, machinery and construction which also generate output, value added and employment to be included in the analysis.

5. It is important to note that attempting to construct broadly comparable estimates across the whole supply chain entails recourse to various assumptions and further data manipulation. In particular, data are often only available at an aggregate level and activities attributable to red meat have to be disentangled from other on-farm enterprises (e.g. dairy, poultry, arable) and also from other supply chains (e.g. pets, manufacturing, imports & exports). Hence the findings presented, and the manner of their derivation, are illustrative rather than definitive but have been “sense checked” with industry sources and are offered as reasonable approximations.

6. Section I focuses on livestock numbers and their distribution across different farm-types and regions. Section II explores how physical production translates into economic output and value added at the farm level, with Section III then considering the wider supply chain. Section IV extends the analysis to consider employment. Section V summarises all of the estimates for the economic contribution of the supply chain. Section VI then considers the scope for improving performance across the supply chain, to increase value added and employment. Section VII concludes. Additional supporting material is presented in various Annexes.

Section I: Livestock Numbers[1]

7. Livestock production is a fundamental component of Scottish agriculture, reflecting the abundance of grazing resources. However, cattle, pig and sheep numbers recorded in the agricultural census are currently at, or close to, their lowest levels since EU accession in 1973. Declines over the past decade (see Table 1) are a response to market pressures and (for cattle and sheep) the switch away from coupled headage payments to decoupled support payments in the past decade. Nevertheless, red meat production remains important and occurs throughout Scotland.

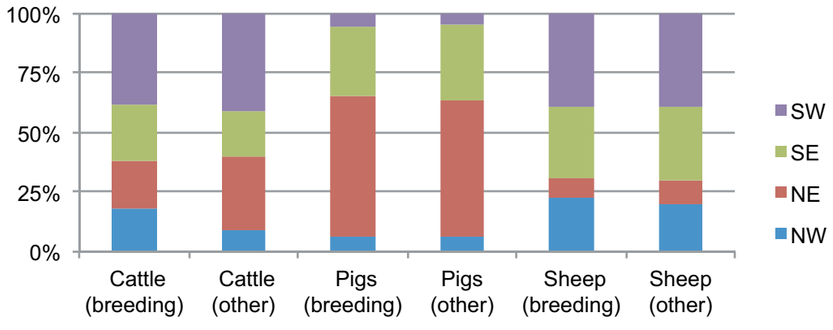
Table 1: Breeding beef cattle, pig and sheep numbers in Scotland, 2006 to 2014.

Year	Cattle	Pigs	Sheep
2006	495,016	41,807	3,028,595
2007	483,389	40,175	2,919,571
2008	472,554	36,939	2,778,503
2009	458,168	33,245	2,708,019
2010	468,413	38,926	2,645,139
2011	471,281	36,338	2,641,664
2012	461,684	31,881	2,623,656
2013	446,939	28,784	2,616,166
2014	436,526	30,228	2,604,185

Regional distribution

8. On a regional basis[2] for 2014, the South West has the highest share of breeding cattle and sheep whilst the North East has the highest share of breeding pigs. Stratification of the beef and sheep sectors means that calves and lambs are not necessarily reared on the holding of birth hence the regional distribution of non-breeding animals differs slightly from that of breeding animals.

Figure 2: Regional distribution of breeding and non-breeding animals in 2014.



[1] More detailed figures are presented in Annex A, together with references to the statistical sources used.

[2] Scotland can be split into various regional configurations. A four-way split is used here, in-line with that used most commonly in SG publications (further disaggregation is less robust, particularly for financial estimates).

9. For example, the share of non-breeding cattle found in the North West is significantly lower than for breeding animals and the share in (especially) the North East is higher, reflecting the movement of store cattle away from the North West for finishing. A similar, but less dramatic pattern is revealed for sheep but the differences for pigs are less marked, reflecting a greater degree of vertical integration or at least between weaner and finisher units.

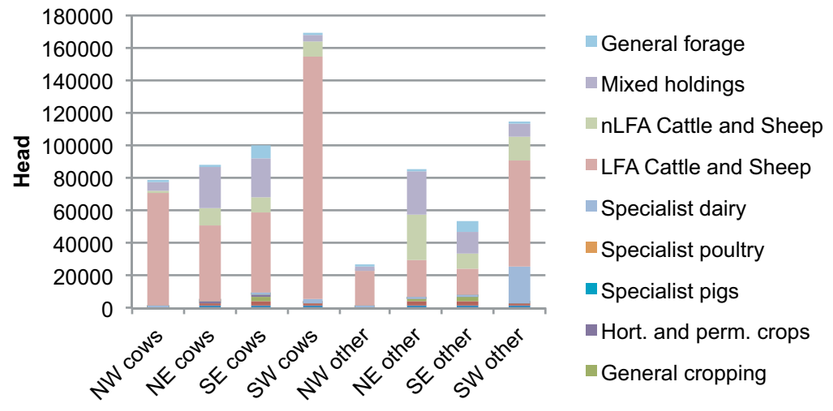
Farm-type distribution

10. The structural distribution of livestock by farm-type is also uneven. This reflects the co-existence of different activities on many farms (farm-type is based on the predominant rather than an exclusive enterprise). For example, although the majority of beef cattle, pigs and sheep are found on specialist livestock farms, some are found on other farm-types. Equally, specialist cattle, pig or sheep farms are not necessarily restricted to their specialism alone but can host other animal and crop enterprises.

11. Hence, although the national beef breeding herd is concentrated on specialist cattle farms, beef cows are found on a variety of other farm-types albeit mostly in relatively small numbers (see Figure 3). In aggregate, the national beef breeding herd is distributed across 9,250 holdings – of which specialist LFA cattle and sheep holdings account for 45% of holdings but 72% of the cows. Non-LFA cattle and sheep holdings account for around 7% of the breeding herd, mixed holdings for almost 10%.

12. For non-breeding beef cattle, the LFA cattle and sheep holdings account for a higher share (60%) of holdings with such cattle but a lower share (45%) of actual animals. Non-LFA cattle and sheep holdings for around 18% and mixed holdings also for around 18%. This reflects the movement of some animals from breeding holdings to finishing holdings. Dairy holdings account for around 10% (almost all in the South West), although surplus calves from the dairy herd will also add to the overall finishing stock elsewhere. Overall, fewer holdings (8629) are involved in finishing than breeding.

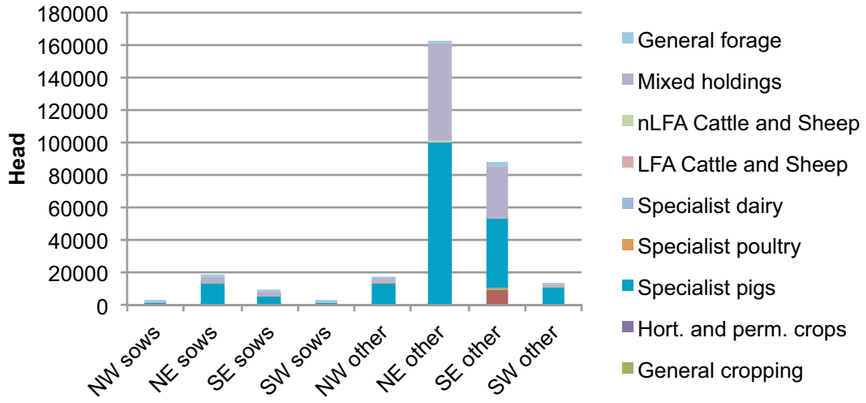
Figure 3: Farm-type distribution of breeding and non-breeding beef cattle, by region 2014



13. For breeding pigs, although specialist holdings dominate in terms of pig numbers (75%), mixed holdings account for a reasonable share (23%) and small herds occur across almost all farm-types; of the 526 holdings with breeding pigs, only 31% are specialist pig holdings (see Figure 4).

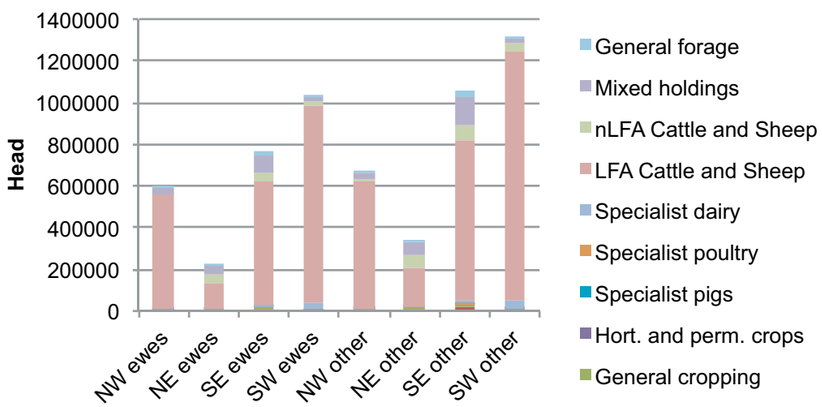
14. A similar picture emerges for fattening pigs, with animals being found on almost all farm-types but only in significant numbers on specialist units and, to a lesser extent, on mixed holdings[3]. More holdings (905) are engaged in fattening than breeding.

Figure 4: Farm-type distribution of breeding and non-breeding pigs, by region 2014



15. For sheep, although breeding ewes are found in small numbers across other farm-types, LFA cattle and sheep farms dominate both in terms of holdings with ewes and actual ewe numbers (see Figure 5). The same is true of non-breeding sheep.

Figure 5: Farm-type distribution of breeding and non-breeding sheep, by region 2014

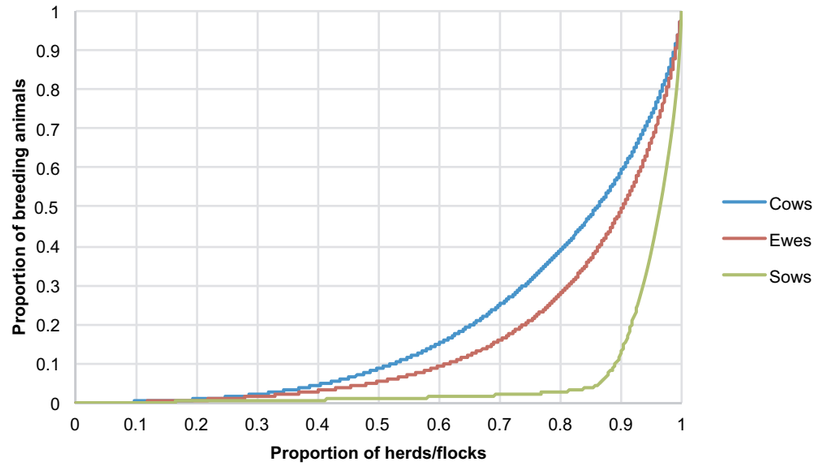


[3] Of these, most have significant arable land reflecting use of home-grown feed: over 80% of pigs on mixed holdings are on holdings with more than 100ha of cereals.

Size distribution

16. The size distribution of breeding herds and flocks is also somewhat uneven, with the majority of herds/flocks being small but collectively accounting for a low proportion of total animals in contrast to the relatively few larger herds and flocks which account for the majority of animals (see Figure 6). For example, 60% of beef herds collectively account for just over 15% of beef cows, 60% of flocks account for less than 10% of ewes and 60% of pig herds account for less than 2% of sows.

Figure 6: Cumulative distribution of breeding animals against cumulative distribution of herds/flocks



Summary

17. To summarise, beef cattle, pigs and sheep are farmed widely across Scotland. Each species is found to some degree on all farm-types, but in each case numbers are concentrated on specialist holdings. Herd/flock sizes vary considerably, with small sizes being most common but accounting for a small proportion of animals relative to that found in fewer but larger herds/flocks. The distributions of breeding and finishing animals differ, with some farms (and by extension regions) hosting both equally but others favouring one or the other. Breeding and total livestock numbers have reduced significantly over the past decade.

18. Overall, red meat livestock are found on around 20,000 of the approximately 52,000 holdings in Scotland. Of these, over 14,300 are LFA specialist cattle and sheep holdings, around 2,300 non-LFA cattle and sheep holdings and nearly 300 specialist pig holdings, meaning that approaching one-third of all holdings are primarily engaged in producing animals for the red meat supply chain. The next section considers how this production translates into economic output, value added and income for agriculture.

Section II: Agricultural Output, Value Added and Income

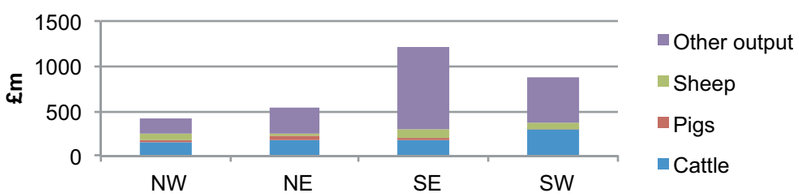
19. Livestock numbers are physical measures of activity, but need to be combined with prices to generate output values. Table 2 summarises changes in output from the three species over the past decade. Year-on-year changes reflect a combination of price volatility and changing livestock numbers, with modestly rising prices (some of which may reflect improved quality as well as supply and demand interactions) partially counteracting falling headage numbers in recent years.

Table 2: Output values for beef cattle, pigs and sheep plus all agriculture, 2006 to 2014

Year	Cattle		Pigs		Sheep		Red Meat	All agriculture
	£m	%	£m	%	£m	%	%	£m (100%)
2006	695	25.4%	84	3.0%	219	8.0%	36.4%	2,734
2007	644	22.2%	78	2.7%	207	7.1%	32.0%	2,904
2008	680	22.9%	80	2.7%	213	7.2%	32.8%	2,964
2009	716	25.2%	78	2.7%	275	9.7%	37.6%	2,839
2010	768	26.0%	84	2.8%	281	9.5%	39.3%	2,959
2011	837	26.0%	99	3.1%	289	9.0%	38.1%	3,222
2012	903	28.8%	90	2.9%	264	8.4%	40.1%	3,137
2013	880	27.1%	82	2.5%	233	7.1%	36.7%	3,251
2014	837	27.5%	95	3.1%	249	8.2%	38.8%	3,049

20. As a proportion of total agricultural output, the red meat sector's share has varied between 32% and 40% over this period, with cattle accounting for over two-thirds of this. Figure 7 reveals some regional variation in the relative importance of red meat – higher in the North West where poorer land quality precludes other enterprises, lower in the South where (e.g.) dairying and arable enterprises are more common.

Figure 7: Regional variation in agricultural output components, 2014



Estimating Value Added

21. Although output levels are of interest, the act of production incurs costs which have to be deducted to determine value added. For example, the consumption of intermediate inputs such as animal feed, energy and veterinary services has to be accounted for to estimate Gross Value Added (GVA). Net Value Added (NVA) is then calculated by making further allowances for the consumption (depreciation) of fixed capital such as machinery, buildings and breeding livestock.

22. Once such costs are considered, the estimated total output in 2014 of c.£3bn for all of Scottish agriculture equates to a GVA of c.£1bn and NVA of c.£0.6bn at Basic Prices (BP). Adding in farm support payments raised the NVA to c.£1.1bn at Factor Cost (FC) and led to Total Income from Farming (TIFF) of c.£0.7bn.

23. Unfortunately, although red meat output is identified separately within the official statistics, the costs (and therefore value added and income associated with red meat production) are not. This reflects the way that costs are recorded and reported on the basis of whole farm-type rather than commodity or enterprise type, meaning that costs are not allocated to specific production activities.

24. However, it is possible to use some additional information and assumptions to estimate how costs are distributed across production activities, and hence to estimate value added and income for red meat production. Such estimates should be viewed as indicative approximations rather than definitive facts but are the best available in the absence of a specific survey exercise.

25. Table 3 presents the results of using two different ways (one at an aggregate level, one at the farm level) of estimating cost shares to adjust the all-agriculture results to generate estimates of GVA and NVA at basic prices[4]. Allocating decoupled subsidies to particular enterprises is difficult but TIFF estimates are also included using subsidy estimates allocated on the same basis as costs. Although not identical, the two sets of estimates are reasonably close and give an indication of the magnitude of value added by on-farm red meat production: around £425m GVA and £200m NVA, about 40% and 33% of the respective all-agriculture national totals.

Table 3: Estimated Red Meat Output, Value Added and TIFF (£m), by region 2014

	NW		NE		SE		SW		Scotland	
Estimation method	Aggr	Farm	Aggr	Farm	Aggr	Farm	Aggr	Farm	Aggr	Farm
Output	249	249	249	249	298	298	365	365	1161	1161
Input	211	209	157	159	194	142	203	199	765	709
GVA	37	40	92	90	104	156	162	166	395	452
Capital consumption	53	66	31	39	37	70	57	89	178	264
NVA (BP)	-16	-26	61	41	67	86	105	77	217	178
Subsidies	69	79	37	41	40	64	54	86	286	270
NVA (FC)	53	53	104	82	107	150	159	163	423	448
TIFF	10	10	80	57	56	113	117	113	263	293

Summary

26. To summarise, red meat output has fluctuated over time as both prices and physical production levels have varied but remains an important component of the larger agricultural economy, accounting for around 40% of farming output and of GVA. Estimates of regional value added rely on certain assumptions but suggest some variation in both variable and fixed cost structures, with capital consumption reducing NVA significantly relative to GVA[5].

27. The next section extends analysis to upstream and downstream portions of the supply chain.

[4] Annex B provides more detail on the estimation procedures.

[5] The negative NVA for the NW region almost certainly reflects under-estimation of store sale values within Scotland: output, GVA, NVA and TIFF are all possibly £20m-£30m higher in the NW (and correspondingly lower elsewhere). SG statisticians are considering how to address this, but the necessary data are not currently available. Figures at the all-Scotland level are not affected, only the regional split.

Section III: Wider Output and Value Added

28. The preceding two sections considered only on-farm production, drawing on the relatively detailed information collected through the Agricultural Census and the Farm Accounts Survey. However, neither of these extend beyond the farmgate.

Beyond the farmgate

29. As highlighted in Figure 1, abattoirs (primary meat processing) and cutting plants (secondary meat processing) feature prominently in the supply chain downstream of farm production. Within Scotland, 23 licensed red meat slaughterhouses are currently operating, five of which are standalone and the remainder have integrated cutting plants. There are also a number of licensed red meat cutting facilities of varying sizes.

30. QMS survey data[6] indicate that slaughter throughput is highly concentrated, with a few large abattoirs accounting for the bulk of animals: 72% for cattle, 88% for sheep and 93% for pigs. Output for 2014 was estimated at £876m, with sales predominantly to multiple retailers but also (particularly for beef) to wholesalers, food manufactures and food service outlets. Unsurprisingly, given the volume of output and the limited domestic market, a significant proportion (c.68%) of output is exported to the Rest of the UK (RUK) and a smaller proportion (c.9%) to the Rest of the World (RoW). These estimates are consistent with earlier surveys (Webb, 2007).

31. Livestock auctions also feature prominently in Figure 1, with around 30 marts (some only seasonal) operating in Scotland with a collective throughput of 2.7m animals (86% sheep, 14% cattle, <1% pigs). Turnover for the marts is approximately £525m, with throughput concentrated in the largest 11 marts – especially the top two – reflecting the small and/or seasonal nature of marts in more remote areas, notably the islands[7].

32. Other identifiably 'core' parts of the red meat supply chain include livestock hauliers, farm veterinary services and suppliers of animal feeds and fertilisers. Information on these is less readily available, but industry sources suggest that there are approximately 108 haulage firms with 275 vehicles registered for carrying livestock in Scotland, 201 veterinary practices registered for treating farm animals (including horses) and 113 feed suppliers[8].

Value added beyond the farmgate

33. Some information for value added in the red meat supply chain beyond the farmgate is available in the Scottish Input-Output (I-O) Tables[9]. These are compiled from various data sources, including the Annual Business Survey (ABS), the Global Connections Survey (GCS), the Purchases Inquiry and HMRC, plus data underpinning the TIFF calculations for agriculture. For various reasons, comparability between I-O data and agriculture-specific figures is not perfect and the coverage and time-lags in I-O data can be problematic. Nevertheless, some interesting insights can still be gleaned.

34. In particular, the reported pattern of sales between different sectors highlights linkages between upstream and downstream activities (see Annex C for supporting tables). For example, there are significant within-industry flows for Scottish agriculture itself – reflecting sales from one sub-sector to another (e.g. cereals for feed, store animals for fattening) – and from farms to meat processors.

35. Other notable expected expenditure flows include the use of wholesalers (including auction marts and farm machinery suppliers), vehicle purchases, animal feed, haulage services and chemicals (e.g. fertilisers) but also perhaps less obvious supporting categories such as construction, utilities (e.g. water, electricity) plus legal, real estate, insurance and financial services.

36. In addition, inputs are also purchased from beyond Scotland – including c.£480m on animal feeds, c.£210m on chemicals and c.£150m on fuels for agriculture plus c.£150m on livestock and part-processed meat for the processing sector.[10] However, the precise composition and destination of imported inputs are unknown (e.g. feed for dairy cattle and poultry or for beef cattle, pigs and sheep).

37. If the all-agriculture and on-farm red meat production output and GVA estimates from Section II are used to apportion the I-O output and GVA figures, it is possible to estimate (albeit crudely) GVA for other parts of the red meat supply chain. Table 4 summarises the results of this process for suppliers to agriculture, with 'core' chain components highlighted in bold. A similar process can be used to apportion I-O figures for suppliers to meat processing and Table 5 summarises the results.

[6] QMS Red Meat Industry Profile 2015. http://www.qmscotland.co.uk/sites/default/files/red_meat_industry_profile_2015.pdf
[7] Pers. comm. IAAS.
[8] Pers. comm. Acoura, RHA, RCVS & SG.
[9] See http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output
[10] Conversely, some input suppliers export beyond Scotland. For example, over half the output of Scottish animal feed suppliers is exported – they are part of supply chains that cross borders.

