Impact of Brexit Scenarios on Grazing Livestock Farms in the Lake District National Park

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Lake District National Park Authority

Contents

Acknowledgements

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Disclaimer

The views expressed in this report are those of the authors and do not necessarily represent opinions of the Lake District National Park Authority, RBR or Newcastle University. We use projections from research commissioned by the National Farmers' Union, Agriculture and Horticulture Development Board and the Economic and Social Research Council. The projections and scenario specifications are not attributed to represent the views of those organisations. Any errors or omissions are the responsibility of the authors.

1 Introduction

The decision of the UK to leave the European Union (EU) represents a pivotal challenge to farming and rural communities. For more than 40 years, UK agriculture has been fundamentally influenced by EU legislation and the support framework of the Common Agricultural Policy. Consequently, the Brexit decision creates considerable uncertainty about the nature of the future regulatory, trade and domestic support policies for UK agriculture outside the EU. These future policy developments may have sizeable impacts on farm incomes and viability. Also related businesses (input supply, processing and retailing) and the rural economy more generally will be affected by the financial health of the primary agriculture sector. Furthermore, Brexit outcomes could instigate changes in land use and management with consequences for the environment and on valued landscapes developed through generations of farming stewardship. Against this background it is not surprising that farming, countryside and environmental stakeholder organisations have an acute interest in the effects of Brexit on the agricultural sector.

In this context, the Lake District National Park (LDNP) Authority commissioned Newcastle University to conduct an analysis of potential impacts of Brexit scenarios on incomes of LFA grazing livestock farms in the Lake District National Park. The terms of reference were as follows:

1. To describe average characteristics (physical and financial) of LFA Grazing Livestock farms in the LDNP using data for the sample of LDNP holdings recorded in Farm Business Survey (FBS); and to compare these with national averages from the full FBS sample of LFA Grazing farms in England.
2. To identify key post-Brexit trade and domestic support policy scenarios based on recent literature (impact studies).
3. To conduct a comparative static analysis of the potential impacts of the Brexit scenarios on Farm Business Income of a representative (average) LFA grazing farm in the LDNP.

2 Descriptive characteristics of LDNP sample farms

Table 1 provides descriptive characteristics for the FBS sample of LDNP farms and national averages for all Severely Disadvantaged Area (SDA) grazing farms and all Less Favoured Area (LFA)[1] grazing farms in England. The sample data in each case are weighted by farm size strata to represent the population of farms using data from the June agricultural census conducted by Defra. Since these statistical weightings are designed only to represent the national population, the use of weighted samples at sub-national levels (e.g. LDNP) requires caution. We proceed with the caveat that the weighted LDNP represents a sub-set of the LDNP population in the farm size strata reflected by the sample farms[2].

[1] Combining Severely Disadvantaged Area and Disadvantaged Area designations.

[2] In other words, if the LDNP sample does not contain farms in specific size groups used in the national stratification then the weighted average for LDNP will be biased due to the under-representation of that group.

It is noted that the holdings in the LDNP sample are substantially larger than the national averages for SDA and LFA (SDA+DA) grazing farms. Specifically, the average area farmed by the LDNP sample is almost 3 times the average for all English SDA grazing farms. However, the proportion of rough grazing is also much higher for the LDNP sample. Average beef herd size of LDNP farms is similar to national averages for SDA and LFA grazing farms, but average sheep flock of the LDNP farms is much larger. The LDNP farms have an average total labour requirement of 2.5 full time equivalents per business compared to 1.6 for all SDA grazing farms in England.

The comparison of financial performance shows the LDNP farms receive higher shares of farm output (revenue) from Basic Payment (Pillar 1) and especially agri-environmental schemes (Pillar 2). Overall performance of the LDNP farms is above the national average with 34% of output value retained as Farm Business Income (FBI) compared 26% for all SDA grazing farms in England.

Table 1 Descriptive physical and financial characteristics of LDNP farms and all English SDA grazing and LFA Grazing farms (2016/17 averages)

	LDNP farms		All SDA Grazing Farms		All LFA Grazing Farms*	
Sample size	15		147		206	
Representative no. in population	432		4042		6,446	
Land Use						
Arable crops (ha)	0.0		0.8		1.8	
Permanent & Temp grassland (ha)	124.1		97.4		93.0	
Rough grazing (ha)	352.6		90.4		58.6	
Woodland, buildings, roads etc (ha)	60.3		8.0		6.6	
Total (ha)	537.0		196.6		160.0	
Tenanted area (%)	48		54		51	
Owner-occupied area (%)	52		46		49	
Stocking						
Beef cow herd (no.) §	35		29		29	
Other cattle (no.)	43		51		57	
Breeding flock (no.) #	1,131		587		491	
Other sheep (no.)	126		284		265	
Farm Labour Units (FTE)	2.5		1.6		1.5	
Financial Performance (£) - 2016/17	**£**	**% of output**	**£**	**% of output**	**£**	**% of output**
Total Output	215,233	100%	126,782	100%	115,500	100%
of which: Agricultural Production	86,899	40%	70,235	55%	70,200	61%
Basic Payment Scheme	63,364	29%	31,518	25%	26,500	23%
Agri-Environmental Schemes	60,709	28%	19,319	15%	13,700	12%
Diversification	4,261	2%	5,710	5%	5,100	4%
Variable Costs	51,684	24%	41,389	33%	39,600	34%
Total Gross Margin	163,548	76%	85,393	67%	75,900	66%
Fixed Costs	91,395	42%	52,236	41%	49,100	43%
Farm Business Income	72,153	34%	33,157	26%	27,000	23%

Source: Farm Business Survey 2016/17 (Defra); *All LFA comprises SDA and DA designations.
§ includes bulls; # includes ewe hoggs