Table 4: Estimated GVA beyond farmgate arising from suppliers to red meat farms

Sector	Red Meat GVA
Animal Feeds	**£4.9m**
Chemicals (inc. fert)	**£4.9m**
Haulage	**£8.8m**
Pharmaceuticals	**£3.4m**
Veterinary Services	**£6.8**
Wholesalers	**£13.9m**
All other sectors	£79.9m
Totals	£122.6m **(£42.7m core total)**

Table 5: Estimated GVA arising from suppliers to red meat processing

Sector	Red Meat GVA
Haulage	**£6.3m**
Wholesalers	**£3.3m**
Electricity	£3.8m
Vehicles	£13.7m
Employment services	£8.6m
All other sectors	£29.9m
Totals	£63.6 **(£9.9m core total)**

38. Summing down the column of estimated GVA arising from supplying farms producing red meat animals in Table 4 suggests GVA of £123m to add to the previous on-farm GVA total of c.£425m for a combined GVA of c.£550m. Of this additional £123m, around £43m is from 'core' parts of the supply chain such as animal feed suppliers, auction marts and vets.

39. Summing down Table 5 suggests that a further £64m of GVA arises from Scottish suppliers (excluding farms) to meat processing, although 'core' elements of the chain are limited to £10m. In addition, meat processing itself generates £181m, of which an estimated £121m is attributable to red meat (rather than poultry). This suggests a total GVA of £185m to add to the on-farm and farm suppliers' GVA.

Summary

40. To summarise, as shown in Figure 1, the red meat supply chain extends both upstream and downstream from the farmgate. Information contained within I-O tables can be used to explore how output and GVA are generated by these different parts of the red meat supply chain.

41. The estimates are necessarily somewhat crude, requiring recourse to assumptions regarding how outputs and value added are distributed across broad categories of activities. Nevertheless, in the absence of more detailed sectoral surveys, the estimates give an indication of the overall size of the supply chain and the relative contribution of its component parts.

42. Including the wider supply chain adds to the on-farm output and GVA figures of £1,161m and £425m estimated in Section II to give overall estimates of £2,429m and £733m respectively. Within this, "core" parts of the supply chain most commonly identified as part of the red meat sector – feed suppliers, fertiliser suppliers, pharmaceuticals, vets, farms, hauliers, auction marts and slaughterhouses/cutting plants – account for over 80% (£2151m and £599m respectively) of the estimated additional economic output and value (Table 6).

Table 6: Summary of estimated output and GVA across the red meat supply chain

	Core farm suppliers	Other farm suppliers	On-farm production	Core MP suppliers	Other MP suppliers	Meat processing	Total 'core'	Overall Total
Output	£114m	£140m	£1161m	£22m	£116m	£876m	£2,151m	£2,429m
GVA	£43m	£80m	£425m	£10m	£54m	£121m	£599m	£733m

43. Imports and exports are included implicitly in the above figures. For example, some of the on-farm production and downstream processing is adding value to imported rather than domestic inputs whilst some of the farm production is exported rather than processed domestically. The implications of this are considered in Section VI.

44. The next section considers employment associated with the estimated output and GVA figures.

Section IV: Employment[11]

On-farm employment

45. In terms of on-farm employment, livestock farming can involve the use of (permanent or casual) hired and/or (unpaid) family labour, in either a part or full-time role. These different types of labour are recorded in the agricultural census. However, many farms have a mix of enterprises and labour usage is not reported separately for each one. Consequently, aggregate labour usage figures provide only a crude guide to usage for specific enterprises.

46. For example, although it may be that all farm workers on a farm will be involved (however trivially) with livestock at some point over a production cycle, given that many of the herds/flocks are very small and not on specialised holdings the majority of such workers will not be engaged primarily in livestock production. Similarly, whilst offering a better guide, restricting attention to only specialist holdings will still over-estimate the livestock-specific workforce since even specialist holdings can have non-livestock enterprises (and, indeed, non-farm enterprises) to which some labour is allocated.

47. Hence the reported presence of almost 42,000 workers (predominantly occupiers and their spouses; paid labour represents around one-third of the total) on farms with beef cattle, pigs or sheep will exaggerate the actual labour deployed on red meat enterprises. The equivalent figure for specialist holdings only is around 24,500. Within this, the majority of workers are male, accounting for around 70% on specialist cattle farms, 65% on sheep farms and 73% on specialist pigs farms.

48. An alternative approach to estimating on-farm labour usage for specific enterprises is to use Standard Labour Requirements (SLRs). SLR coefficients represent an estimate of the labour typically required for a given activity and are derived from various sources, including surveys and economic models. Applying SLRs to regional census data for beef cattle, pigs and sheep plus estimated grassland used for their grazing generates results summarised in Table 7.

Table 7: SLR estimates of farm labour deployed on beef cattle, pigs and sheep, by region (2014)

Species	NW	NE	SE	SW	Total
Beef cattle	1,132	1,171	1,631	3,081	7,615
Pigs	28	256	124	22	430
Sheep	2,770	1,256	4,031	5,013	13,070
Sub-total	**3,929**	**3,283**	**5,786**	**8,116**	**21,114**
Grass etc.	2,211	606	1,067	1,183	5,066
Total	**6,140**	**3,889**	**6,853**	**9,299**	**26,180**
of which paid	*1,167*	*1,244*	*1,302*	*3,441*	*7,154*

49. The estimated total on-farm labour force is 26,180. For comparison, the estimated total SLR-derived workforce for all of Scottish agriculture is 46,700 – implying that over 55% of on-farm labour usage is devoted to animals for the red meat sector. Of the total farm labour usage, the majority is unpaid family labour.

[11] More detailed figures are presented in Annex D.
[12] SG ERSA 7.3 http://www.gov.scot/Publications/2015/06/8844/58

Employment beyond the farmgate

50. Beyond the farm level, labour will also be deployed on a range of activities throughout the wider red meat supply chain. For example, upstream in the manufacture of inputs such as animal feed, pharmaceuticals and chemicals plus in advisory, haulage and veterinary services. Equally, downstream usage of farm outputs will create employment, most notably in the meat processing sector.

51. Unfortunately, specific data on employment across the wider supply chain are not as readily available for agriculture. However, as with output and GVA figures, certain assumptions can be used with I-O data to derive estimates. The estimates are somewhat crude, but again are the best available. Tables 8 and 9 summarise results for suppliers to farms and processors respectively.

Table 8: Estimated employment in supply sectors arising from supporting agriculture

Supply sector	Red meat jobs
Animal feeds	102
Chemicals (inc. fert)	49
Haulage	210
Pharmaceuticals	11
Veterinary services	316
Wholesale	260
All other sectors	1,148
Totals	2,396 (948)

52. Overall employment in sectors supplying red meat farms is estimated at 2,400, within which 'core' supply chain partners such as vets, haulage firms and auction marts feature prominently – but (as with the GVA estimates) other supply sectors such as vehicles and construction, plus labour intensive services provided by legal, real estate and financial firms, also feature.

Table 9: Estimated employment in supply sectors arising from supporting meat processing

Sector	Red meat jobs
Haulage	150
Wholesalers	256
Food & beverage	67
Rubber & plastic	61
Vehicles	77
All other sectors	680
Totals	1,291 (406)

53. Overall employment in sectors supplying processors is estimated at 1,291, within which 'core' activities account for 406 jobs. I-O data further suggest that red meat processing itself employs around 4,430 people.

54. Table 10 combines the various employment estimates. The first row uses SLR-estimates for on-farm employment and I-O estimates for all other parts of the supply chain. The second row uses industry estimates to replace I-O estimates for veterinary services, marts and meat processing. Hence total employment associated with red meat production is estimated at approximately 33,000 to 34,000.

Table 10: Summary of estimated employment across the red meat supply chain

Method	Core farm suppliers	Other farm suppliers	On-farm production	Core MP suppliers	Other MP suppliers	Meat processing	Total 'core'	Overall Total
SLR/IO	948	1,448	26,180	406	885	4,430	31,964	34,297
SLR/IO+	1,121	1,448	26,180	406	885	2,700	30,407	32,740

Summary

55. To summarise, estimation of employment arising from red meat production has to disentangle it from labour usage on other enterprises. At the farm level, this was attempted using SLR coefficients. For upstream and downstream sectors, output shares were used to apportion employment reported in the I-O tables for suppliers and processors, supplemented by various industry sources.

56. The estimates are necessarily somewhat crude, requiring recourse to various assumptions. Nevertheless, in the absence of more detailed sectoral surveys, the estimates indicate the overall level of employment across the supply chain and the contribution of component parts, with perhaps 33,000 jobs being involved in total – of which most are on-farm.

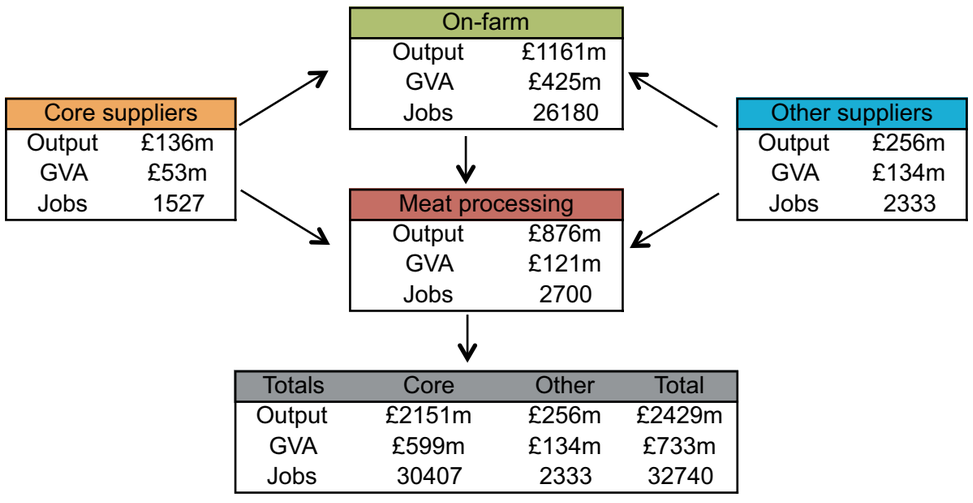
Section V: Overall Summary of Estimated Economic Contribution

57. The red meat supply chain encompasses on-farm production and downstream processing of farm products plus upstream provision of goods and services to farms and processors. Official data for agriculture and the wider economy can be used, with some assumptions, to estimate the economic contribution of the red meat supply chain to Scottish output, value added and employment.

58. Although caveats and assumptions accompany them, Figure 8 summarises the estimated output, value added and employment levels arising from different parts of the Scottish red meat supply chain. The "core" elements of farms and meat processors contribute the most, but input suppliers (both core and non-core) are also important.

59. The accuracy of the estimates presented is difficult to verify due to data limitations and all figures should be viewed as indicative. However, comments received from industry stakeholder/analysts suggest that the figures are not unreasonable. Moreover, they are broadly comparable with a previous study undertaken for QMS (Doyle, 2003) and more formal multiplier analysis (see Annex E).

Figure 8: Summary of estimated output, GVA and employment across the red meat supply chain



60. The process of deriving these estimates has highlighted a number of weaknesses in official data. For example, the representation of heterogeneity in farming systems, the calculation of import flows, the aggregated nature of I-O sectors and the (in)frequency and sampling intensity of surveys supporting the I-O tables. Nevertheless, official data remain the most comprehensive available and seeking to improve them and/or supplement them with additional primary data is likely to be disproportionately expensive and would reduce comparability with analysis of other sectors.

61. Consequently, although the estimates presented here could perhaps be refined, they are indicative of the economic contribution of the red meat sector and are sufficient to consider how overall performance could be enhanced.

Section VI: Scope for Improving Supply Chain Performance[13]

62. Irrespective of the current economic contribution of the red meat sector, there is always room for improvement. This section briefly considers three main ways in which Scottish red meat supply chains could generate further added value and employment: retaining more livestock for processing; improving efficiency; and reorganising supply chain relationships.

Retaining more livestock in Scotland

63. A proportion of finished Scottish livestock are slaughtered outwith Scotland. In addition, a smaller number of animals are also finished outwith Scotland. These movements of live animals to other countries potentially represent missed opportunities for retaining further value-added and employment within Scottish supply chains. Table 11 presents the numbers of animals moving to England and Wales, together with throughput at Scottish abattoirs, highlighting the significant additional numbers that could be processed in Scotland if more livestock were retained.

Table 11: Approximate numbers of Scottish red meat animals moving (2015)

	Moving to England and Wales		Within Scotland
	To Slaughter	To Other	To Slaughter
Cattle	37,000	60,000	411,000
Pigs	181,000	335,000	296,000
Sheep	889,000	779,000	1,342,000

64. Processing such significant additional volumes in Scotland would depend on processors' ability to find market outlets and on physical capacity (e.g. killing lines, chill storage). The latter is likely to be a constraint during seasonal peaks, particularly for sheep. Nevertheless, given that domestic volumes have declined in recent years, there is likely to be sufficient existing headroom to cope with some increase. In the case of pigs, the opening of upgraded facilities at Brechin is intended to repatriate most of the current non-Scottish slaughtering of finished pigs (which rose following the closure of the plant at Broxburn).

65. The lack of species-specific data on processing GVA and employment hinders accurate quantification of the potential gains arising from greater domestic processing throughputs. However, crude pro rata estimates suggest that core GVA could increase by 1 or 2% if a reasonable proportion of animals was retained domestically[14].

Technical and marketing efficiency

66. Various information sources highlight variability in the performance of on-farm red meat production. For example, the gross margin for suckler cows can differ by several hundred pounds between top and bottom quartile herds. Raising bottom performers to the average level would improve the position of those individual farmers but also increase the overall GVA of the sector[15].

67. In most cases the better results for higher performers reflects a combination of lower costs and higher physical outputs and/or higher prices for better meeting market specifications, all of which can be influenced by management and best practice. The aggregate effect of raising performance depends on what proportion of total output is currently accounted for by bottom performers. Although often characterised as quartiles, this proportion relates to farms not overall production, and since smaller enterprises account for a small share of total output care has to be taken with scaling results up. Nevertheless, it is possible to explore possible aggregate outcomes using some simple pro rata calculations, as summarised in Table 12.

[13] See Annex F for further details
[14] Although employment gains would also be realised, their magnitude is less certain since it is not clear how closely tied processing employment is to throughput. Moreover, productivity improvements have reduced jobs per unit of output over time. Indeed, the latter point applies more widely and output or GVA growth is unlikely to be matched by employment growth.
[15] Gross margins calculations are not identical to GVA calculations, but are sufficiently similar to be used as such for the illustrative purposes of this section.

Table 12: Illustrative GVA gains potentially achievable through improving enterprise gross margins

	GM/hd gain	Share of national herd/flock improved		
		10%	25%	33%
Cows	£50	£2.2m	£5.5m	£7.3m
	£100	£4.4m	£10.9m	£14.6m
	£150	£6.5m	£16.4m	£21.8m
Sows	£50	£0.2m	£0.4m	£0.5m
	£100	£0.3m	£0.8m	£1.0m
	£150	£0.5m	£1.1m	£1.5m
Ewes	£10	£2.6m	£6.5m	£8.7m
	£20	£5.2m	£13.0m	£17.4m
	£30	£7.8m	£19.5m	£26.1m

68. For example, if one-third of Scottish suckler cows improved their gross margin by £150/hd, overall beef GVA would increase by over £20m[16], equivalent to about 3% of GVA for the whole core red meat supply chain; if 10% improved by £50, GVA would rise by about £2.2m, or 0.4%. Similar overall gains could potentially be made for sheep, but for pigs the total impact is lower due to the smaller national herd size. The figures are illustrative of the order of magnitude of potential gains available, and assume all other things remain equal.

69. Data on the technical and marketing efficiency of other parts of the supply chain are not as readily available as for farm level production. Nevertheless, operational cost savings of only 1% would equate to c.£8m across core suppliers and processors, representing perhaps 5% of their GVA.

70. Processors could also increase GVA through improved carcase utilisation, finding new market outlets and developing new products. However, many market segments (e.g. catering, food manufacturing) are price sensitive and fiercely competitive. In addition, the demand for different (primal) cuts from a carcase are seldom balanced. For example, UK demand for pork loin exceeds that for leg cuts which exceeds that for shoulder cuts – meaning that meeting demand for any one specific cut inevitably leads to either excess or deficit with respect to the other cuts. As a result, different cuts are likely to be simultaneously imported and exported. Nevertheless, the seeking of new market opportunities is an essential aspect of achieving and retaining competitiveness.

Structure and conduct

71. The third approach to improving performance relates to how the supply chain is organised in terms of the number and structure of firms, the relationships between them and the business strategies that they pursue. In particular, the degree to which information is shared along the chain, the extent to which firms act independently or collaboratively and whether production is focused on adding value or minimising costs.

72. Historically, both domestically and internationally, red meat production has been characterised by independent firms interacting through short-term commercial transactions. This led to the prevalence of large numbers of small firms, the central role of auction marts in selling live animals and the dominance of spot markets for commodity meat. This structure maintains individual firms' flexibility and the opportunity to seek the best prices on any given day, but also incurs exposure to supply and demand uncertainty which can hamper business planning and divert resources to risk management rather than productive uses.

73. For example, reliance on spot markets rather than forward contracts or vertical integration means that processors are not guaranteed their desired volume of throughput on any given day and often have to devote time and effort to sourcing additional supplies and/or holding larger than desired inventory stocks. Equally, farmers' overall financial performance can be highly dependent on prices achieved on only a few discrete occasions throughout the year, again hindering budget planning and increasing exposure to risk.

[16] This could be through less efficient producers improving their own performance or by them exiting the industry and other, more efficient, producers.

74. Recognition of the effects of volatility and risk on overall performance have led to greater interest in closer interactions between different parts of the supply chain to identify where costs can be reduced, risks managed better and value added by better meeting market needs. However, achieving such chain re-organisation is not easy since it involves changing the nature of interactions, from short-term transactions to longer-term relationships. In turn, this requires a cultural shift – a change in attitudes – to achieve mutual trust and greater openness with respect to information sharing. Shifting from a strategy of undifferentiated commodity production with a focus on cost control to a value-added, market-focused strategy also requires a cultural shift.

75. In the UK, various initiatives have attempted to promote change, most notably through value-chain analysis. For example, case studies for the Red Meat Industry Forum identified opportunities to save 2–3% of supply-chain costs. If replicated in Scotland, this equates to perhaps £30m of savings, implying an increase in GVA of around 5% for the core chain.[17]

76. However, the scope for achieving such change in beef and lamb supply chains is constrained by their fragmented structure – even if prevailing attitudes to change mellow, co-ordination between a large number of firms would be challenging. Seasonality of supply and of demand also make management more complex than in chains with more constant throughput volumes.

77. Consideration of supply-chain relationships should also extend to upstream suppliers, without whom farms and processors would be unable to function. For example, the future availability of veterinary and haulage services for red meat animals is key to continued production activities. Yet tighter regulatory controls on livestock haulage (e.g. biosecurity cleaning relative to grain or milk haulage) and higher margins for small animal veterinary practices may reduce the willingness of firms to service the red meat sector. This suggests that moves towards formal longer-term relationships to lock-in security of service supply may be as applicable to upstream suppliers as between farms and processors.

Enhancing environmental and social contributions[18]

78. Although improving the economic contribution of the red meat sector is an important objective, the influence of production on environmental and social outcomes is also important. In particular, livestock farmers can play important roles in rural communities whilst grass-based cattle and sheep systems have a visible impact upon landscape and all three species can emit pollutants (see Annex G for a longer discussion).

79. On-farm production has a readily apparent influence on landscapes, affecting their overall appearance and the presence (or absence) of specific features. As evidenced by current debates about land abandonment, this matters and concern has been expressed about the visual appeal (to residents and tourists) of less-managed landscapes. Equally, less-visible effects on the habitats and biodiversity found in semi-natural areas are also valued and depend on the continuation of some form of active management. Hence funding is available to maintain farming activities, including through the Common Agricultural Policy (CAP) Pillar I and Pillar II area payments (i.e. Basic Payment Scheme and LFASS) plus more prescriptively through agri-environment schemes within Pillar II.

80. Conversely, the potential for livestock production to emit pollutants is less welcome but is also typically targeted by measures to promote the uptake of best management practice – through provision of advice, funding and regulatory penalties. For example, improvements to on-farm nutrient and waste management are encouraged through advisory services and Pillar II grants, but also through regulatory sanctions (often linked to compliance with Pillar I funding).

81. Reducing emissions from ruminant livestock is challenging, but can be achieved through genetic selection and manipulation of diet (including feed additives). More immediately, emissions per breeding animal (or kg of meat) can be reduced by increasing the number of finished animals per breeding animal (i.e. higher calving percentage, lower mortality rate) and the growth rate of progeny. In turn, these can be improved through appropriate management attention to animal health and nutrition and culling of under-performing animals. Given that such management will also deliver productivity improvements, such emission savings can often be secured at no or even negative cost. On-farm greenhouse gas emissions arising from, for example, fossil fuel use and fertiliser applications can also often be reduced through improved management techniques that also deliver cost savings.

82. For upstream suppliers and downstream processors, environmental impacts are less visible than the (positive) landscape effects of on-farm production and are generally restricted to the (negative) effects of pollution, for example, emissions to air and water from using fossil fuels and other chemical inputs plus generation of waste materials. Consequently, enhancing environmental performance often aligns with technical efficiency and cost savings. For example, adopting and maintaining modern buildings and equipment (e.g. vehicles, refrigeration equipment) to reduce energy and water usage plus improving efficiency to reduce waste.[19]

[17] This is not necessarily additive to the potential gains already noted above since the options for cost savings are likely to overlap to an extent.
[18] see also Annex G
[19] Conversely, some regulations may impose costs. For example, restrictions on drivers hours, pensions auto-enrolment and use/disposal of offal and SRM material.

83. The social contributions of red meat production are less tangible and difficult to measure. For example, maintenance of the cohesiveness of rural communities through continuation of farming families. As such, enhancing them tends to be an indirect result of other policy support measures primarily intended to maintain farming. However, some funding under Pillar II (e.g. LEADER) is explicitly targeted at social rural development outcomes.

Summary

84. The scope for improving performance across the red meat sector has been articulated previously in various industry reports. For example, in the Scottish Sheep Industry: The Way Forward (2000), the Strategy for the Scottish Pig Industry (2008) and Beef 2020 (2014). Hence, the issues and potential solutions should be familiar. Moreover, various formal mechanisms are in place to encourage improvements. For example, advice and training programmes, support for benchmarking and value-chain analysis, and modernisation and marketing grants. Consequently, the onus is on all members of the supply chain and its supporting public bodies to recognise the challenges faced and to accept the opportunities presented.

85. The largest potential GVA gains relate to retaining more livestock within Scotland, but wider adoption of best practice at farm level also offers significant potential gains, as does greater information sharing and collaboration across the supply chain. Consequently, there is ample scope to achieve an increase in core GVA of 2–3%.

Section VII: Conclusions

86. The red meat supply chain encompasses on-farm production but also upstream provision of farming inputs and downstream processing of farm products. Evaluation of its economic contribution in terms of total output, value added and employment thus needs to consider the activities of, for example, animal feed suppliers, vets, hauliers, auction marts and abattoirs alongside the farm level activities actually producing beef cattle, pigs and sheep. In addition to the "core", firms in other sectors – such as construction, energy and financial services – also support the supply chain.

87. Livestock production is a fundamental component of Scottish agriculture, reflecting the abundance of grazing resources. However, cattle, pig and sheep numbers recorded in the agricultural census are currently at or close to their lowest levels since EU accession in 1973. Moreover, livestock numbers are distributed unevenly across Scotland and across different types and sizes of farms. A large number of small farms have red meat livestock, but a small number of large farms actually account for the majority of animals. This variation in size and structure has implications for the efficiency of on-farm production, with many farm enterprises being loss-making and reliant on continued support payment under the CAP. Nonetheless, on-farm production accounts for the majority of red meat employment and a significant share of output and GVA.

88. The number of firms involved upstream and downstream in the core supply chain is less than the number of farms, and information on technical and financial performance is less readily available than for farms. However, the estimated contribution of core (and non-core) suppliers and processors to overall employment, output and GVA is significant. This highlights the importance of considering linkages along supply chains in the design of government policies and industry strategies. For example, changes to agricultural policy have knock-on effects for processors and input suppliers. Separately, the influence of the supply chain on social and environmental outcomes also needs to be acknowledged.

89. Identification of the relative contributions of different parts of the supply chain also adds further support to previous analysis of how overall sectoral performance could be enhanced. In particular, there is scope to increase GVA through retaining more livestock within Scotland for processing and through raising the average efficiency of farms. There is also potential to improve performance through greater information sharing and co-ordination along the supply chain, provided that sufficient mutual trust and sharing of rewards can be established between different parties. However, the practical and organisational challenges of achieving any gains should not be under-estimated.

90. The estimates presented here are subject to a number of caveats concerning the quality of available data and the necessary deployment of working assumptions for various calculations. As such, estimates should be regarded as indicative rather than definitive. However, they are based on the best available data, and attempts to refine them are likely to be disproportionately expensive – analytical effort would be better directed at supporting attempts to improve performance across the supply chain. The practical and organisational challenges of achieving any gains should not be under-estimated and require sustained commitment by all concerned.

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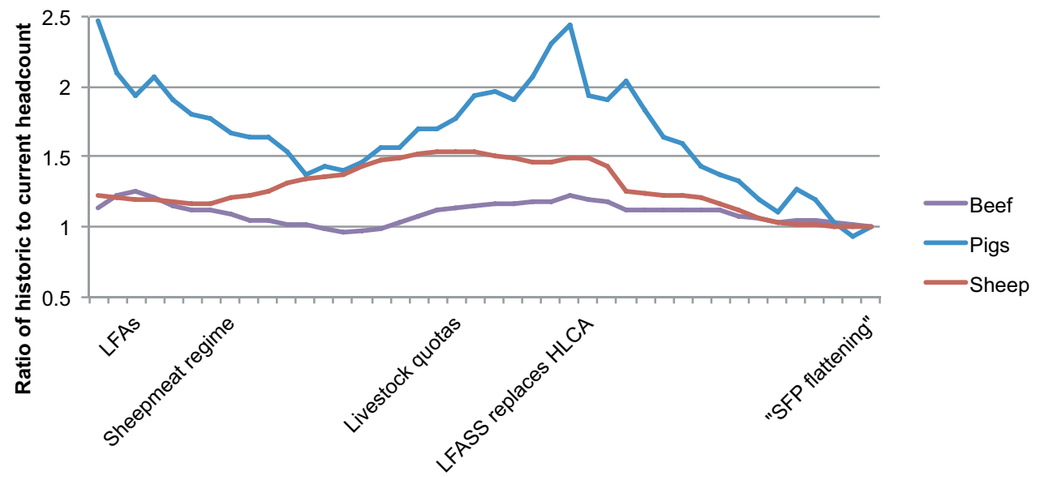
Annex A: More Detailed Livestock Numbers to Support Section I

91. Historically, breeding numbers of cattle, pigs and sheep recorded in the agricultural census have fluctuated considerably but are currently at or close to their lowest levels since EU accession in 1973 (see Figure A1).

Figure A1: Breeding numbers over time relative to current position, with selected policy events



Source: Derived from Scottish Abstract of Statistics 1982 plus Scottish Agricultural Statistics www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubAbstract/Abstract2014

Table A1: Regional distribution of breeding animals (headcount and share of national total), 2014

	North West		North East		South East		South West	
Species	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Beef Cattle	78,452	17.9%	88,671	20.3%	100,823	23.1%	168,580	38.6%
Pigs	1,887	6.2%	18,020	59.5%	8,586	28.4%	1,775	5.9%
Sheep	587,953	22.6%	223,833	8.6%	76,7392	29.5%	1,025,007	39.4%

Source: Scottish Government ERSA, C10(ii) http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries/ERSAC10b

Table A2: Regional distribution of non-breeding animals (headcount and share of national total), 2014

	North West		North East		South East		South West	
Species	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Beef Cattle	26,196	9.4%	85,765	30.7%	53,820	19.3%	113,384	40.6%
Pigs	19,759	6.2%	181,442	57.4%	100,405	31.7%	14,692	4.6%
Sheep	665,315	19.7%	337,582	10.0%	1,058,306	31.4%	1,309,241	38.8%

Source: Scottish Government ERSA, C10(ii) http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries/ERSAC10b. Note: non-breeding beef cattle are approximated here as male cattle over 1 yr old and non-breeding sheep as lambs and other sheep not for breeding

Table A3: Regional distribution of holdings with breeding beef cows by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	61	0.7%	100	1.1%	96	1.0%	135	1.4%
Specialist cereals	13	0.1%	54	0.6%	82	0.9%	17	0.2%
General cropping	3	0.0%	16	0.2%	60	0.7%	3	0.0%
Hort. & perm. crops	4	0.0%	3	0.0%	11	0.1%	2	0.0%
Specialist pigs	2	0.0%	7	0.1%	2	0.0%	0	0.0%
Specialist poultry	1	0.0%	4	0.0%	6	0.1%	8	0.1%
Specialist dairy	19	0.2%	14	0.2%	22	0.2%	286	3.1%
LFA Cattle and Sheep	2,472	26.8%	730	7.9%	702	7.6%	2,554	27.7%
nLFA Cattle and Sheep	31	0.3%	274	3.0%	184	2.0%	252	2.7%
Mixed holdings	128	1.4%	373	4.0%	308	3.3%	108	1.2%
General forage	19	0.2%	40	0.4%	135	1.5%	7	0.1%
Total	*2,753*	*29.8%*	*1,615*	*17.5%*	*1,608*	*17.4%*	*3,254*	*35.3%*

Source: derived from pers. comm. Scottish Government. Female beef animals over 2yrs with offspring.
Percentage share of all holdings with beef cows in Scotland.

Table A4: Regional distribution of breeding beef herd by farm-type (headcount, 2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	437	0.1%	1,486	0.3%	1,642	0.4%	1,747	0.4%
Specialist cereals	332	0.1%	1,386	0.3%	3,258	0.7%	794	0.2%
General cropping	78	0.0%	710	0.2%	2,741	0.6%	18	0.0%
Hort. & perm. crops	46	0.0%	395	0.1%	445	0.1%	234	0.1%
Specialist pigs	102	0.0%	381	0.1%	66	0.0%	0	0.0%
Specialist poultry	30	0.0%	248	0.1%	527	0.1%	375	0.1%
Specialist dairy	198	0.0%	87	0.0%	350	0.1%	2,748	0.6%
LFA Cattle and Sheep	70,273	16.1%	45,799	10.5%	49,810	11.4%	148,940	34.1%
nLFA Cattle and Sheep	646	0.1%	11,731	2.7%	9,172	2.1%	9,581	2.2%
Mixed holdings	5,571	1.3%	24,234	5.6%	24,258	5.6%	3,894	0.9%
General forage	739	0.2%	2,214	0.5%	8,554	2.0%	249	0.1%
Total	*78,452*	*18.0%*	*88,671*	*20.3%*	*100,823*	*23.1%*	*168,580*	*38.6%*

Source: derived from pers. comm. Scottish Government.
Female beef animals over 2yrs with offspring.
Percentage of all beef breeding cows in Scotland.

Table A5: Regional distribution of holdings with non-breeding beef cattle by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	32	0.4%	77	0.9%	77	0.9%	119	1.4%
Specialist cereals	13	0.2%	73	0.8%	87	1.0%	20	0.2%
General cropping	4	0.0%	21	0.2%	68	0.8%	4	0.0%
Hort. & perm. crops	3	0.0%	4	0.0%	13	0.2%	2	0.0%
Specialist pigs	3	0.0%	7	0.1%	1	0.0%	1	0.0%
Specialist poultry	1	0.0%	2	0.0%	6	0.1%	9	0.1%
Specialist dairy	30	0.3%	29	0.3%	49	0.6%	654	7.6%
LFA Cattle and Sheep	1,535	17.8%	709	8.2%	643	7.5%	2,343	27.2%
nLFA Cattle and Sheep	24	0.3%	296	3.4%	167	1.9%	264	3.1%
Mixed holdings	100	1.2%	443	5.1%	324	3.8%	138	1.6%
General forage	17	0.2%	49	0.6%	163	1.9%	5	0.1%
Total	*1,762*	*20.4%*	*1,710*	*19.8%*	*1,598*	*18.5%*	*3,559*	*41.2%*

Source: As above. Male beef animals over 1yr. Percentage share of all holdings with such animals.

Table A6: Regional distribution of non-breeding beef herd by farm-type (2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	156	0.1%	2,133	0.8%	1,478	0.5%	2,280	0.8%
Specialist cereals	485	0.2%	2,391	0.9%	2,468	0.9%	511	0.2%
General cropping	77	0.0%	881	0.3%	2,575	0.9%	51	0.0%
Hort. & perm. crops	18	0.0%	259	0.1%	171	0.1%	114	0.0%
Specialist pigs	44	0.0%	293	0.1%	44	0.0%	38	0.0%
Specialist poultry	6	0.0%	330	0.1%	55	0.0%	205	0.1%
Specialist dairy	485	0.2%	838	0.3%	1084	0.4%	23,067	8.3%
LFA Cattle and Sheep	21,547	7.7%	22,716	8.1%	16,310	5.8%	64,162	23.0%
nLFA Cattle and Sheep	307	0.1%	27,496	9.8%	8,793	3.1%	14,393	5.2%
Mixed holdings	2,626	0.9%	26,364	9.4%	13,637	4.9%	8,461	3.0%
General forage	445	0.2%	2,064	0.7%	7,205	2.6%	102	0.0%
Total	*26,196*	*9.4%*	*85,765*	*30.7%*	*53,820*	*19.3%*	*113,384*	*40.6%*

Source: As above. Male beef animals over 1yr. Percentage share of all such animals in Scotland.

Table A7: Size distribution of beef breeding herd, by region (2014)

	North West		North East		South East		South West	
Herd size	Hldgs	Hd	Hldgs	Hd	Hldgs	Hd	Hldgs	Hd
1–4	31.2%	2.5%	16.1%	0.6%	13.6%	0.5%	18.5%	0.8%
5–19	32.4%	11.2%	21.2%	4.5%	15.0%	2.7%	21.5%	4.6%
20–49	18.9%	20.7%	20.9%	12.7%	24.8%	13.2%	23.3%	15.3%
50–74	6.1%	13.2%	13.6%	15.2%	15.2%	14.8%	13.2%	15.7%
75–99	3.8%	11.4%	8.8%	13.7%	10.2%	14.1%	8.3%	13.9%
100–149	4.3%	18.1%	8.8%	19.3%	10.1%	19.4%	7.9%	18.6%
150+	2.9%	21.8%	7.4%	31.6%	9.0%	33.0%	6.0%	28.2%

Source: Scottish Government. ERSA Table C12 http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries/ERSAC12 Percentage of beef holdings and animals within region.

Table A8: Regional distribution of holdings with breeding pigs by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	1	0.2%	1	0.2%	5	1.0%	0	0.0%
General cropping	0	0.0%	0	0.0%	3	0.6%	0	0.0%
Hort. & perm. crops	2	0.4%	1	0.2%	2	0.4%	0	0.0%
Specialist pigs	56	10.6%	44	8.4%	33	6.3%	33	6.3%
Specialist poultry	5	1.0%	1	0.2%	2	0.4%	3	0.6%
Specialist dairy	1	0.2%	0	0.0%	0	0.0%	4	0.8%
LFA Cattle and Sheep	38	7.2%	9	1.7%	16	3.0%	64	12.2%
nLFA Cattle and Sheep	0	0.0%	3	0.6%	6	1.1%	11	2.1%
Mixed holdings	58	11.0%	38	7.2%	42	8.0%	31	5.9%
General forage	4	0.8%	2	0.4%	5	1.0%	2	0.4%
Total	*165*	*31.4%*	*99*	*18.8%*	*114*	*21.7%*	*148*	*28.1%*

Source: derived from pers. comm. Scottish Government. Percentage share of all holdings with breeding pigs.

Table A9: Regional distribution of breeding pigs by farm-type (headcount, 2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	1	0.0%	5	0.0%	13	0.0%	0	0.0%
General cropping	0	0.0%	0	0.0%	8	0.0%	0	0.0%
Hort. & perm. crops	4	0.0%	2	0.0%	6	0.0%	0	0.0%
Specialist pigs	1,577	5.2%	13,845	45.8%	5,808	19.2%	1,509	5.0%
Specialist poultry	16	0.1%	3	0.0%	2	0.0%	5	0.0%
Specialist dairy	4	0.0%	0	0.0%	0	0.0%	7	0.0%
LFA Cattle and Sheep	77	0.3%	24	0.1%	84	0.3%	153	0.5%
nLFA Cattle and Sheep	0	0.0%	7	0.0%	9	0.0%	19	0.1%
Mixed holdings	164	0.5%	4,131	13.7%	2,629	8.7%	80	0.3%
General forage	4	0.0%	3	0.0%	27	0.1%	2	0.0%
Total	*1,847*	*6.1%*	*18,020*	*59.6%*	*8,586*	*28.4%*	*1,775*	*5.9%*

Source: derived from pers. comm. Scottish Government. Percentage share of all breeding pigs.

Table A10: Regional distribution of holdings with fattening pigs by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	2	0.2%	3	0.3%	8	0.9%	0	0.0%
General cropping	0	0.0%	1	0.1%	4	0.4%	1	0.1%
Hort. & perm. crops	5	0.6%	1	0.1%	3	0.3%	3	0.3%
Specialist pigs	64	7.1%	58	6.4%	48	5.3%	48	5.3%
Specialist poultry	15	1.7%	10	1.1%	4	0.4%	14	1.5%
Specialist dairy	1	0.1%	0	0.0%	0	0.0%	8	0.9%
LFA Cattle and Sheep	73	8.1%	22	2.4%	32	3.5%	92	10.2%
nLFA Cattle and Sheep	0	0.0%	11	1.2%	22	2.4%	18	2.0%
Mixed holdings	83	9.2%	81	9.0%	69	7.6%	56	6.2%
General forage	13	1.4%	7	0.8%	20	2.2%	5	0.6%
Total	*256*	*28.3%*	*194*	*21.4%*	*210*	*23.2%*	*245*	*27.1%*

Source: derived from pers. comm. Scottish Government. Percentage share of all holdings with fattening pigs.

Table A11: Regional distribution of fattening pigs by farm-type (headcount, 2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	19	0.0%	712	0.3%	10,341	3.7%	0	0.0%
General cropping	0	0.0%	5	0.0%	1,282	0.5%	2	0.0%
Hort. & perm. crops	34	0.0%	2	0.0%	43	0.0%	5	0.0%
Specialist pigs	14,073	5.0%	99,919	35.7%	41,593	14.9%	11064	4.0%
Specialist poultry	122	0.0%	32	0.0%	8	0.0%	46	0.0%
Specialist dairy	3	0.0%	0	0.0%	0	0.0%	58	0.0%
LFA Cattle and Sheep	302	0.1%	143	0.1%	390	0.1%	677	0.2%
nLFA Cattle and Sheep	0	0.0%	103	0.0%	110	0.0%	113	0.0%
Mixed holdings	1,839	0.7%	59,841	21.4%	31,708	11.3%	457	0.2%
General forage	802	0.3%	364	0.1%	3,308	1.2%	10	0.0%
Total	*17,194*	*6.2%*	*16,1121*	*57.6%*	*88,783*	*31.8%*	*12,432*	*4.4%*

Source: derived from pers. comm. Scottish Government. Percentage share of all fattening pigs.

Table A12: Size distribution of pig breeding herd, Scotland-level (2014)

Herd size	Hldgs		Hd	
1–4	390	74.1%	725	2.4%
5–49	66	12.5%	697	2.3%
50–99	10	1.9%	694	2.3%
100–249	14	2.7%	2152	7.1%
250 & over	46	8.7%	25960	85.9%

Source: Scottish Government. ERSA Table C15 http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries/ERSAC15. No regional breakdown available.

Table A13: Regional distribution of holdings with breeding ewes by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	17	0.1%	67	0.5%	83	0.7%	13	0.1%
General cropping	12	0.1%	21	0.2%	42	0.3%	4	0.0%
Hort. & perm. crops	11	0.1%	5	0.0%	4	0.0%	6	0.0%
Specialist pigs	18	0.1%	11	0.1%	7	0.1%	7	0.1%
Specialist poultry	19	0.1%	9	0.1%	17	0.1%	18	0.1%
Specialist dairy	11	0.1%	2	0.0%	19	0.1%	170	1.3%
LFA Cattle and Sheep	5,534	43.5%	566	4.5%	993	7.8%	2,818	22.2%
nLFA Cattle and Sheep	47	0.4%	293	2.3%	311	2.4%	243	1.9%
Mixed holdings	349	2.7%	330	2.6%	321	2.5%	183	1.4%
General forage	12	0.1%	23	0.2%	94	0.7%	4	0.0%
Total	*6,030*	*47.4%*	*1,327*	*10.4%*	*1,891*	*14.9%*	*3,466*	*27.3%*

Source: derived from pers. comm. Scottish Government. Percentage share of all holdings with breeding ewes.

Table A14: Regional distribution of breeding ewes by farm-type (headcount, 2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	2,322	0.1%	6,197	0.2%	10,427	0.4%	1,858	0.1%
General cropping	1172	0.0%	3,420	0.1%	4,923	0.2%	632	0.0%
Hort. & perm. crops	147	0.0%	1,020	0.0%	67	0.0%	194	0.0%
Specialist pigs	718	0.0%	1,696	0.1%	1042	0.0%	87	0.0%
Specialist poultry	183	0.0%	76	0.0%	7,303	0.3%	3,317	0.1%
Specialist dairy	2,064	0.1%	140	0.0%	5,406	0.2%	29,531	1.1%
LFA Cattle and Sheep	553,846	21.3%	125,249	4.8%	587,918	22.6%	946,852	36.4%
nLFA Cattle and Sheep	2,020	0.1%	39,467	1.5%	42,332	1.6%	25,193	1.0%
Mixed holdings	22,873	0.9%	42,502	1.6%	87,338	3.4%	16,748	0.6%
General forage	2,608	0.1%	4,066	0.2%	20,636	0.8%	595	0.0%
Total	*587,953*	*22.6%*	*223,833*	*8.6%*	*767,392*	*29.5%*	*1,025,007*	*39.4%*

Source: derived from pers. comm. Scottish Government. Percentage share of all breeding ewes.

Table A15: Regional distribution of holdings with non-breeding sheep by farm-type (holdings, 2014)

	North West		North East		South East		South West	
Farm-type	Hldgs	Share	Hldgs	Share	Hldgs	Share	Hldgs	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	17	0.1%	74	0.6%	88	0.7%	16	0.1%
General cropping	14	0.1%	22	0.2%	44	0.3%	3	0.0%
Hort. & perm. crops	11	0.1%	4	0.0%	5	0.0%	6	0.0%
Specialist pigs	23	0.2%	10	0.1%	11	0.1%	9	0.1%
Specialist poultry	28	0.2%	19	0.1%	25	0.2%	24	0.2%
Specialist dairy	12	0.1%	5	0.0%	19	0.1%	171	1.3%
LFA Cattle and Sheep	5,364	42.2%	571	4.5%	983	7.7%	2,793	22.0%
nLFA Cattle and Sheep	52	0.4%	317	2.5%	319	2.5%	254	2.0%
Mixed holdings	350	2.8%	349	2.7%	352	2.8%	205	1.6%
General forage	12	0.1%	24	0.2%	97	0.8%	4	0.0%
Total	*5,883*	*46.3%*	*1,395*	*11.0%*	*1,943*	*15.3%*	*3,485*	*27.4%*

Source: derived from pers. comm. Scottish Government. Percentage of all holdings with non-breeding sheep.

Table A16: Regional distribution of non-breeding sheep by farm-type (2014)

	North West		North East		South East		South West	
Farm-type	Hd	Share	Hd	Share	Hd	Share	Hd	Share
Unclassified	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Specialist cereals	3,691	0.1%	10,590	0.3%	17,031	0.5%	3,055	0.1%
General cropping	1,999	0.1%	5,816	0.2%	7,724	0.2%	1,004	0.0%
Hort. & perm. crops	218	0.0%	1,686	0.1%	91	0.0%	208	0.0%
Specialist pigs	1,190	0.0%	2,743	0.1%	1900	0.1%	140	0.0%
Specialist poultry	433	0.0%	332	0.0%	11,015	0.3%	4,697	0.1%
Specialist dairy	2,809	0.1%	369	0.0%	8,388	0.2%	42,389	1.3%
LFA Cattle and Sheep	614,377	18.2%	180,807	5.4%	775,943	23.0%	1,192,646	35.4%
nLFA Cattle and Sheep	2,796	0.1%	64,567	1.9%	67,984	2.0%	39,911	1.2%
Mixed holdings	33,770	1.0%	63,924	1.9%	136,391	4.0%	24,274	0.7%
General forage	4,032	0.1%	6,748	0.2%	31,839	0.9%	917	0.0%
Total	*665,315*	*19.7%*	*337,582*	*10.0%*	*1,058,306*	*31.4%*	*1,309,241*	*38.8%*

Source: derived from pers. comm. Scottish Government. Percentage of all non-breeding sheep.

Table A17: Size distribution of breeding ewe flocks, by region (2014)

	North West		North East		South East		South West	
Flock size	Hldgs	Hd	Hldgs	Hd	Hldgs	Hd	Hldgs	Hd
1–24	40.0%	5.1%	30.3%	1.9%	23.3%	0.5%	21.0%	0.7%
25–49	20.3%	7.3%	11.0%	2.4%	6.6%	0.6%	10.0%	1.2%
50–99	16.1%	11.6%	14.8%	6.3%	7.1%	1.2%	10.8%	2.6%
100–199	11.2%	16.0%	17.6%	14.9%	11.3%	4.0%	14.1%	6.9%
200–299	4.4%	10.8%	10.2%	14.7%	7.8%	4.7%	10.9%	8.9%
300–499	4.0%	16.2%	8.4%	18.9%	13.3%	12.7%	13.9%	18.4%
500–699	2.0%	12.1%	3.4%	11.6%	9.0%	13.1%	7.2%	14.4%
700–999	1.2%	10.0%	2.2%	10.7%	9.7%	20.0%	6.0%	16.5%
1000 & over	0.8%	10.9%	2.1%	18.7%	12.0%	43.1%	6.1%	30.3%

Source: Scottish Government. ERSA Table C14 http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubEconomicReport/TimeSeries/ERSAC14 Percentage of regional holdings with breeding ewes in each flock size and percentage of regional ewes in each flock size.

Table A18: Cross-tabulation of beef breeding herd size against ewe flock size (number of holdings)

	Flock size										
Herd size	0	1-24	25-49	50-99	100-199	75-99	100-149	500-699	700-999	>1000	Total
0	33,483	3,021	1,439	1,412	1,039	487	455	244	214	526	42,320
1–4	889	140	74	86	65	32	27	19	22	25	1,379
5–19	1,064	116	127	163	208	97	83	29	32	53	1,972
20–49	820	60	51	97	159	114	122	62	74	129	1,688
50–74	435	29	20	38	67	68	93	54	51	121	976
75–99	312	17	11	26	41	43	50	55	46	125	726
100–149	522	25	20	30	61	55	78	64	86	244	1,185
>150	1,800	116	74	101	154	124	226	199	276	884	3,954
Total	*39,325*	*3,524*	*1,816*	*1,953*	*1,794*	*1,020*	*1,134*	*726*	*801*	*2,107*	*54,200*

Source: pers. comm. Scottish Government.

92. Overall, red meat livestock are found on around 20,000[20] of the approximately 52,000 holdings in Scotland. Of these, over 14,300 are LFA specialist cattle and sheep holdings, around 2,300 non-LFA cattle and sheep holdings and nearly 300 specialist pig holdings, meaning that approaching one-third of all holdings are primarily engaged in producing animals for the red meat supply chain.

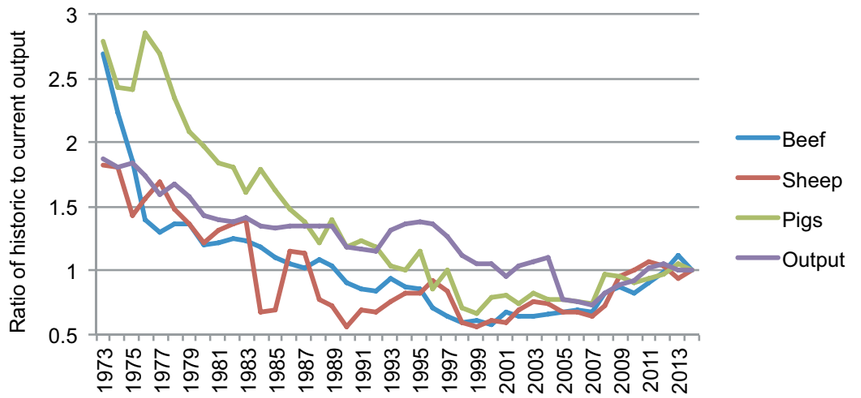
[20] Since cattle, sheep and pigs can co-exist on the same holding, simply adding together the numbers of holdings with each species individually (as reported in Tables above) will result in double counting. In terms of red meat species (but not necessarily other enterprises), around 4600 holdings are beef cattle only, 8,800 holdings are sheep only, 5,600 cattle and sheep only, and 500 pigs only.

Annex B: More Detailed Agricultural Output, Value Added and Income Figures to Support Section II

93. Livestock numbers are physical measures of activity, but need to be combined with prices to generate output values. Figure B1 traces fluctuations in indicative average prices for prime animals and total red meat output since EU accession in 1973, relative to current levels.

It is apparent that price and output levels have fluctuated considerably over time, with recent years marking a slight upturn after sustained periods of decline and stagnation.

Figure B1: Prime livestock prices and red meat output over time, relative to 2014 levels.



Source: Derived from historical editions of ERSA and predecessor publications http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/Publications/histagstats/. GDP deflator used to convert all values to 2014 prices prior to dividing by 2014 levels. https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp. Basis for price reporting has changed over time, so some inconsistencies may be present and trends are indicative rather than definitive.

94. Table B1 summarises changes in output from the three species over the past decade. Year-on-year changes reflect a combination of price volatility and changing livestock numbers, with rising prices (some of which may reflect improved quality as well as supply and demand interactions) partially counteracting falling headage numbers in recent years.

95. As a proportion of total agricultural output, the red meat sector's share has varied between 32% and 40% over this period, with cattle accounting for over two-thirds of throughput. Table B2 separates the results for 2014 into different components by region, revealing some variation – higher relative importance in the North West where poorer land quality precludes other enterprises, lower in the South where (e.g.) dairying and arable enterprises are more common. Finished animals account for the bulk of output value, with store animals' relatively minor contribution reflecting statistical methodology. Store output is based on the revenue generated from cross-border sales of livestock rather than from sales within Scotland.

Table B1: Output values for beef cattle, pigs and sheep plus all agriculture, 2006 to 2014

Year	Cattle		Pigs		Sheep		Red Meat	All agriculture
	£m	%	£m	%	£m	%	%	£m (100%)
2006	695	25.4%	84	3.0%	219	8.0%	36.4%	2,734
2007	644	22.2%	78	2.7%	207	7.1%	32.0%	2,904
2008	680	22.9%	80	2.7%	213	7.2%	32.8%	2,964
2009	716	25.2%	78	2.7%	275	9.7%	37.6%	2,839
2010	768	26.0%	84	2.8%	281	9.5%	39.3%	2,959
2011	837	26.0%	99	3.1%	289	9.0%	38.1%	3,222
2012	903	28.8%	90	2.9%	264	8.4%	40.1%	3,137
2013	880	27.1%	82	2.5%	233	7.1%	36.7%	3,251
2014	837	27.5%	95	3.1%	249	8.2%	38.8%	3,049

Source: SG ERSA, A1 various years http://www.gov.scot/Publications/2014/10/6277/0 GDP deflator used to convert all values to 2014 prices. https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp % share of all Scottish agricultural output.
Finished and store animals plus capital formation.

Table B2: Output values for beef cattle, pigs and sheep, by region 2014

	NW		NE		SE		SW	
	£m	Share	£m	Share	£m	Share	£m	Share
Finished cattle	114	9.8%	161	13.9%	148	12.7%	218	18.8%
Store cattle	10	0.9%	9	0.8%	11	0.9%	19	1.6%
Finished pigs	18	1.6%	44	3.8%	27	2.3%	5	0.4%
Finished sheep	65	5.6%	13	1.1%	68	5.9%	57	4.9%
Store sheep	4	0.3%	1	0.1%	4	0.3%	3	0.3%
Capital formation	38	3.3%	21	1.8%	40	3.4%	63	5.4%
Red meat output	249	21.4%	249	21.4%	298	25.7%	365	31.4%
Regional output	410	13.4%	549	18.0%	1,215	39.8%	876	28.7%

Source: derived from pers. comm. Scottish Government. Percentage share of national total.

96. Subtracting variable and fixed costs from output yields Value Added. Confusingly, both output and value added can be expressed in different ways depending on the prices used. “Basic prices” accounts for direct taxes and subsidies on production and tends to be presented more prominently, with decoupled support payments accounted for by adding them to NVA at Basic Prices (BP) to yield NVA at Factor Cost (FC). The latter NVA is then used to calculate TIFF to represent business profits and remuneration for work by unpaid labour – the returns to farmers and family members for their time and efforts. It is calculated by deducting wages, rent and interest payments from NVA.

Table B3: Agricultural Output, Value Added and TIFF, by region 2014

	NW		NE		SE		SW		Scotland
	£m	%	£m	%	£m	%	£m	%	£m
Output	409	13.4%	549	18.0%	1,215	39.8%	876	28.7%	3,049
Input	348	17.7%	346	17.6%	791	40.2%	485	24.6%	1,970
Gross Value Added	61	5.7%	202	18.7%	424	39.3%	391	36.3%	1,078
Capital consumption	88	19.8%	68	15.3%	152	34.2%	137	30.8%	445
Net Value Added (bp)	-27	-4.3%	134	21.2%	272	43.0%	254	40.1%	633
Subsidies	114	23.3%	81	16.5%	165	33.7%	130	26.5%	490
Net Value Added (fc)	87	7.7%	215	19.1%	437	38.9%	384	34.2%	1,123
TIFF	16	2.3%	160	23.3%	230	33.4%	282	41.0%	688

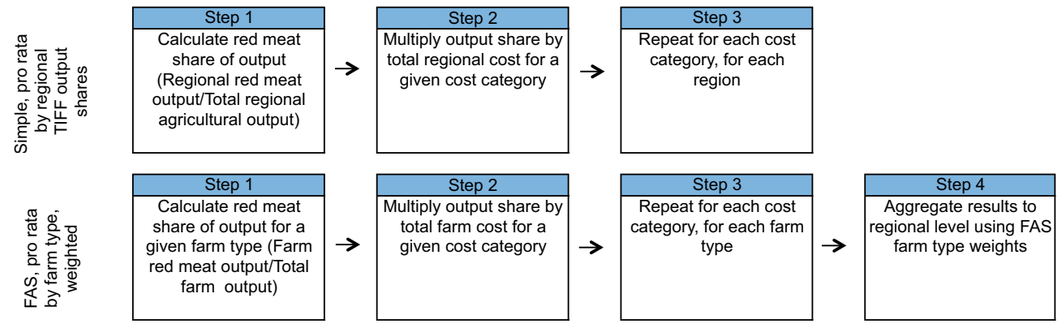
Source: pers. comm. SG, but see also http://www.gov.scot/Resource/0046/00469121.xlsx % of national total.

97. Although red meat output is identified separately within the official statistics, the costs (and therefore value added and income associated with red meat production) are not. This reflects the way that costs are recorded and reported on the basis of whole farm-type rather than commodity type, meaning that costs are not allocated to specific production activities.

98. However, it is possible to use some additional information and assumptions to estimate how costs are distributed across production activities, and hence to estimate value added and income for red meat production. Any such estimation process is inevitably subject to various inaccuracies and results should be viewed as indicative approximations rather than definitive facts. For example, data from different sources may have been collected in different ways at different times and/or using different definitions whilst using averages neglects acknowledged variation across farms. Nevertheless, such approximations are the best available in the absence of a specific survey exercise.

99. Two approaches to cost allocation were deployed here (Figure B2). First, the regional TIFF costs were simplistically allocated pro rata according to the share of regional output accounted for by red meat production. However, since cost structures vary somewhat between different enterprises a more refined approach to cost allocation should generate better estimates. For example, some aggregate cost categories (e.g. veterinary services, livestock capital consumption) will arise solely from livestock production (including dairy and poultry) whilst others (e.g. crop protection) will arise mainly from arable and horticultural enterprises. Hence, second, input and capital costs were allocated pro rata from output shares at the level of the FAS farm-type, and then aggregated to the regional level using the same farm-type weighting system as used for the published TIFF results. This has the advantage of being consistent with the existing aggregate figures whilst improving on the simplistic aggregate pro rata approach by taking some account of variation in cost structures between farm-types.[21] Output and cost data for each farm-type were provided by the Scottish Government from the Farm Accounts Survey, together with the ‘Standard Output’ weights used to aggregate results to the regional level.

Figure B2: Two approaches to cost allocation



[21] A third approach of using farm level input-output coefficients (e.g. see Moxey & Tiffin, 1994; Craig, 2014) was explored, but produced results inconsistent with the TIFF figures and requires refinement beyond the scope of this project.

100. Table B4 summarises results for the two approaches, revealing a high degree of agreement for estimated variable costs.[22] The lower variable cost share in the SE appears to reflect the dominance of arable crops but also the presence of poultry production (which accounts for a large share of feedstuff costs). Estimated capital costs shares are, however, uniformly higher, reflecting the relative importance of livestock capital and the number of specialist red meat livestock holdings.

Table B4: Estimated cost shares for red meat sector, by region, estimated at aggregate and farm level

	NW		NE		SE		SW		Scotland	
	Simple	FAS	Simple	FAS	Simple	FAS	Simple	FAS	Simple	FAS
Variable costs	61%	60%	45%	46%	25%	18%	42%	49%	38%	36%
Capital costs	61%	75%	45%	57%	25%	46%	42%	53%	38%	59%

Source: farm-type estimates derived from FAS data via pers. comm. SG;

101. Table B5 presents the results of using the cost share estimates in Table B4 to adjust the input cost and capital consumption rows in Table B3 in order to generate estimates of GVA and NVA at basic prices. Allocating decoupled subsidies to particular enterprises is difficult but TIFF estimates are also included in Table B5 using subsidy estimates allocated on the same basis as costs.[23]

Table B5: Estimated red meat Output, Value Added and TIFF (£m), by region 2014

	NW		NE		SE		SW		Scotland	
		Farm		Farm		Farm		Farm		£m
Output	249	249	249	249	298	298	365	365	1161	1161
Input	211	209	157	159	194	142	203	199	765	709
GVA	37	40	92	90	104	156	162	166	395	452
Capital consumption	53	66	31	39	37	70	57	89	178	264
NVA (bp)	-16	-26	61	41	67	86	105	77	217	178
Subsidies	69	79	37	41	40	64	54	86	286	270
NVA (fc)	53	53	104	82	107	150	159	163	423	448
TIFF	10	10	80	57	56	113	117	113	263	293

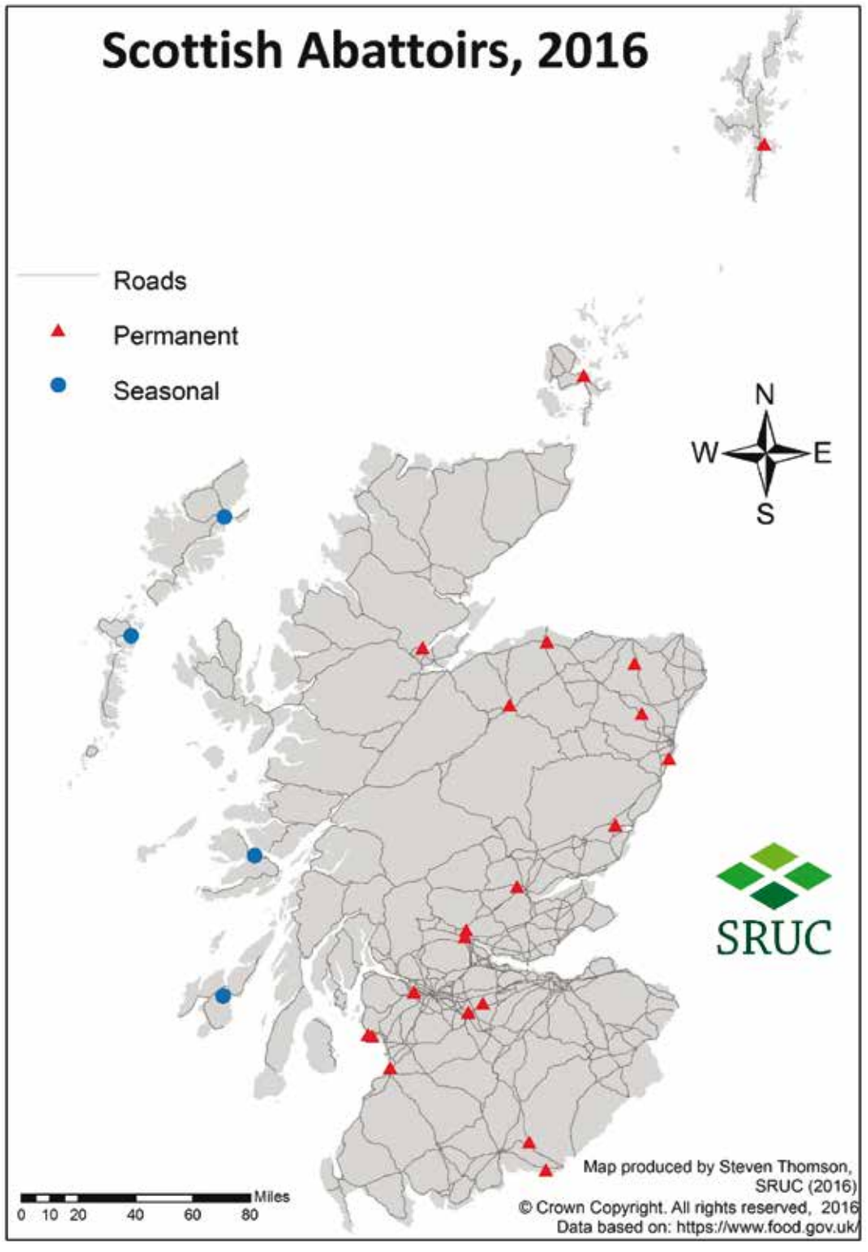
Source: derived from Tables 21, 22 and 23. Subsidy estimated using farm-type share approach, with 70% allocated to red meat production – which seems plausible given that LFASS is essentially only for cattle and sheep and the majority of historical coupled support (and thus, still, current payments) also went to cattle and sheep production (see SG ERSA http://www.gov.scot/Publications/2007/05/15131914/5).

102. To summarise, red meat output has fluctuated over time as both prices and physical production levels have varied but remains an important component of the larger agricultural economy, accounting for around 40% of output and GVA. Estimates of regional value added rely on certain assumptions but suggest some variation in both variable and fixed cost structures, with capital consumption reducing NVA significantly relative to GVA.[24,25]

[22] Although the totals are similar, the composition is slightly different with the farm-type approach allocating higher shares of feedstuffs and veterinary costs but lower shares of seeds and crop protection.
[23] These may underestimate implicit subsidy; prior to decoupling, beef and sheep subsidies (headage and LFASS) accounted for approximately 70% of total support, implying c.£60-£70m could be added to Scotland totals for NVAfc and TIFF (see SG ERSA http://www.gov.scot/Publications/2007/05/15131914/5).
[24] The treatment of capital costs at the aggregate level is problematic, since assumed rates of depreciation may not be universally appropriate to all forms of capital under different farming systems.
[25] Negative NVA for the NW almost certainly reflects under-estimation of store sale values within Scotland: output, GVA and NVA are possibly £20m-£30m higher in the NW (and correspondingly lower elsewhere). SG statisticians are considering how to address this, but the necessary data are not currently available. Figures at the all-Scotland level are not affected, only the regional split.

Annex C: More Detailed I-O Figures to Support Section III

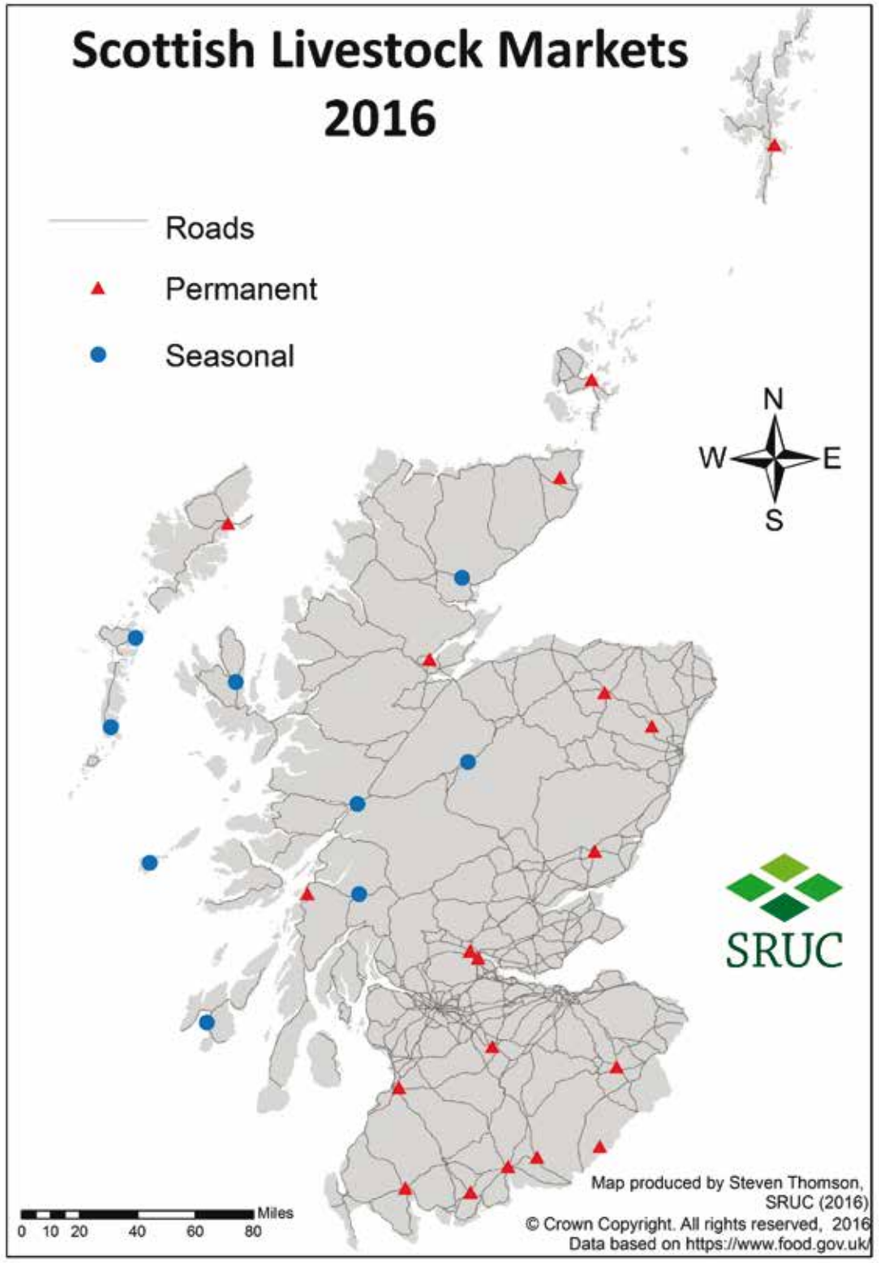
Figure C1: Map showing location of slaughterhouses[26]



Source: courtesy of Steven Thomson, SRUC (updated from Thomson, 2008)

[26] Adapted from the current (but inaccurate) list published by the Food Standards Agency https://www.food.gov.uk/enforcement/sectorrules/meatplantsprems/meatpremlicence

Figure C2: Map showing location of livestock auction marts



Source: courtesy of Steven Thomson, SRUC.

103. Comparability between I-O figures and agricultural data is not perfect. First, there is no regional break-down of figures within Scotland and red meat is not distinguished from other aspects of agriculture. Second, some data 'balancing' adjustments are required to ensure internal consistency and compatibility between sectors, meaning that agricultural data used in I-O analysis can diverge from that reported elsewhere. Third, many upstream agricultural supply activities are presented within broad Standard Industrial Classification (SIC2007) categories alongside non-agricultural-related activities[27] and the apportionment of imported inputs across sectors is imprecise - making it difficult to disentangle the red meat supply chain from other chains. Nevertheless, some interesting – but only indicative – insights can still be gleaned under various working assumptions.

104. In particular the reported pattern of sales between different sectors highlights linkages between upstream and downstream activities. Although the values vary from year-to-year, the general patterns of linkages between sectors are readily apparent. For example, there are significant within-industry flows for Scottish agriculture itself (Table C1) reflecting sales from one sub-sector to another (e.g. cereals for feed, store animals for fattening) accounting for about one-sixth of input expenditure in 2012.

105. Other notable expected expenditure flows include the use of wholesalers (including auction marts and farm machinery), vehicle purchases, animal feed, haulage services and chemicals (e.g. fertilisers) but also perhaps less obvious categories such as construction, utilities (e.g. water, electricity) plus legal, real estate, insurance and financial services.

106. Inputs are also purchased from beyond Scotland, with the rest of the UK (RUK) accounting for about 40% of expenditure and the rest of the world (RoW) a further 10%: almost half of Scottish agriculture's input expenditure flows to Scottish firms, but over half flows to firms outwith Scotland. Within this, imported animal feeds account for c.£480m, fertilisers and other chemicals for c.£210m and fuels for c.£150m. The precise destination use of imported inputs (e.g. feed for pigs or poultry) is not known.

107. Meat processing (slaughtering, but also cutting/boning/packing) is also identified as a separate activity in the I-O tables, meaning that its linkages to upstream suppliers are also reported. Unsurprisingly, agriculture (which can be inferred to be livestock production, although including poultry as well as red meat species) is the largest single supply sector, but sales within meat processing (e.g. carcases sold to separate cutting plants) are important too whilst wholesale (including marts and dealer services), plus haulage and employment services are also significant (Table C2). Notably, imports are also significant, both from the rest of the UK and the rest of the World at over 40% of total input expenditure. Within this, agricultural imports (i.e. live animals) account for c.£150m and meat processing imports (e.g. carcases or part-cut meat) for c.£240m.

108. Reconciliation of the estimated value for on-farm production of finished red meat animals (see Table 20) with the I-O meat processors' expenditure of only £353m (including poultry) on agriculture is problematic since the difference implies that either a very high proportion of Scottish farm output is exported for processing and/or the estimates are inaccurate. It is possible that a proportion of agricultural imports has been misclassified and is actually from domestic sources, although the level of pre-processed meat is also surprisingly high. It should also be noted that the data underpinning the I-O Tables are somewhat dated and do not yet reflect the effects of, for example, closure of slaughtering facilities at Broxburn and upgrading of facilities at Brechin. The precise destination use of imported inputs (e.g. feed for pigs or poultry) is not known.

[27] For example, auction marts are included alongside a range of wholesaler and agent activities, some for agriculture, many for other sectors.

Table C1: Most significant supply sectors to Scottish agriculture in 2006 and 2012

	Purchases in 2006		Purchases in 2012	
Purchases from:	£m	%share	£m	%share
Agriculture	308.5	15.0%	302.9	14.6%
Wholesalers	89.9	4.3%	89.3	4.3%
Vehicles	88.9	4.4%	77.0	3.7%
Animal feeds	63.4	3.1%	60.0	2.9%
Haulage	53.9	2.6%	54.5	2.6%
Real estate services	19.5	0.9%	40.6	2.0%
Legal services	58.7	2.9%	40.0	1.9%
Construction	23.7	1.2%	38.8	1.9%
Chemicals	22.1	1.1%	28.8	1.4%
Insurance and pensions	20.0	1.0%	25.7	1.2%
Veterinary services	17.3	0.8%	25.5	1.1%
Water and sewerage	25.1	0.75%	15.4	0.8%
Financial services	16.1	0.8%	14.3	0.7%
Electricity	16.9	0.8%	14.2	0.7%
Pharmaceuticals	15.1	0.7%	9.9	0.5%
Imports RUK	817.8	39.9%	884.1	42.7%
Imports RoW	187.8	9.2%	214.5	10.4%

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp.

Table C2: Most significant supply sectors to Scottish meat processing, in 2006 and 2012

	Purchases in 2006		Purchases in 2012	
Purchases from:	£m	%share	£m	%share
Agriculture	333.2	30.3%	352.9	31.4%
Meat processing	88.8	8.1%	83.4	7.4%
Wholesalers	47.5	4.3%	47.2	4.2%
Haulage	27.0	2.5%	20.9	1.9%
Electricity	27.9	2.5%	20.8	1.9%
Employment services	9.4	0.9%	18.3	1.6%
Rubber and plastic	9.7	1.5%	14.2	2.2%
Vehicles	9.6	1.5%	8.9	1.4%
Paper	11.2	1.7%	7.8	1.2%
Gas	5.9	0.9%	6.7	1.0%
Imports RUK	325.8	29.6%	318.3	28.3%
Imports RoW	124.8	11.3%	156.8	14.0%

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp.

109. The I-O tables also allow total sector outputs to be broken down into components elements, namely inputs (excluding paid labour), wages, profit and GVA plus reliance on export markets. For agriculture, over one-quarter of output is exported directly and GVA is around 30% of total output (Table C3).[28]

The Input and GVA figures compare reasonably with those derived separately in Section II and Annex B, offering some reassurance of consistency between the two sets of estimates.

[28] This could be consistent with a high proportion of red meat animals being exported for processing, but would leave little margin for other sub-sectors' exports.

Table C3: Components of Total Output for Scottish agriculture in 2006 and 2012

	2006		2012	
	£m	%share	£m	%share
Inputs	2,051.1	70.2%	2,071.7	65.5%
Gross Value Added	816.6	28.0%	1036.6	32.8%
Total Output	2,921.4	100.0%	3,161.1	100.0%
of which exports	764.1	26.2%	838.2	26.5%

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Share of total output (excluding decoupled support payments). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp.

Table C4: Components of Total Output for Scottish meat processing, in 2006 and 2012

	2006		2012	
	£m	%share	£m	%share
Inputs	1,100.4	81.5%	1,124.1	86.1%
Gross Value Added	249.8	18.5%	181.1	13.9%
Total Output	1,349.6	100.0%	1,305.9	100.0%
of which exports	799.5	59.2%	836.3	64.0%

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Share of total output. Share of total output (excluding decoupled support payments). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp.

Table C5: Agricultural expenditure share of supply sector output and estimated GVA

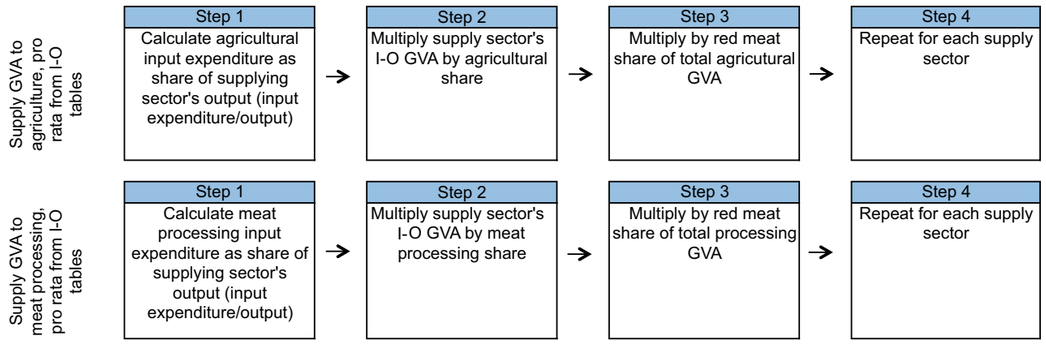
Sector	Share of output	GVA contribution	Red Meat GVA
Agriculture	9.6%	-	-
Animal feeds	34.3%	£14.0m	**£4.9m**
Chemicals	9.9%	£11.9m	**£4.9m**
Pharmaceuticals	0.9%	£8.0m	**£3.4m**
Rubber and plastic	0.9%	£4.5m	£1.6m
Cement	1.4%	£1.3m	£0.6m
Fabricated metal	0.4%	£4.9m	£2.1m
Water and sewerage	1.2%	£11.4m	£4.1m
Construction	0.2%	£16.1m	£6.9m
Vehicles	2.6%	£42.8m	£18.4m
Wholesalers	1.0%	£38.8m	**£13.9m**
Haulage	1.5%	£24.5m	**£8.8m**
Financial services	0.2%	£9.1m	£3.3m
Insurance and pensions	0.3%	£10.1m	£3.6m
Real estate	2.6%	£26.9m	£9.6m
Legal activities	3.6%	£29.3m	£10.5m
Veterinary services	13.3%	£15.9m	**£6.8m**
All other sectors	0.04%	£53.4m	£19.2m
Totals	*0.4%*	*£322.9m*	£122.6m **(£42.7m)**

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp. All-agriculture GVA estimated pro rata on basis of agriculture's share of each supply sector's output. Red Meat GVA share then estimated as proportion of all-agriculture GVA, using shares estimated previously for Table B5 using farm-type data. 'Core' parts of red meat supply chain highlighted in bold.

110. The geographical distribution of firms in different supply sectors means that not all of the employment and income associated with supplying agriculture will necessarily be local to the farms buying goods and services, or indeed even in rural areas. For example, whilst construction and veterinary services may be likely to be sourced locally, other services such as legal, financial and real estate may not be, whilst manufactured inputs (pharmaceuticals, rubber and plastic) may be purchased through local agents but will generally be produced elsewhere.

111. If share of GVA is assumed to mirror share of output, GVA arising from the different supply sectors can also be apportioned, with red meat's contribution within this then further approximated by using the shares of input expenditure estimated previously in Section II (see Figure C3). This apportionment process is crude, but the best available in the absence of more detailed information. In particular, the pro rata allocation of sectoral GVA to agriculture may be inaccurate for broad supply sector categories encompassing diverse activities or products (e.g. chemicals) and the presence of significant imported inputs means that it is possible that some estimated supplier GVA arising from red meat actually accrues outwith Scotland. For example, if imported feed is used mainly by pigs rather than poultry.

Figure C3: Method for estimating supplier GVA



112. Given that supply sectors vary in size, a small share of output in a large sector may represent an absolutely bigger level than a large share in a small sector. Hence Table C5 also lists some other sectors where agricultural expenditure is a small share of the sector's overall output, but nonetheless a sizeable contribution to GVA. For example, pharmaceuticals and rubber and plastic.

113. Table C6 presents an equivalent breakdown for meat processing. As with agriculture, apart from the obvious strong linkages to agriculture and within meat processing itself, the share of meat processoring in the output of most supply sectors is low. However, low shares still translate into meaningful GVA contributions. For example, from expenditure on vehicles and their maintenance.

Table C6: Meat processing expenditure share of supply sector output and estimated GVA

Sector	Share of output	GVA contribution	Red Meat GVA
Agriculture	11.2%	-	-
Meat processing	6.4%	-	-
Paper	0.7%	£2.4m	£1.6m
Rubber and plastic	1.0%	£5.2m	£3.5m
Fabricated metal	0.2%	£2.2m	£1.5m
Electricity	0.3%	£5.6m	£3.8m
Construction	0.03%	£2.0m	£1.3m
Wholesalers	0.3%	£4.9m	£3.3m
Vehicles	0.5%	£20.5m	£13.7m
Haulage	0.6%	£9.4m	£6.3m
Food & Beverage	0.1%	£2.8m	£1.9m
Employment services	0.7%	£12.8m	£8.6m
All other sectors	0.02%	£27.0m	£18.1m
Totals	0.2%	£94.8	£63.5

Source: SG Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). Adjusted to 2014 prices using GDP deflators at https://www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp.

114. Summing down the column of estimated GVA arising from supplying agriculture gives £323m (excluding sales within agriculture, already included in the agriculture GVA total) to add to the agricultural GVA figure of £1036m as a crude estimate of on-farm and upstream GVA.[29] The same process for supplies to red meat production suggests GVA of £123m[30] to add to the previous on-farm GVA total of £452m for a combined GVA of £575m. Of this additional £123m, around £43m is from 'core' parts of the supply chain such as animal feed suppliers, auction marts and vets.

115. Red meat may account for a higher or lower proportion of some supply sectors than estimated here. For example, within the wholesale supply category, red meat is likely to dominate auction marts' GVA. Conversely, given the regularity of milk transportation from dairy farms, red meat may account for a smaller share of haulage GVA. However, although more detailed information could be sought to refine the estimates, the magnitude of imported agricultural inputs means that their assumed utilisation will probably swamp any such refinements. For example, in the extreme, imports could displace all domestic supplies to red meat. Hence the figures presented here are offered only as broadly indicative estimates.

116. The I-O meat processing figures include poultry, which therefore needs to be deducted to get an estimate for the red meat sector. QMS estimates that red meat output from the processing sector was around £876m in 2014[31], 67% of the sector's total output in the I-O tables. Applying this adjustment to the processing sector's GVA of £181m (Table C4) suggests GVA of c.£121m. Summing down the red meat column in Table 29 suggests that a further £64m of GVA arises from Scottish suppliers to meat processing. Adding these values to the on-farm and upstream GVA estimates gives a total GVA across the whole red meat supply chain of c.£760m.

117. However, expenditure on imported inputs for meat processing is significant at around 42% (see Table C2). This means that it is misleading to attribute all meat processing output and GVA to a uniquely Scottish supply chain: a proportion of output and GVA is not supported by domestic suppliers. Indeed this phenomenon is the rationale for this study not extending to consider retail and food service activities, since they too are not necessarily reliant on domestic suppliers for their existence and value-adding activities. A pro rata deduction of 42% would imply meat processing GVA of c.£70m as an indicative value supported solely by domestic suppliers.

[29] Extending analysis to consider the effect of suppliers own input expenditure would increase this estimate (see multiplier discussion below).
[30] To avoid double-counting this excludes agriculture since inputs of livestock passing between farms are already included in the farm GVA estimates presented earlier.
[31] Scottish Red Meat Industry Profile 2015
http://www.qmscotland.co.uk/sites/default/files/red_meat_industry_profile_2015.pdf, confirmed by pers. comm. SAMW.

118. In principle, a similar adjustment could be made to on-farm GVA to account for imported agricultural inputs. For example, a pro rata deduction of 53% (see Table C1) would suggest on-farm GVA arising from using domestic supplies of only £212m. In practice, the heterogeneity of agriculture makes it difficult to justify such a simplistic pro rata approach and the absence of more detailed information precludes a more refined adjustment. The adjustment to meat processing GVA is more reasonable given the more homogenous nature of the sector, but is still crude. Consequently the unadjusted figures are retained here, with the caveat that the role of imported inputs and hence a cross-border supply chain has to be acknowledged.

119. To summarise, as shown in Figure 1, on-farm production is only part of the economic activity associated with red meat production and account has to be taken of the actions of both upstream and downstream firms in generating output and value added. Although data relating to upstream and downstream activities are not as detailed as for agriculture, they can be used together with some assumptions to generate crude estimates beyond the farmgate. Hence the on-farm output and GVA figures of £1,161m and £452m estimated in Section II increase to £2,429m and £760m respectively when the wider supply chain is included.

120. Within this, "core" parts of the supply chain most commonly identified as part of the red meat sector – feed suppliers, fertilisers and other agro-chemicals, pharmaceuticals, vets, farms, hauliers, auction marts and slaughterhouses/cutting plants – account for over 80% of the additional economic output and value. However, a proportion of economic activity arising from red meat production occurs (albeit spread thinly) across a wide range of sectors not primarily associated with the supply chain. For example, construction, packaging materials and utilities plus legal, real estate and financial services.

C7: Summary of estimated output and GVA across the red meat supply chain

	Core farm suppliers	Other farm suppliers	On-farm production	Core MP suppliers	Other MP suppliers	Meat processing	Total 'core'	Overall total
Output	**£114m**	£140m	**£1,161m**	**£22m**	£116m	**£876m**	£2151m	£2,429m
GVA	**£43m**	£80m	**£452m**	**£10m**	£54m	**£121m**	£626m	£760m

Source: derived from Tables C5 and C6. 'Core' elements in bold.

121. To summarise, information contained within I-O tables can be used to explore how output and GVA is generated by different parts of the red meat supply chain. The estimates are necessarily somewhat crude, requiring recourse to assumptions regarding how outputs and value added are distributed across broad categories of activities and domestic vs. imported inputs.

122. Nevertheless, in the absence of more detailed sectoral surveys, the estimates give an indication of the overall size of the supply chain and the relative contribution of its component parts, suggesting that overall output is around £2.4bn and GVA around £0.75bn. Within this, the 'core' supply chain accounts for around £2.1bn and £0.6bn respectively, although utilisation of imported inputs means that not all of the totals arise from a uniquely Scottish supply chain.

Annex D: More Detailed Employment Figures to Support Section IV

123. Standard Labour Requirement (SLR) coefficients offer a convenient way of approximating average labour requirements as an aid to benchmark comparisons and aggregate statistical analysis. Care has to be taken in their interpretation since they do not necessarily capture variation between different production systems or over time, but they nonetheless offer a means to overcome the allocation problems inherent in the aggregate census figures.

124. The Scottish Government (SG) currently uses SLRs based around the year 2007. Distinctions are drawn between animals of different ages, plus for sheep within and outwith the Less Favoured Area (LFA). Slightly more recent and more detailed SLR estimates are available from the Farm Business Survey (FBS) for England and Wales. Using the method shown in Figure D1, relevant coefficients are presented in Table D1 and have been applied to census data to generate the estimates shown in Table D2, assuming 1900 hours for a Full Time Equivalent (FTE) worker.[32]

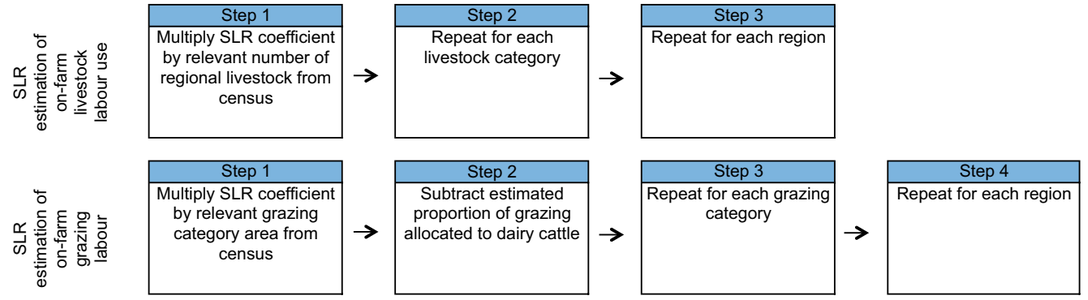


Figure D1: Method for using SLRs to estimate on-farm red meat labour usage

Table D1: Standard Labour Requirements (hours per head or ha) for beef cattle, pigs and sheep

	SG (2007)	Wilson (2009)
Beef cows	12	25.8
Other cattle	9	11.7
Sows	14	28.1
Other pigs	1.9	2.3
Piglets	0.2	0.2
Ewes	4.2 (LFA), 5.2 (nLFA)	3.7 (LFA), 5.2 (nLFA)
Other sheep	2.6 (LFA), 3.3(nLFA)	3.1 (LFA), 2.9 (nLFA)
Grass	4	4
Forage crops	6	7
Rough grazing	1.5	1.6

Source: SG Standard Output Coefficients http://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/Publications/SOCoeffs and Wilson, P. (2009) Analysis of Labour Usage Data from the Farm Business Survey from 2004/05 to 2007/08 http://www.fbspartnership.co.uk/documents/Labour%20Use%20in%20Agriculture.pdf

[32] A figure of 2200 hours is used by some analysts and would reduce figures in Table 20 by around 15%.

Table D2: SLR estimates of farm labour deployed on beef cattle, pigs and sheep, by region (2014)

	SG (2007)					Wilson (2009)				
Species	NW	NE	SE	SW	Total	NW	NE	SE	SW	Total
Beef cattle	1,132	1,171	1,631	3,081	7,615	1,922	2,828	2,705	4,995	12,450
Pigs	28	256	124	22	430	49	464	238	42	793
Sheep	2,770	1,256	4,031	5,013	13,070	2,543	1,100	3,642	4,656	11,941
Sub-total	3,929	3,283	5,786	8,116	21,114	4,514	4,391	6,584	9,693	25,182
Grass etc.	2,211	606	1,067	1,183	5,066	2,323	624	1,098	1,283	5,328
Total	6,140	3,889	6,853	9,299	26,180	6,837	5,015	7,682	10,976	30,510
Paid	1,167	1,244	1,302	3,441	7,154	1,299	1,605	1,460	4,061	8,425

Source: derived from pers. comm. Scottish Government and SLR coefficients.

125. Wilson's SLR coefficients are generally higher than the SG coefficients, generating an higher overall estimate of c.25,000 FTEs for livestock against the SG-SLR-based estimate of c.21,000, although sheep account for less labour usage. For comparison, the estimated total SG SLR-derived workforce for all of Scottish agriculture is reported as 46,700[33] – implying that around 45% of on-farm labour usage is devoted to animals for the red meat sector. The equivalent proportion using Wilson's coefficients is similar (c.25,000 of c.55,000).

126. In addition, labour deployed in producing grass and fodder crops for red meat livestock also needs to be accounted for. In 2014, the national totals for temporary and permanent grassland, rough grazing and fodder crops were 1.3m, 3.6m and 17k ha respectively. Of these, around 0.3m ha of grassland, 75k ha of rough grazing and 8k ha of fodder crops are on dairy holdings (mostly in the South West)[34], implying around 1m ha of grassland, 3.5m ha of rough grazing and 9k ha of fodder crops are primarily supporting beef cattle and sheep. Applying the SLR coefficients translates these into approximately a further 5,000 to 5,300 labour units to add to those estimated for the livestock themselves, raising the red meat sector's share of on-farm labour usage to around 55%. Of these totals, the majority will be unpaid family labour – hired labour is approximately 9,000 (SG) to 12,000 (Wilson) of the total.

127. None of the figures in Table D2 should be regarded as definitive, being based on slightly dated and/or not Scottish-specific coefficients. Moreover, given the heterogeneity of herd/flock sizes and farming systems across Scotland, applying the average SLRs[35] presented in Table D1 is a simplification that will inevitably over-estimate labour usage on some farms and under-estimate it on others. Nevertheless, the use of SLRs is sufficient to give an indication of the magnitude of on-farm labour usage within the red meat supply chain. The lower estimates based on the SG SLRs are used hereafter.

[33] SG ERSA 7.3 http://www.gov.scot/Publications/2015/06/8844/58
[34] Pers. comm. SG.
[35] Wilson (2009) provides a range of values relating to different farm-types and sizes e.g. labour use per animal is higher on smaller herds/flocks. Given the concentration of overall numbers in larger herds/flocks, adoption of size-varying coefficients would reduce estimates of overall labour usage but not necessarily the relative importance of livestock. Variation in productive efficiency will be discussed further later.

128. SLRs convey no information on the gender split for farm employment, so reported workforce figures have to be used. Unfortunately, the data are incomplete and a degree of extrapolation is required. Table D3 summarises estimates calculated by the Scottish Government, highlighting that the majority of FTEs are accounted for my men but that women represent around 32% of the total agricultural workforce. For specialist sheep farms, this rises to 35% but is lower at 30% for cattle farms and lower still at 27% for specialist pigs farms.

Table D3: Estimated gender split of agricultural workforce (FTEs)

Farm-type	Males	Females	Total	Males	Females	Total
	Hd	Hd	Number	%	%	%
Cereal	2,705	894	3,599	75.2%	24.8%	100.0%
General cropping	1,243	396	1,639	75.8%	24.2%	100.0%
Specialist horticulture	3,102	2,031	5,133	60.4%	39.6%	100.0%
Specialist pigs	384	141	525	73.1%	26.9%	100.0%
Specialist poultry	1,130	465	1,595	70.8%	29.2%	100.0%
Dairy	2,501	789	3,290	76.0%	24.0%	100.0%
Specialist sheep (LFA)	7,507	3,966	11,473	65.4%	34.6%	100.0%
Specialist cattle (LFA)	7,028	2,970	9,998	70.3%	29.7%	100.0%
Sheep and cattle (LFA)	2,762	1,231	3,993	69.2%	30.8%	100.0%
Lowland cattle and sheep	2,637	1,269	3,906	67.5%	32.5%	100.0%
Mixed	5,254	3,024	8,278	63.5%	36.5%	100.0%
Forage	7,847	3,423	11,270	69.6%	30.4%	100.0%
Unclassified	437	222	659	66.3%	33.7%	100.0%
All	44,537	20,821	65,358	68.1%	31.9%	100.0%

Source: pers. comm. Scottish Government. Where gender of occupier or spouse is unknown. Gender has been assigned based on known gender of other occupiers and spouses.

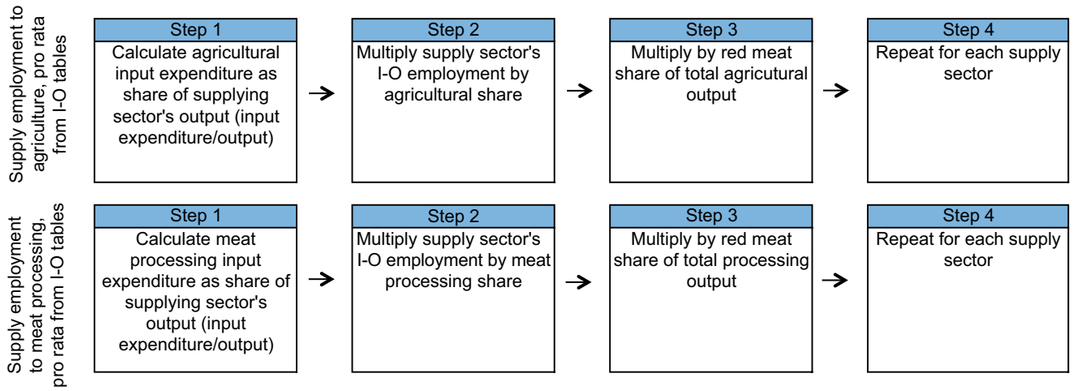
129. Beyond the farm level, labour will also be deployed on a range of activities throughout the wider red meat supply chain. For example, upstream in the manufacture of inputs such as animal feed, pharmaceuticals and chemicals plus in advisory, haulage and veterinary services. Equally, downstream usage of farm outputs will create employment, most notably in the meat processing sector.

130. Unfortunately, specific data on employment across the wider supply chain are not readily available. First, not all firms engaged in the red meat supply chain will be engaged exclusively in it but will also be members of other supply chains. For example, veterinary surgeries may also serve other large (e.g. horse, dairy cattle) or small (e.g. pets) animals, auction marts and haulage operators may handle non-agricultural goods. More significantly, manufacturers of pharmaceuticals, chemicals and machinery will serve multiple markets. Hence, as with farms, not all recorded employment can be attributed to red meat production.

131. Second, as noted previously, whereas farms are identified explicitly as a unique category of firm, other types of firm likely to be engaged in the red meat supply chain are often reported alongside other firms in broader SIC categories within the I-O tables, making it difficult to separate them from unrelated supply chains.

132. Consequently, as with estimating GVA contributions, some further assumptions and/or recourse to informal rather than official data sources are required to establish a crude indication of employment associated with the red meat supply chain. Hence, as before, agriculture and meat processing shares of employment within an I-O supply sector are simply estimated pro rata according to output share (Figure D2). This effectively assumes that the ratio between output and jobs in a given supply sector is constant regardless of where output is sold to. The red meat share is then estimated in the same manner as the GVA share, as for Tables C5 and C6.

Figure D2: Method for estimating supplier employment



133. Overall employment in sectors supplying agriculture is estimated at around 6,000 by this method, with red meat's share being almost 2,400 (Table D4). Within this, 'core' supply chain partners such as vets, haulage firms and auction marts feature prominently, but (as with the GVA estimates) so do other supply sectors - most notably vehicles and construction, but also labour intensive services provided by legal, real estate and financial firms.

Table D4: Estimated employment in supply sectors arising from supporting agriculture

Supply sector	All agriculture	Red Meat
Wholesale and retail – vehicles	1,006	433
Wholesale	722	**260**
Legal activities	658	237
Veterinary services	752	**316**
Haulage	583	**210**
Real estate	383	138
Construction	317	136
Animal feeds	291	**102**
Chemicals	117	**49**
Financial services	107	39
Fabricated metal	83	36
Rubber and plastic	80	29
Pharmaceuticals	27	**11**
All others	1,112	400
Totals	6,035	2,396

Source: derived from pers. comm. SG and Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl). 'core' supply chain in bold.

134. The absence of detailed official employment statistics for sub-sectors makes it difficult to gauge the robustness of these estimates. However, industry figures[36] for employment in livestock haulage suggest 150 to 270 jobs and livestock mart employment of 200 to 260 jobs, both of which are reasonably close. By contrast, industry figures for livestock veterinary employment suggest around 1,000 jobs in agriculture, which (allowing for dairy and poultry) suggests around 500 for red meat species, significantly higher than estimated here.

135. Adjusting I-O figures for poultry output implies red meat processing employs around 4,430 people. This is significantly higher than the industry estimates of 2,700, although the discrepancy may arise in relation to secondary processing (i.e. cutting plants rather than abattoirs) and/or because the IO Tables do not yet reflect closure of facilities at Broxburn. As with GVA estimates, the utilisation of imported inputs means that not all of these jobs are uniquely attributable to the domestic supply chain – deducting 42% for imports would suggest 2,570 rather than 4,430 jobs.

136. Applying the GVA shares from Table C6 for supplies to meat processing generates the estimates presented in Table D5 for further employment in sectors supplying meat processing.

Table D5: Estimated employment in supply sectors arising from supporting meat processing

Supply sector	All meat processing	Red Meat
Employment services	454	304
Wholesale	381	256
Haulage	224	150
Vehicles	116	77
Food and beverage	99	67
Rubber and plastic	92	61
Construction	40	27
Fabricated metal	37	25
Paper and paper products	36	24
All others	448	300
Totals	1,927	1,291

Source: derived from pers. comm. SG and Industry by Industry Table, http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2012lxl

137. Table D6 combines the various employment estimates. The first row uses SLR-estimates for on-farm employment and I-O estimates for all other parts of the supply chain. The second row uses industry estimates to replace I-O estimates for veterinary services, marts and meat processing. Hence total employment associated with red meat production is estimated at approximately 32,500 to 34,000.

Table D6: Summary of estimated employment across the red meat supply chain

Method	Core farm suppliers	Other farm suppliers	On-farm production	Core MP suppliers	Other MP suppliers	Meat processing	Total 'core'	Overall total
SLR/IO	**948**	1,448	**26,180**	**406**	885	**4,430**	**31,964**	34,297
SLR/IO+	**1,121**	1,448	**261,80**	**406**	885	**2,700**	**30,407**	32,740

Source: derived from Tables D2, D3 & D4

[36] Pers. comm. Acoura, RHA, IAAS, RCVS.
[37] QMS cottish Red Meat Industry Profile 2015 http://www.qmscotland.co.uk/sites/default/files/red_meat_industry_profile_2015.pdf

Annex E: Multiplier Analysis as an Alternative Estimation Method

138. Although preceding sections have presented estimates of the economic contribution of the red meat supply chain drawing on information within the I-O tables, an alternative, more formalised approach is offered by the application of I-O multipliers. Due to linkages along supply chains and the circular flow of income, the effect of a change (increase or decrease) at one point in the chain is multiplied across the wider system.[38]

139. For example, the direct impact of livestock production on output, employment and incomes occurs on farms. However, expenditure on inputs used on farm passes to upstream suppliers, indirectly creating output, value added, income and employment elsewhere. For example, backward linkages to firms providing animal feed, fertilisers and veterinary services to farms. Forward linkages to downstream firms, notably meat processors, also exist. In addition, income to employees and investors across the supply chain ultimately flows beyond the supply chain to induce further economic activity as households consume goods and services across the wider economy. For example, farmers, hauliers and veterinarians buy clothes, furniture and TV subscriptions. Multipliers are coefficients expressing the strength of these linkages.

140. Multipliers can be estimated for a variety of different measures of economic activity, including output, income, value added and employment. Most commonly, they are estimated as responses to a change in final demand for goods and services (e.g. if a recession dampens household expenditure on meat) but they can also be estimated for a change in an activity's output level (e.g. if a disease outbreak reduces livestock numbers). The precise interpretation of multiplier values varies across these different formulations. Although multipliers can be estimated for both backward and forward linkages, adding them together risks double-counting and is seldom practised.

141. In addition, multipliers can be estimated in a variety of ways that differ in their underlying assumptions, modelling sophistication and data requirements. For example, they can be derived from 'open' (Type I) models which ignore household expenditure and focus purely on (direct and indirect) production linkages, or from "closed" or "endogenous" (Type II) models which include households and hence account also for (induced) consumption linkages as income (e.g. wages) is spent on goods and services in the wider economy. "Closed" models can be extended to form a 'Social Accounting Model" (SAM) which also considers the distribution of income across different for example, households and their varying propensity to spend on different goods and services. Again, the precise interpretation of multiplier values needs to be with reference to how they were estimated.

142. Type I and Type II (backward) multipliers are published by the Scottish Government as part of its annual I-O analysis and serve as a starting point for considering linkages between agriculture and the wider economy. For example, the most recently (2012) calculated Type I and II output multipliers for all of agriculture are 1.4 and 1.6 respectively. These are interpreted as meaning that a £1m change in the demand for agricultural output would lead to a further £0.4m change in upstream industries and another £0.2m elsewhere in the economy. At the extreme, this implies that the c.£3bn output of Scottish agriculture generates a further £1.8bn of output throughout the economy.

143. Similarly, the Type I and II GVA multipliers are 1.6 and 1.8, implying that the c.£1bn of agricultural GVA generates a further £0.6bn in upstream industries plus a further £0.2bn throughout the wider economy (out of a total Scottish GVA of c.£120bn).

144. Applying the all-agriculture multipliers to on-farm output (£1,161m) and GVA (£452m) levels estimated for red meat in previous sections, would suggest an additional output effect of almost £700m and additional GVA of £361m, similar to estimates presented in Table 30.

145. However, different agricultural activities use different technologies and can be embedded in different supply chains, meaning that the way inputs are sourced and combined varies across different sub-sectors of agriculture. For example, some inputs such as animal feeds and veterinary services are solely for livestock production, which is often relatively labour-intensive. Consequently, aggregate multiplier values for all of agriculture may not adequately represent the detail of sub-sectors such as red meat production. Moreover, regional differences in farming systems and supply chains mean that national-level multipliers may not be appropriate at a regional level.

146. The need to disaggregate agriculture within I-O tables has long been recognised and various attempts to do so have been made. Beyond noting various conceptual and empirical problems[39] with I-O analysis, past (e.g. Midmore, 1993) and more recent (e.g. Lindberg, 2011) reviews of such studies highlight two main points.

147. First, that multiplier values do indeed vary across different sub-sectors to reflect how inputs are combined. For example, intensive systems more reliant on supplementary animal feed (e.g. pig production) have stronger upstream linkages than extensive systems (e.g. sheep production). Hence inferences drawn from aggregate multipliers will be misleading. Second, however, multiplier values also vary spatially to reflect geographical variation both in local production systems and also in local supply chains. For example, there are production differences between upland and lowland livestock systems but also in the availability of and relationships with local input suppliers in different areas so care has to be taken in transferring multiplier values between different locations.

148. Unfortunately, formal disaggregation of I-O tables is a time consuming and data-hungry task beyond the scope of this project. Consequently, multiplier estimates from previous studies are used cautiously here to suggest plausible ranges applicable to Scotland. Table E1 summarises reported output and employment multipliers presented in selected previous studies.

Table E1: Indicative multiplier values from previous international studies

	Output		Employment	
Sector	Type I	Type II	Type I	Type II
Cattle	1.2 to 2.4	1.4 to 2.8	-	2.8 to 3.3
Pigs	1.5 to 2.3	1.9 to 2.7	1.5 to 2.7	1.9 to 3.0
Sheep	1.4 to 1.9	1.6 to 2.6	-	1.6 to 1.9

Sources: John & Leat, (1988); Leat & Chalmers (1991); Midmore (1991 & 1993); Moxey et al. (2008); Jones (2009); Léon & Surry (2009); Lindberg (2011); Renwick (2013).

149. In each case, there is some variation in the estimates presented. This partly reflects methodological differences between studies but also that even specific commodities can be produced in different ways. For example, beef cattle reared under a predominantly grazing system use less purchased animal feed than more intensively managed cattle and will accordingly have a lower output multiplier. Equally, a small region is less likely to host all components of the upstream supply chain and hence inputs may be imported, lowering local multiplier effects.

150. The most recent Scottish-specific estimates of disaggregated agricultural multipliers are presented by Lloyd (2003), Schwarz et al. (2006) and Moxey et al. (2008). The latter consider only pig production, suggesting Type II multipliers of 2.2 for output and 2.3 for employment. Schwarz et al (2006) consider only LFA farms, suggesting a Type II output multiplier of 1.7 for cattle and sheep. By contrast, Lloyd offers more detailed figures broken down by region as well as activity, summarised in Table E1.

Table E2: Estimated regional red meat output and employment multipliers

	NW		NE		SE		SW	
Output	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Beef	1.57	2.07	1.57	2.28	1.58	2.32	1.60	2.37
Pigs	1.43	1.63	1.42	1.70	1.41	1.71	1.43	1.74
Sheep	1.27	1.71	1.26	1.88	1.31	1.89	1.34	1.89
Employment	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Beef	2.79	4.08	1.79	2.63	1.41	1.84	2.63	4.43
Pigs	2.21	2.73	1.56	1.90	1.34	1.51	2.08	2.79
Sheep	1.83	2.96	1.36	2.09	1.22	1.56	1.93	3.20

Source: Lloyd (2003).

[38] Midmore (1991 & 1993) and Midmore & Harrison-Mayfield (1996) provide helpful overviews of I-O and multiplier analysis in an agricultural or rural context. See also Doyle et al. (1997), Lindberg & Hansson (2009), Papadas & Dahl (1999), Rabinowicz (1982), Roberts (1994, 1995, 2000).

[39] For example, I-O analysis assumes constant returns to scale of linear technologies with no substitution possibilities between inputs and combining backward and forward linkages is awkward. Equally, the level of detail required is often absent from available data, forcing recourse to ad hoc and mechanistic adjustments.

151. Although slightly dated, Lloyd's multiplier values are the most detailed and comprehensive currently available for Scottish agriculture. In general, with the exception of some of the employment coefficients, the values lie within the range suggested in Table E2 and are thus considered appropriate for use here.

In the absence of specific estimates, GVA multiplier values are approximated here by using the output multiplier estimates. Applying the multiplier values in Table E2 to the regional output, GVA and employment figures presented in Tables 3 and 10 generates the results shown in Table E3.

Table E3: Estimated additional output (£m), GVA (£m) and employment (k) from multiplier effects

	NW		NE		SE		SW		Scotland	
Output	T I	T II	T I	T II	T I	T II	T I	T II	T I	T II
Output	115	230	130	287	146	341	200	464	592	1321
Labour 1	4,359	8,964	1,521	3,508	1,598	3,691	9,708	21,636	17,185	37,799
Labour 2	828	1,703	487	1,123	304	701	3,592	8,005	5,210	11,532
GVA	18	37	47	104	76	179	91	211	232	531

Source: derived from combining Tables 20, 23, 30 and 32.

152. The output and GVA totals are of the same order of magnitude as those presented previously in Section III, with the advantage of a regional breakdown[40] but lacking the distribution across the supply chain.

153. Two employment estimates are offered, one using total estimated on-farm employment as the base to be multiplied, the other restricted to paid labour only. The representation of unpaid family labour (indeed self-employment more generally) in I-O tables and in the derivation of employment multipliers is somewhat unclear. If multipliers have been calculated using only paid labour rather than total on-farm employment, their application to total on-farm labour will result in exaggerated employment estimates elsewhere. Certainly, the first row of employment estimates is high relative to those in Table D5 but conversely adding unpaid labour back into the second row yields a lower figure of c.28000 – meaning that the two multiplier results straddle the previous estimates of c.32,000 to c.34,000.

154. To summarise, multiplier analysis offers a more formal means of using I-O information to estimate economic linkages between different sectors. In principle, more accurate mathematical representation of relationships – including further sales beyond the first round - should yield better results. In practice, problems of dis/aggregation remain and the additional data requirements are onerous. Moreover, the precise methods (and assumptions) by which multipliers are calculated are not easy to discern. Nevertheless, for the purposes of this study, existing (if slightly dated) agricultural-specific multipliers for the Scottish regions were used to estimate output, GVA and employment associated with red meat production. The results are of the same order of magnitude as those generated by the less formal approach presented in earlier Sections.

155. In addition, a previous study of the economic contribution of red meat undertaken on behalf of QMS a decade ago also used multipliers (Doyle, 2003). Although the results differ from the current estimates, they are broadly comparable at the aggregate level. For example (excluding retail), GVA was estimated at around £1bn and employment at around 30000. The differences are likely to reflect variation in methodological assumptions (including the use of earlier I-O tables) but also genuine changes across the supply chain as markets and technologies have evolved.

[40] Although the under-estimate of output in the NW noted previously will also affect the regional values here

Source Material for Annex E

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Annex F: More Detailed Improvement Figures to Support Section VI.

156. Although the estimates presented above are subject to various caveats regarding their underpinning data and assumptions, they are sufficient to indicate the size and profile of the red meat supply chain(s) in Scotland. This portrayal also prompts consideration of how the overall contribution could be increased through improving economic performance across the supply chains.

157. This Annex considers three main ways in which Scottish red meat supply chains could improve their economic contribution. First, retaining more Scottish livestock within the domestic supply chain. Second, increasing the technical and marketing efficiency of individual links in the chain, most notably on-farm production. Third, improving co-ordination across the chain through better sharing of information and/or collaboration. Ways to enhance environmental and social contributions are also discussed briefly (see also Annex G).

Retaining more livestock in Scotland

158. Industry commentators, livestock movement data, I-O analysis and various ad hoc survey exercises all indicate that a proportion of finished Scottish livestock are slaughtered outwith Scotland. In addition, other Scottish animals move across the border to farms and marts and are presumed to eventually also be slaughtered outwith Scotland (Table F1). For example, the number of Scottish-born cattle slaughtered in England and Wales in 2015 was greater than the number of Scottish animals moved directly to slaughter there in 2015. These movements of live animals to other countries potentially represent missed opportunities (i.e. finishing, slaughtering) for retaining further value-added and employment within Scottish supply chains.

Table F1: Approximate numbers of Scottish red meat animals moving (2015)

	Moving to England and Wales		Within Scotland
	To Slaughter	To Other	To Slaughter
Cattle	37,000	60,000	411,000
Pigs	181,000	335,000	296,000
Sheep	889,000	779,000	1,342,000

Source: QMS data. Other includes farms, marts and collection centres.

159. Crudely, if all Scottish animals moving directly from Scotland to slaughter in England and Wales were retained for slaughter in Scotland, throughput at Scottish abattoirs would increase by around 9% for cattle, 61% for pigs and 66% for sheep. If all animals moving outwith Scotland were retained, the increases would be 24%, 174% and 124% respectively. In either case, the step-change in domestic abattoir throughput would be significant.

160. However, increasing domestic throughput to this extent may pose some practical challenges. First, any contractual arrangements between Scottish producers and non-Scottish processors will have to be unwound and replaced by equivalent arrangements with Scottish processors. This may not be difficult in all cases, but there may be some instances where Scottish processors do not have access to certain markets and are unable to offer sufficiently attractive terms to producers. It is also possible that some processors may be constrained by contractual commitments to existing customers that preclude expanding to supply other customers.

161. Second, Scottish processors will need to have sufficient spare capacity to accommodate additional throughput. Information about individual abattoir capacities is commercially sensitive and it is therefore not possible to determine categorically whether additional throughput could be accommodated. Although domestic volumes have been higher in the recent past, such that there is likely to be some headroom (including use of extra shifts), the magnitude of changes would almost certainly exceed any current spare capacity and necessitate additional investment. Moreover, much may depend on the timing of additional throughput since there are times of year (e.g. Christmas) where there may be limited capacity for further activity, not necessarily because of line capacity but because of cold storage capacity. The seasonality of sheep production is particularly problematic since achieving sufficient throughput capacity to handle peak season flows would inevitably lead to significant over-capacity at other times.

162. Given a lack of species-specific data on processing GVA and employment, it is difficult to accurately estimate the potential gains arising from greater domestic throughputs. However, the I-O tables imply that the ratio of processing output to processing GVA is between 7:1 and 5:1 (see Appendix C). Although these are crude estimates that take no account of possible differences between the three species nor of changes to ratios as output varies (i.e. economies of scale), they are sufficient to indicate the likely upper-bound magnitude of GVA gains that might be associated with retaining more Scottish livestock. For example, an increase in processing output of £10m might add between £1.4m to £2.0m of GVA.

163. If all of the c.37k of Scottish cattle slaughtered out-with Scotland were retained domestically, this would represent a c.£55m increase in throughput, equating pro rata to perhaps £8m to £12m of additional GVA. For sheep and pigs, the equivalent figures are c.£80m and £30m of output, £12m to £18m and £5m to £6m of GVA respectively. Table F2 extends this to consider all livestock currently moved out-with Scotland, and also the possible pro rata implications for job gains.

Table F2: Estimated GVA and employment gains from retaining more livestock in Scotland

	Direct to slaughter cross-border moves			Other cross-border moves		
	Output	GVA	Jobs	Output	GVA	Jobs
Cattle	£55m	£8m - £12m	179	£89m	£13m - £19m	290
Pigs	£30m	£5m - £6m	98	£56m	£9m - £11m	181
Sheep	£80m	£12m - £18m	262	£70m	£11m - £16m	230
Total	£165m	£25m - £36m	539	£215m	£33m - £46m	

164. If only the direct to slaughter moves are considered, a collective GVA gain of £25m to £36m across the three species would represent around 5% of the current core GVA; inclusion of all other moves more than doubles this. Given the challenges to absorbing all of the current movements, these upper-bound gains are unlikely to be fully realised. Nevertheless, repatriating only a proportion should be feasible and could still deliver meaningful gains. For example, retaining half of direct to slaughter moves would add over 2% to core GVA.

165. The number of animals involved is absolutely smallest for cattle, probably reflecting the price premium associated with the Scotch Beef PGI brand offering an incentive to stay within the domestic supply chain. Scottish cattle moving elsewhere for finishing and/or slaughter may already not be eligible for Scotch labelling and/or be of poorer quality (i.e. otherwise producers would presumably use local abattoirs to benefit from the Scotch premium), meaning that the value-added lost to Scotland on such animals may be relatively modest.

166. Conversely, it is possible that some beef producers are "exporting"[41] higher-value animals into non-Scotch brands operated by, for example, some retailers. The reverse is certainly true, with a limited number of non-Scottish live animals moving to slaughter in Scotland under specific arrangements with some retailers (i.e. the beef is subject to different Quality Assurance processes and is marketed under a non-Scotch brand). In both cases, the associated GVA may be relatively high per animal – with some being lost on Scottish cattle moving elsewhere but also some gained on cattle moving into Scotland.

[41] Albeit mainly only to other parts of the UK; live exports from the UK are extremely limited.

167. Until 2013, processing of Scottish pigs was dominated by an abattoir in Broxburn with only a minority of production being handled by other Scottish plants or non-Scottish plants. Over-reliance on one processor was identified as a risk and attempts were already being made to broaden the processing base, but closure of the plant exposed the sector to a lack of domestic capacity. As a consequence, a high proportion of Scottish pigs have been processed outwith Scotland in recent years.

168. However, following a change of ownership, a processing facility in Brechin has been upgraded and expanded. As a result, it is anticipated that the bulk of Scottish pig production will once again be processed in Scotland. Although it will take time to achieve its target capacity, the ambition is effectively to repatriate around the c.180k finished pigs currently slaughtered in England.

Technical and marketing efficiency

170. Information on the performance of Scottish beef and sheep producers is routinely collected in Scotland through the FAS and for QMS enterprise studies. Information on pig production is not collected, but some comparable data are available for England from the Farm Business Survey. Benchmark data are also available in, for example, the SAC Farm Management Handbook. All of these sources confirm industry perspectives that considerable variation exists across farms, as summarised in Tables F3 to F10.

169. Of the three species, by far the highest number of movements outwith Scotland are accounted for by sheep. Some exports, particularly light lambs, are essentially to niche markets to which Scottish processors have limited access. However, the bulk of exports arise from the extreme seasonality of on-farm production. This seasonality is the major impediment to increasing domestic throughput, since ensuring sufficient capacity at peak times would inevitably mean idle capacity at other times. This suggests a need for consideration of alternative strategies, such as extending the production season alongside possible investments in additional capacity.

171. For example, the gross margin gap between the bottom third of hill suckler enterprises and the average hill suckler herd was estimated to be around £134 per cow in 2014 by QMS, with the net margin gap being around £117. The gross margin gap between the bottom and top herds was £266; between average and top herds it was £132.

Table F3: Quartile margin gaps for beef enterprises (£ per cow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Hill suckler	Gross margin	£134	£266	£132
	Net margin	£117	£227	£110
Extensive upland suckler	Gross margin	£95	£204	£109
	Net margin	£69	£200	£131
Upland suckler	Gross margin	£107	£274	£167
	Net margin	£100	£314	£213
Lowground suckler	Gross margin	£132	£304	£173
	Net margin	£147	£295	£149
Rearer-finisher	Gross margin	£114	£276	£162
	Net margin	£76	£275	£200

Source: derived from QMS (2015) Cattle and Sheep Profitability in Scotland 2015 edition.

Table F4: Quartile margin and Output/input gaps for beef enterprises (£ per cow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Upland suckler	Gross margin	£542	£266	£276
	Output/input	0.6	1.2	0.6
Lowland suckler	Gross margin	£218	£441	£223
	Output/input	0.4	0.8	0.4
Mixed	Gross margin	£206	£433	£227
	Output/input	0.6	1.4	0.8
Finishing	Gross margin	£228	£445	£217
	Output/input	0.6	1.3	0.7

Source: derived from RESAS (2015) Scottish Farm Enterprise Performance Analysis

172. Estimates from the Farm Accounts Survey suggest wider performance gaps, possibly reflecting different calculation methodologies and/or samples. The FAS results also contain estimated output/input ratios as an alternative indicator of performance gaps. Again, there is clear variation across the quartiles. For example, top upland suckler herds have a ratio of outputs to inputs that is 1.2 better than the bottom herds.

173. Variation in performance is attributable to a variety of causes, as highlighted in numerous research reports and on-going demonstration activities. For example, monitor farms and the "Top Quartile Project" run by QMS. Table F5 highlights two main factors – the yield of calf weight ultimately achieved per cow and the weight of concentrates fed to cows.

174. The higher calf weights achieved by top performers reflect higher calving/weaning percentages (lower mortality) plus faster live-weight gains, both of which can be managed through attention to animal heath and nutrition. Equally, attention to feed costs (including concentrates, but also pasture management) influences financial returns, with higher performance often (but not always) associated with lower reliance on concentrates.

Table F5: Quartile calf yield and concentrate usage gaps for beef enterprises (kg per cow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Hill suckler	Yield	5	14	9
	Concentrates	-88	-188	-100
Extensive upland suckler	Yield	19	43	24
	Concentrates	-131	-211	-80
Upland suckler	Yield	35	62	27
	Concentrates	11	56	45
Lowground suckler	Yield	41	114	73
	Concentrates	-105	45	150
Rearer-finisher	Yield	86	49	37
	Concentrates	-93	-428	-335

Source: derived from QMS (2015) Cattle & Sheep Profitability in Scotland 2015 edition.

175. All figures presented are indicative, but those for pigs particularly so due to their reliance on data for England and the volatile nature of pig markets. For example, sensitivity to feed costs and cyclical output prices on international markets (currently distorted by Russian trade sanctions).

Table F6: Quartile margin gaps for pig enterprises (£ per sow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Indoor breeder-finishers	Gross margin	£81	£172	£91
	Net margin	£8	£17	£9

Source: derived from FBS and ADHB data

Table F7: Quartile pig yield and feed usage gaps for pig enterprises (per sow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Indoor breeder-finishers	Pigs per sow	2.8	5.5	2.7
	Feed per sow	20kg	60kg	40kg

Source: derived from FBS, ADHB and AgriSoft data

176. Given the overall dominance of feed costs, the primary driver of pig productivity is efficiency of feed use. This is partially determined by careful management of feed rations, not only in terms of the cost of ingredients but also, for example, the energy balance and the efficiency of feed conversion into meat. This can be maximised by using commercial breeds bred specifically for efficient feed conversion and monitoring growth rates (e.g. feed conversion rates decline with age, so the value of finishing older heavier pigs may be less than selling younger lighter ones). For indoor pigs, heating and lighting can also be manipulated to enhance growth rates.

177. However, variations in feed conversion ratios and therefore overall productivity are also attributable to differences in the number of piglets per sow (i.e. piglets per litter, litters per year) and proportion of animals actually finished for slaughter. These have improved in recent years in Scotland (e.g. piglets per sow has risen from low to high 20s) but variation still exists across producers and relative to overseas competitors. Further improvements will require continued attention to animal nutrition and, crucially, animal health and welfare: higher herd health is closely associated with higher overall productivity. Although increasing litter sizes may incur some additional costs (e.g. added labour, more nursing sows), higher output per sow boosts productivity.

178. Sheep enterprise performance exhibits a similar pattern to that of beef cattle, as summarised in Tables F8 to F10. Again, there is considerable variation across the quartiles and higher performance is associated with more output per ewe and better control of feed costs.

Table F8: Quartile margin gaps for sheep enterprises (per ewe), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Hill ewes	Gross margin	£15	£33	£18
	Net margin	£5	£25	£19
Upland ewes	Gross margin	£14	£30	£17
	Net margin	£18	£30	£13

Source: derived from QMS (2015) Cattle & Sheep Profitability in Scotland 2015 edition.

Table F9: Quartile margin and Output/input ratio gaps for sheep enterprises (£ per cow), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Extensive hill	Gross margin	21	45	24
	Output/input	0.6	1.5	0.9
Finished/store	Gross margin	37	73	36
	Output/input	0.6	1.1	0.5
Lowland	Gross margin	61	106	45
	Output/input	0.6	1.6	1.0

Source: derived from RESAS (2015) Scottish Farm Enterprise Performance Analysis

Table F10: Quartile lamb yield and concentrate usage gaps for sheep enterprises (kg per ewe), 2014

Farming system	Measure	Bottom Third to Average	Bottom Third to Top Third	Average to Top Third
Hill ewes	Yield	3	8	5
	Concentrates	-9	-15	-6
Upland ewes	Yield	2	6	5
	Concentrates	-3	0	3

Source: derived from QMS (2015) Cattle & Sheep Profitability in Scotland 2015 edition.

179. The gross margin gaps described above are indicative of the scope for improvement in performance at the farm level. Moreover, although the distribution of performance across individual farms is not known, the aggregate impact on sectoral GVA[42] of closing the performance gap can be estimated by simplistically multiplying the gap by a proportion of breeding animals (from Table 1, the beef breeding herd is 436,526; the pig breeding herd is 30,228; and the ewe breeding flock is 2,604,185).

180. For example, raising 10% of the beef breeding herd by £100/cow would add around £4.4m to GVA, equivalent to perhaps 1% of on-farm red meat GVA. Table F11 presents some other illustrative calculations, using the variation in Tables F3, F6 and F8 as guides to the type of improvement possible. Realisation of potential gains could result not only from individual enterprises improving their performance, but also from structural change – from lower performers exiting the sector and higher performers expanding.

Table F11: Illustrative GVA gains potentially achievable through improving enterprise gross margins

	GM/hd gain	Share of national herd/flock improved		
		10%	25%	33%
Cows	£50	£2.2m	£5.5m	£7.3m
	£100	£4.4m	£10.9m	£14.6m
	£150	£6.5m	£16.4m	£21.8m
Sows	£50	£0.2m	£0.4m	£0.5m
	£100	£0.3m	£0.8m	£1.0m
	£150	£0.5m	£1.1m	£1.5m
Ewes	£10	£2.6m	£6.5m	£8.7m
	£20	£5.2m	£13.0m	£17.4m
	£30	£7.8m	£19.5m	£26.1m

[42] Strictly, Gross margins and Gross Value Added are calculated slightly differently. However, they are sufficiently similar to be used for illustrative purposes here – to give a crude "ballpark" estimate of potential GVA gains.

181. Another potential source of margin gains lies in improving the proportion of carcases meeting abattoir specifications, as described using the EUROP grid structure. Failing to meet a target specification results in price penalties, reflecting the cost of extra processing and/or lower value to final customers. For example, there is limited demand for lighter lambs whilst overly fat carcases either have to be trimmed more and/or sold at a lower price. Penalties may also be charged on over-weight animals or dirty animals.

182. Specification is a combination of conformation and fatness. The former is largely determined by genetics and hence can be managed through breed and sire selection. By contrast, fatness is determined by nutrition and age such that it can be controlled through, for, example, routine weighing of animals to determine feed intakes, drug dosages and time of sending to slaughter.

183. Individual abattoirs set their own price grids which vary throughout the year. Moreover, accurate data on the proportion of Scottish animals meeting particular grid specifications is unavailable. Nonetheless, it is possible to use GB-level figures and indicative average price penalties to explore the magnitude of potential gains from increasing the proportion of carcases meeting higher specifications (see Tables F12 and F13). Table F12: Indicative demand for and supply of different beef carcase grades at GB abattoirs, with average percentage price differentials.

Table F12: Indicative demand for and supply of different beef carcase grades at GB abattoirs, with average percentage price differentials

			→ Increasing fatness →							
			1	2	3	4L	4H	5L	5H	
		Description	Very lean	Lean	Optimum	Acceptable	Over	Fat	Very fat	
→ Improving conformation →	E	Excellent	Med/Low <0.1% N/A	Medium 0.3% N/A	High 0.4% N/A	High 0.2% N/A	Medium 0.1% N/A	Low <0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	U+	Very good	Med/Low 0.1% N/A	Medium 0.9% N/A	High 2.1% 0.8%	High 1.6% 0.8%	Medium 0.2% 0.5%	Low <0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	-U	Good	Med/Low 0.1% N/A	Medium 1.5% N/A	High 5.9% 1.9%	High 7.9% 2.15	Medium 2.1% 1.2%	Low 0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	R	Avg	Low 0.1% N/A	Medium 2.5% N/A	High 11.5% -0.5%	**High** **19.3%** **0 (366p)**	Medium 7.1% -0.1%	Low 0.5% N/A	Low 0.1% N/A	Demand % carcases Δ%price
	O+	Fair	Low 0.1% N/A	Medium 1.6% N/A	Med/High 6.1% -2.9%	Med/High 9.8% -2.0%	Medium 3.3% -2.9%	Low 0.3% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	-O	Fair	Low 0.1% N/A	Med/Low 2.2% N/A	Med/ Low 5.3% -14.3%	Med/Low 3.7% -12.6%	Low 0.5% -13.1%	Low <0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	P+	Poor	Low 0.1% N/A	Low 0.8% N/A	Low 0.8% N/A	Low 0.3% N/A	Low <0.1% N/A	Low <0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price
	-P	Very poor	Low 0.1% N/A	Low 0.1% N/A	Low 0.1% N/A	Low 0.1% N/A	Low 0.1% N/A	Low <0.1% N/A	Low <0.1% N/A	Demand % carcases Δ%price

Source: derived from ADHB and QMS data.

184. For cattle, R4L is the base specification (bold), with price bonuses offered for a few grid cells (shaded) with superior conformation and fatness but penalties for other grid cells (N/A indicates not accepted i.e. zero price). Less than 40% of carcases meet the base specification or better.

Table F13: Indicative demand for and supply of different lamb carcase grades at GB abattoirs, with average percentage price differentials

			→ Increasing fatness →							
			1	2	3L	3H	4L	4H	5	
		Description	Very lean	Lean	Optimum	Over	Fat	Very Fat	Excess fat	
→ Improving conformation →	E	Excellent	Med/Low <0.1% -1.1%	High 1.1% 1.6%	High 5.3% 1.7%	Med 1.8% -3.5%	Med/Low 0.5% -9.6%	Low <0.1% -15.2%	Low <0.1% -30%	Demand % carcases Δ%price
	U	Very good	Med/Low <0.1% -1.7%	High 3.2% 1.4%	High 1.6% 1.3%	Med 7.0% -2.7%	Med/Low 1.8% -8.5%	Low 0.2% -14.1%	Low 0.1% -21.3%	Demand % carcases Δ%price
	R	Good	Med/Low 0.3% -0.7%	High 8.4% 1.0%	**High** **26.3%** **0 (370p)**	Med 12.3% -2.1%	Med/Low 3.5% -5.6%	Low 0.6% -11.0%	Low 0.1% -18.1%	Demand % carcases Δ%price
	O	Fair	Low 0.4% -5.9%	Med/Low 3.4% -0.3%	Med/Low 4.9% -1.1%	Med/Low 2.1% -1.7%	Low 0.4% -3.3%	Low 0.1% -10.3%	Low 0.1% -17.7%	Demand % carcases Δ%price
	P	Poor	Low <0.1% -23.5%	Low <0.1% -23.0%	Low <0.1% -27.1%	Low <0.1% -24.7%	Low <0.1% N/A	Low <0.1% N/A	Low <0.1% N.A	Demand % carcases Δ%price

Source: derived from ADHB and QMS data.

185. For sheep, R3L is the base specification (bold), with price bonuses offered for a few grid cells (shaded) with superior conformation and fatness but penalties for other grid cells (N/A indicates not accepted i.e. zero price). Approaching 50% of carcases meet the base or better specification.

186. If the GB proportions are representative of Scottish livestock sent for slaughter and the average price penalties are reasonably accurate, then the magnitude of potential gains for farm level GVA (assuming no additional cost of meeting higher specifications, only better management) can be estimated simplistically by multiplying each grid's share of supply by its price differential. For example, 12.3% of sheep carcases are R3H, equating to around 5,300t of Scottish sheepmeat. If this could instead meet the R3L specification, it would increase in value by 2.1%, equivalent to about £0.4m. Similarly, for cattle, 9.8% of carcases (14,600t) are O+4L. If these could instead meet the R4L specification, they would increase in value by 2%, equivalent to about £1.1m. If all sub-base sheep carcases reached the base specification, the aggregate gain would be around £1.9m; for cattle, it would be about £10m.

187. Against on-farm GVA of around £400m, such potential gains from increasing the proportion of carcases meeting market demand specifications would represent perhaps up to 3%. In practice, carcase quality may be constrained in many cases by farming circumstances and existing breeding stock. In addition, the GB cattle figures will inevitably be distorted by dairy cows, so will exaggerate the scope for improvement in Scotland. Nevertheless, over time, improvements could be achieved if farmers were made more aware of specification requirements and how they could better target them. Initiatives such as the Beef Efficiency Scheme and various advisory and training programs contribute in this regard, but more information sharing along the supply chain would also be helpful. Some abattoirs in Australia and New Zealand go beyond simple grade reporting to farmers on individual animals and provide information on the value of the actual cuts derived from a carcase.

188. Farms also vary significantly in the efficiency with which labour, especially unpaid family labour, is utilised. In particular, economies of scale mean that larger herds/flock require significantly less labour per animal than smaller herds/flocks. Table F14 summarise FBS data for England, but QMS enterprise studies also confirm variation in labour efficiency across farms.

Table F14: Quartile variation in labour usage per breeding animal (hours per animal per year)

Farming system	Bottom	Average	Top
Cows	52.7	25.8	11.8
Sows	64	28	9.5
Ewes	7.3	3.7	1.8

Source: Wilson (2009).

189. Raising low performers towards the average would increase enterprise productivity and release labour for other income-generating activities on and/or off-farm. For example, saving 26.9 hours per cow for the c.60% of flocks accounting for c.15% of breeding cows would yield around c.1.8m hours (c.925 FTEs), equivalent to approaching £12m at the national minimum wage; saving 3.6 hours per ewe for the c.60% of flocks accounting for c.10% of breeding ewes would yield around c.780,000 hours (c.410 FTEs), equivalent to over £5m at the national minimum wage.

190. Data on the technical and marketing efficiency of other parts of the supply chain are not as readily available as for farm level production. Nevertheless, there is scope for adopting new technologies. For example, auction marts and abattoirs are keen to accelerate the introduction of bovine EID as a way to reduce the administrative costs of handling cattle passports. Equally, product shelf life can be extended through improved within-plant hygiene. Similarly, technical efficiencies are also possible with respect to energy, water and vehicle fuel usage. Operational cost savings of only 1% would equate to c.£8m across core suppliers and processors, representing perhaps 5% of their GVA.

191. Processors could also increase GVA through improved carcase utilisation, finding new market outlets and developing new products. However, many market segments (e.g. catering, food manufacturing) are price sensitive and fiercely competitive. In addition, the demand for different (primal) cuts from a carcase are seldom balanced. For example, UK demand for pork loin exceeds that for leg cuts which exceeds that for shoulder cuts – meaning that meeting demand for any one specific cut inevitably leads to either excess or deficit with respect to the other cuts. As a result, different cuts are likely to be simultaneously imported and exported. Nevertheless, the seeking of new market opportunities is an essential aspect of achieving and retaining competitiveness.

Structure and conduct

192. The academic literature on supply chain management in the red meat sector has expanded considerably since its origins in the 1990s. Over this period, conceptual/theoretical advances have been increasingly supported by empirical evidence from both qualitative case studies and more quantitative analysis. In general, the literature highlights how overall chain performance is hindered by a lack of coordination across firms, resulting in pervasive inefficiencies (e.g. Fearne, 2008 & 2012; Fischer, 2013; Grandori, 2015).

193. For example, failure to share information leads individual parts of the chain to make their own demand forecasts, which are often inconsistent and lead to mismatches between supply and demand across the chain. This exacerbates[43] volatility already arising from the influence of growing conditions on the timing and volume of supply (e.g. via lambing percentages, grass growth) and international commodity markets, and further hinders budgeting and production planning. As a result, firms can often find themselves carrying excessive (expensive) inventories and having to sell at lower than desired (or buy at higher than desired) prices (e.g. Taylor, 2005 & 2006a). Disconnection from final consumers also means that upstream parts of the chain often lack an understanding of market needs, impairing both existing product quality and new product development (e.g. Kularatna et al., 2001; Walters, 2005; Bonney et al., 2007; Canever, 2008; Leat, 2008; Jie, 2015).

194. A lack of coordination and information sharing also means that there is no over-riding system to seek performance improvements and individual firms do not typically assume responsibility for driving change beyond their own gates. For example, there are no binding Key Performance Indicators or management mechanisms to force change across the chain, and whilst industry fora or levy bodies can promote best practice, they have little power to compel it. Hence inefficient practices can persist, even if scope for improvement has been identified (e.g. Taylor, 2006a; Taylor & Fearne, 2009). Nilsson & Lind (2015) offer a cautionary Swedish tale of sectoral decline through inability to adapt.

[43] Dubbed "demand amplification" or the "bullwhip effect".

195. Although "lean" production techniques first adopted in, for example, automotive and aerospace sectors are often presented as *the* model for more efficient supply chains, the nature of red meat production is not necessarily amenable to lean principles. For example, disassembly (i.e. cutting) of carcases is qualitatively different from manufacturing assembly, breeding cycles mean that there are long-lead times for changing production volumes (particularly for cattle and sheep) and demand varies seasonally and for different cuts which are produced in (more-or-less) fixed ratios, meaning that matching carcase utilisation to demand is harder than for more uniform products (e.g. Taylor, 2006a; Cox et al., 2007). However, coordination/collaboration can be achieved through a variety of formal and informal mechanisms. For example, co-operatives, vertical integration and forward contracts (e.g. Grandori, 2015; Lees & Nuthall, 2015). Hence, supply chain perspectives are not limited solely to the application of lean principles.

196. Irrespective of the specific perspective adopted, the common theme is seeking improved sharing of information and closer alignment of objectives as ways of improving overall performance. However, achieving these requires mutual trust between different parts of the chain, which is often difficult in the face of historical behaviours and ingrained cultural attitudes (e.g. Fischer, 2013; Jie et al., 2013; Ding, 2014; Benseman & Shadbolt, 2015; Lees & Nuthall, 2015). In particular, many individual firms appear to prefer the (opportunistic) freedom offered by using spot markets to the greater certainty (i.e. of outlet and price) offered by more constrained contractual relationships.[44]

197. In the UK context, the dominance of the major multiples is problematic, with admissions of past abuses of purchasing power[45] emerging after pressure from the Grocery Code Adjudicator likely to have a lingering effect on trust and the preservation of adversarial relationships. Moreover, Cox et al. (2007), note that the relative market power of supermarket buyers has skewed gains towards them rather than the rest of the chain. Addressing this imbalance remains challenging.

198. More generally, studies in the UK, many under the Red Meat Industry Forum (Simons et al., undated), do confirm the findings of international studies in terms of the potential gains to be made from greater collaboration and information sharing. For example, economies of scale and/or scope, improved product flow and faster processing cycles, longer product shelf life, greater flexibility, reduced waste, enhanced traceability and improved product quality.

199. The specific gains vary across different firms and chains, but overall fall within the 2–3% range. Although this may seem small in absolute terms, given the tight operating margins that characterise red meat supply chains, they are potentially significant (e.g. Simons et al., 2003; Simons & Zokaei, 2005; Cox et al., 2007; Francis et al., 2008; Leat & Revoredo-Giha, 2008; Fischer, 2013; Leat & Revoredo-Giha, 2013a & b).

200. Consideration of supply chain relationships should also extend to upstream suppliers, without whom farms and processors would be unable to function. For example, the future availability of veterinary and haulage services for red meat animals is key to continued production activities. Yet tighter regulatory controls on livestock haulage (e.g. biosecurity cleaning relative to grain or milk haulage) and higher margins for small animal practices may reduce the willingness of firms to service the red meat sector. This suggests that moves towards formal longer-term relationships to lock-in security of service supply may be as applicable to upstream suppliers as between farms and processors.

Summary

201. The scope for improving performance[46] across the red meat sector has been articulated previously in various industry reports and support mechanisms. For example, in the Scottish Sheep Industry: The Way Forward (2000), the Strategy for the Scottish Pig Industry (2008) and Beef 2020 (2015); advice and training programmes, support for benchmarking and value-chain analysis, and modernisation and marketing grants. As such, the onus is on members of the supply chain to recognise the challenges faced and to accept the opportunities presented to maintain and increase the contribution of the red meat sector.

[44] Although perceived independence tends to disregard structural dependence on (e.g.) agricultural support and the actions of others in the supply chain, muddling independence with individualism (Emery, 2015).

[45] For example, in oral evidence given by supermarket representatives to the House of Commons Environment, Food and Rural Affairs Committee in relation to farmgate prices: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/environment-food-and-rural-affairs-committee/farmgate-prices/oral/26237.html

[46] Although it is important to note that performance improvement includes increased labour productivity, which means that employment is unlikely to increase as rapidly as output or GVA and indeed may reduce (freeing labour for other sectors) even if output grows. This highlights the difference between the sector and the individual firms or employees currently within it – improving sectoral performance does not necessarily improve the position of all those within it, and some may leave the sector.

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Annex G: Contributions to the Wider Rural Economy

Introduction

202. Historically, agriculture accounted for significantly higher shares of national economic activity than implied by the current c.1% of GDP and c.2% of employment. This long-term decline in relative importance reflects a number of inter-related trends.

203. First, as other sectors have emerged and grown, agriculture's relative share of the enlarged total economy has necessarily fallen, even when the absolute contribution has grown. Second, whereas farming systems were once essentially self-contained, modern farming typically utilises more purchased inputs and marketing services, meaning that some value added (and employment) previously located on-farm has moved beyond the farmgate.

204. Third, on-farm labour has been displaced by the use of energy, machinery and chemicals as new technologies have been adopted. Fourth, on-farm employment has also fallen as static or declining farm output prices have led to the exploitation of economies of scale and/or off-farm employment in the pursuit of parity with rising household income levels elsewhere in the economy.

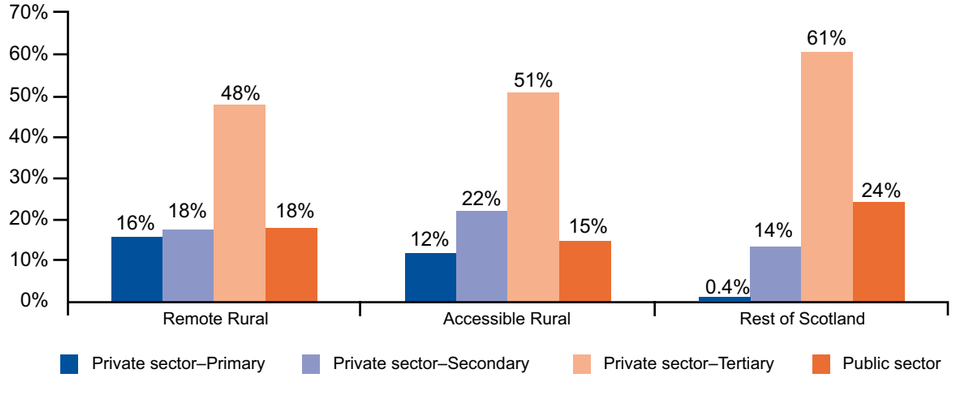
205. Consequently, the decline in agriculture's share of headline economic indicators represents the result of diversification and growth in the wider economy arising from specialisation and improved productivity in agriculture and other sectors. However, assessment of agriculture's contribution to rural economies needs to go beyond simple headline national indicators. This partly reflects a need to consider regional variation and employment in allied industries, but also to acknowledge agriculture's broader contribution to culture and heritage.

Employment

206. As noted previously, linkages along the supply chain to upstream suppliers and downstream processors mean that on-farm measures of activity underestimate the total value added and employment associated with red meat production. Including allied industries raises the share of economic activity, although care has to be taken not to exaggerate the effect (e.g. due to the possibility of downstream activities utilising imported rather than domestic produce) and the share of overall national output and employment remains modest. However, at a regional level, the importance of agriculture and red meat production is relatively greater.

207. For example, using the SG urban-rural classification, Figure G1 shows that primary sector employment (agriculture plus forestry and fishing) is vanishingly small in urban areas but into double figures in rural areas. Given the predominance of cattle and sheep in many remoter areas, red meat production will account for a sizeable proportion of this. Moreover, some of the allied upstream and downstream activities will feature in local secondary sector employment. However, Figure G1 also highlights the importance of employment in the service and public sectors: even in rural areas, agriculture does not dominate and declines in agricultural employment have been at least partially offset by job creation in other sectors, although this can be challenging in some remote locations and in many cases imposes disruptive adjustment costs on households and communities.

Figure G1: Employment by sectors by urban-rural geographic area, 2014



Source: SG Rural Scotland Key Facts 2015 http://www.gov.scot/Publications/2015/03/5411/4

Consumption and community roles

208. Beyond their activities in the red meat supply chain, farm households also play a consumption role, contributing to the demand for other goods and services. In some cases, goods and services may be sourced outwith the local area, perhaps via visiting larger settlements or internet shopping, thereby supporting value added and employment elsewhere. Yet in other cases, goods and services may be sourced locally, thereby helping to maintain a minimum level of local demand and viability of local provision. For example, using a village store, GPs or school. Of course, farm households are not unique in this respect – any rural household has a consumption role. However, living and working in situ could make some farm households more predisposed than, for example, commuters to utilise some local goods and services.

209. Perhaps more obviously, farm households can have a greater propensity than other households to contribute to the provision of some local public services by virtue of possessing large vehicles and land. For example, clearing heavy snow from roads, supporting land-use-based flood control measures (as well as transporting flood victims) and providing temporary use of buildings and/or land for local events or offering recreational access more generally. This is not to say that such services could not be provided by other means (e.g. local councils), merely that farm households can have a dual role in both consuming and providing local services.

210. Equally, as members of a local community, farm households can participate in civic activities such as volunteering and/or membership of representative bodies. For example, serving on community councils, as school governors or running local charitable events. Again, farm households are not unique in this respect – local residents from a variety of backgrounds may or may not choose to participate in local community affairs. However, some farm households may be predisposed to playing such roles through tradition (i.e. previous generations have done so) and/or experience of similar roles in the narrower farming community (e.g. local NFUS committees, common grazings).

Cultural heritage

211. More broadly, agriculture features prominently in rural cultural heritage – both in terms of tangible features such as landscapes and historical artefacts but also intangibles such as customs and languages/dialects. This encompasses both the specific affinities that locals may have for particular parcels of land (e.g. a sense of place) but also a broader attachment to land and farming across society - although Scottish (and UK) society is seemingly less attuned to its agrarian and rural roots than in many other EU countries.

212. For example, many farms have been worked by generations of the same family and feelings for a place are often rooted in morality and emotional ties as well as utilitarian interests – the prospect of change raises concern about not only economic self-interest (e.g. farm income) but also stewardship legacies and what will happen to the land, the animals and community culture. Similarly, even outwith rural areas, the general public often favours (amongst other things) maintenance of traditional farming systems as a means of preserving family farms and their cultural heritage.

213. These social values are not expressed through market prices, but nonetheless are real and need to be accounted for alongside more obvious headline economic contributions. Moreover, red meat production also contributes to the provision of other public goods produced jointly with cattle and sheep as externality effects, some positive and some negative, which also need to be considered. For example, food security, various forms of pollution, and landscape influences.

Landscapes

214. Scottish landscapes reflect long-term interactions between the natural environment and management by humans. Centuries of burning, draining, felling, grazing and cultivating plus building, mining and quarrying, have shaped most landscapes, transforming their appearance through altering land cover (e.g. grassland instead of woodland) and introducing new features (e.g. roads, towns). Agriculture plays a prominent role in this with farms occupying over 70% of the total land area, filling most of the mosaic in-between other land uses and influencing expectations about the attractiveness of a place to live and work in or to visit.

215. Given that over 75% of Scottish farmland is down to grassland and rough grazing used primarily for cattle and sheep, red meat production clearly exerts considerable influence on the landscape. Hence, for example, many Landscape Character Assessments (LCAs) explicitly mention grazing livestock as well as field boundaries (e.g. dry stone walls) and farm buildings (e.g. barns). In addition, a proportion of land grows cereals for feed purposes and red meat production thus influences arable as well as pastoral landscapes.

216. The influence of red meat production on the landscape at a given location depends partly on the underlying topography/geology and partly on management choices made by farmers and their neighbours. That is, whilst the shape of hills and mountains is relatively stable, the skyline (e.g. trees vs. rough grazing), colour (e.g. heather vs. grassland) and patterns (e.g. improved land next to unimproved) are all affected by the scale and intensity of management, as are the numbers and breed of animals.

217. For example, intensively managed grassland is shorter and greener with more grazing livestock than extensively managed grassland; large uniformly-managed parcels of land are visually different to arrangements of more varied parcels; field boundaries marked by fences look different to those marked by hedges or walls. Variability in both underlying geology (plus non-agricultural land use) and red meat farmers' management choices generates considerable landscape heterogeneity across Scotland, with each (sub) region having its own distinctive character and sensitivity to land use change.

Other externalities

218. Management influences extend beyond the physical appearance of the landscape to also affect the type and size of habitats they contain and species (biodiversity) they support. For example, intensively managed, short-sward grassland tends to host fewer species of plants and invertebrates; hedges and walls offer richer habitats (and greater connectivity between other habitats) than fences; and a mix of land parcels (e.g. woodland next to grassland), can suit some larger animal species (e.g. birds, mammals) more than larger uniform land parcels.

219. As with visual impact, the effect on biodiversity at a given location will depend partly on management choices made by farmers and their neighbours. For example, mixed grazing by cattle and sheep can produce different results to single-species grazing whilst both over and under-grazing can lead to changes in habitat structures and biodiversity. Widespread land abandonment may lead to encroachment by, for example, bracken and shrubs, altering both visual appearance and habitats within a landscape whilst perceived coherence can be diminished by the juxtaposition of incongruous land covers or developments.

220. Negative environmental pollution impacts can also arise from biological or chemical contamination of water courses and from greenhouse gas (GHG) emissions. The latter stem from the use of fossil fuels in farm machinery and of nitrogen fertilisers but also unavoidably as a by-product of ruminant digestion. Water pollution can arise from, for example, livestock trampling (and eroding) river banks or from chemical run-off from fields. Livestock production can also be associated with noise and odour.

221. Although these various externality effects occur outwith any market and thus have no market price, they nonetheless have an economic value. For example, attractive landscapes have a positive value reflected by tourist visits and demand for residential property whilst rare habitats and species (e.g. peatlands, eagles) can also attract visitors. In such cases, the economic value generated – at least in-part – by land management is captured by others providing, for example, accommodation, catering and guiding services. Conversely, negative values arising from air and water pollution impose costs on others through, for example, having to tolerate odours or a need for additional water treatment.

Assessing externalities

222. Assessing the importance of particular public goods and red meat production's contribution to them is not straightforward. First, the degree to which an outcome is attributable to jointness with red meat production has to be established. For example, how strong is the relationship between particular management regimes and landscape character or habitat quality? Second, in the absence of market pricing, non-market valuation techniques have to be used, raising issues of the appropriateness and accuracy of different approaches.

223. For example, how aware are survey respondents of the role of farming in shaping the environment and how well can they articulate their preferences for particular landscapes or different habitats? Moreover, given that some externality effects are localised (e.g. habitats) whilst others are felt at some distance or even globally (e.g. GHG emissions), issues arise over whose preferences need to be included and indeed how differences in perspectives (e.g. expert vs. lay) should be accommodated.

224. It is also necessary to consider counterfactual scenarios – what would happen in the absence of particular management activities? For example, a local reduction in red meat production could reduce Scottish emissions of greenhouse gas emissions but would not necessarily lower global emissions if consumers simply switched to eating non-Scottish beef and lamb. Equally, a change in land management that altered a landscape would not necessarily lead to dramatic changes in tourism expenditure since visitor attractions also include, for example, castles, museums and recreational facilities, meaning that landscape is not necessarily the sole nor primary determinant of tourists' or residents' interest in a given location - not all tourism expenditure can be automatically ascribed to land management.

225. These analytical challenges and choices lead to somewhat divergent reported estimates for externality effects. Moreover, most published results are for agriculture in general rather than red meat production and/or are not specific to Scotland. Hence only general inferences can be drawn. Nevertheless, it is apparent that estimated positive effects are typically substantial. For example, in relation to the maintenance of semi-natural habitats and land cover mosaics, particularly in High Nature Value (HNV) areas.

226. However, negative effects are also substantial, more so if GHG emissions are included. For example, habitat degradation and contamination of water courses. Yet many negative effects can be mitigated to an extent through the adoption of best management practices. For example, improved utilisation of inputs and more appropriate grazing regimes. Opportunities for the enhancement of positive externalities and the mitigation of negative externalities are both reflected to some extent in the design of current agricultural and agri-environmental policies, albeit that there is not necessarily consensus amongst different stakeholder groups regarding efficacy or compliance burdens. For example, regulatory standards for land and livestock management plus funding for the creation and/or maintenance of specific habitats.

Food security

227. Beyond the types of externality effects considered above, maintenance of agricultural production (and by extension upstream and downstream parts of the supply chain) is also sometimes presented as a strategic objective in pursuit of domestic food security. In the case of red meat, the volume of output relative to the size of the Scottish market means that supply comfortably exceeds domestic demand. As such, food security in a narrow sense is not really an issue.

228. However, in terms of creating products that can be traded for other goods and services (including other food items), maintenance of domestic red meat production may represent a source of comparative advantage. That is, Scotland has an abundant grazing resource well suited to extensive production systems, an established supply chain with a degree of brand recognition and an expanding food manufacturing sector. This does not necessarily mean that red meat production is economically rational unless the benefits (including the various public goods) of doing so outweigh the costs. In some cases, it may be that resources (land, labour, capital) currently allocated to red meat production would be better used for other purposes – either alternative land management or in other sectors. However, there is strategic merit in seeking to exploit and enhance any comparative advantage.

Summary

229. In summary, the influence of red meat production extends beyond simply on-farm activities involving cattle, pigs and sheep to include not only other parts of the red meat supply chain but also other aspects of the rural economy and environment. Employment on farm and in allied industries is significant, if not dominant, in rural areas and represents a source of income to rural households that in turn will support the provision of some other local goods and services. At the aggregate level, a comparative advantage in red meat supports the wider economy through increased trading possibilities.

230. In addition, cattle and sheep farming strongly influence biodiversity, habitats and landscapes, all of which have economic value and can contribute to tourism activities, further supporting rural economies and communities as well as helping to secure the provision of some public goods. Similarly, the cultural heritage embodied in continuation of agricultural practices is valued both by local communities and by society more widely. Conversely, red meat production can generate negative externalities, including habitat degradation and pollution, partially offsetting some of the positives.

231. Hence, although exaggerated claims and rhetoric should be avoided, consideration of the multifunctional benefits of red meat production offers a rationale for continued public support and for the development of targeted policy measures to encourage socially desirable outcomes.

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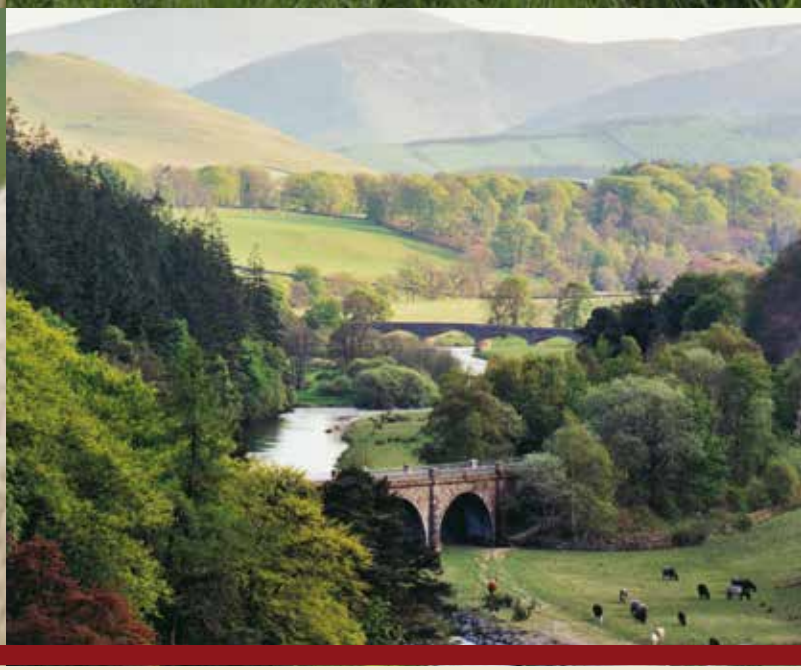

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