3 Scenario comparison strategy

In this report we implement projections from three independent research studies that evaluate impacts of Brexit scenarios for UK agriculture. This approach provides a form of 'sensitivity analysis' by assessing levels of consensus or divergence among the alternate sets of projections for specific post-Brexit trade scenarios. The projections we use are drawn from the following studies (titled in each case by the name of the organisation[3] that commissioned the research):

'ESRC'

- Hubbard, C., Harvey, D.R., Wallace, M., Scott, C., Ojo, M., Moxey, A., Patton, M., Davis, J., Feng, S., Philippidis, G., Shrestha, S. 'Brexit: How might UK agriculture survive or thrive?' ESRC Grant No. ES/R001928/1. Project in progress, due to report September 2018.
    - Trade scenario projections are from FAPRI-UK partial equilibrium model (Davis *et al*., 2017) with factor market (land and labour) projections from a Computable General Equilibrium model (Boulanger and Philippidis, 2015)

'AHDB'

- Bradley, D. and Hill, B. (2017). Quantitative modelling for post-Brexit scenarios. Final report for AHDB. Submitted by Agribusiness Consulting|Informa https://ahdb.org.uk/brexit/documents/Quantitative_Modelling_For_Post_Brexit_Scenarios-12oct17.pdf
    - Trade scenario projections from a gravity model

'NFU'

- van Berkum, S., Jongeneel, R.A., Vrolijk, H.C.J., van Leeuwen, M.G.A. and Jager, J.H. (2016). Implications of a UK exit from the EU for British agriculture. Study for the National Farmers' Union (NFU), Warwickshire. Wageningen: LEI Wageningen LEI Report 2016- 046. UR https://www.nfuonline.com/assets/61142
    - Trade scenario projections from a partial equilibrium model (AGMEMOD)

3.1 Trade scenarios

Each of the above studies evaluated three potential trade scenarios representing a range of possible outcomes from the UK-EU Brexit negotiations. General details of these trade scenarios are shown in Table 1 and are briefly described as follows:

Scenario 1 (***FTA***): comprehensive UK/EU free trade agreement

This scenario is closest to the status quo and could be considered as a possible transitional arrangement on the path to a longer term outcome. It assumes that the UK would leave the Single Market but a Free Trade Agreement (FTA) would permit continuing tariff free trade between the UK and EU. The UK is assumed to closely align its regulatory systems with those of the EU and to adopt the EU Common Customs Tariff (CCT) rates on trade with the rest of the world (RoW). However,

[3] It is noted that the projections do not necessarily represent the views of the organisations that commissioned these studies.

additional trade facilitation costs (non-tariff costs on UK-EU imports and exports) would be encountered through extra cross-border administration paperwork and inspections costs.

Scenario 2 (***WTO***): World Trade Organisation (WTO) default

In the absence of a FTA between the UK and EU, the UK would revert to WTO default Most Favoured Nation (MFN) tariffs which would apply to UK exports to the EU as well as imports from the EU to the UK. The default MFN tariff are extremely high for most agricultural products and consequently their imposition would lead to significant adjustments in trade between the UK and EU-27. In the case of products (e.g. beef) where the UK is a net importer the imposition of tariffs reduces the competitiveness of the imported product resulting in a higher producer prices in the UK. The converse applies for products (e.g. lamb) where the UK is a net exporter to the EU.

Scenario 3 (***LIB)***: UK implements unilateral trade liberalisation

Under WTO rules, the UK could decide that it will not apply the high default MFN tariffs. In this context it would adopt a policy of unilateral trade liberalisation where tariffs on imports from the EU and the RoW are reduced. Reduction in tariff barriers is likely to have a depressing effect on UK prices for agricultural products due to increased competition from lower cost imports from the RoW. The extent of this effect will depend on the gap between UK prices and their world market equivalents.

The specific market projections relating to the above trade scenarios, derived from the three aforementioned studies, are shown in Table 3. These projections indicate a relatively high level of consensus among the studies but there are some noticeable areas of difference. For example, under the LIB scenario FAPRI model projections for the 'ESRC' study suggest a beef price reduction of 42% compared to a 0.5% reduction in the 'AHDB' study. Bradley and Hill (2017) explain possible reasons for the divergence including differences in chosen baseline and the use of blended tariff rates in their study compared to final bound tariff rates for beef carcases in the FAPRI study. The 'AHDB' study projects substantial increases in wage costs for certain Brexit scenarios while the 'ESRC' study incorporates estimates of reductions in land rents that are omitted in the other studies. The differences between studies highlight some of the inherent ambiguities and methodological challenges associated with modelling complex trade scenarios. This also supports our strategy of undertaking 'sensitivity analysis' by comparing estimated impacts of scenario projections based on the three separate studies.

Table 2 Description of Post-Brexit Trade Scenarios

	Scenario 1: FTA *'Soft' Brexit Scenario. UK remains in the European Customs Union. Regulatory and trade alignment to EU rules. Possible as transitional deal*	**Scenario 2: WTO** *'Hard' Brexit scenario. UK trades with EU and Rest of World (RoW) under WTO rules*	**Scenario 3: LIB** *'Hard' Brexit similar to Scenario 2 but UK also implements unilateral trade liberalisation by reducing its tariffs on imports of agricultural products (i.e. cheap food policy)*
Trade relationship with EU	• Comprehensive FTA with tariff-free trade between UK and EU	• No trade deal agreed between UK and EU • WTO rules apply • EU applies its external Common Customs Tariffs (CCT) to UK exports • UK applies same CCT rates to its imports from EU	• No trade deal agreed between UK and EU • WTO rules apply • EU tariffs (CCT) on UK exports to EU • UK implements zero tariffs on agricultural products
Trade relationship with Rest of World (RoW)	• UK maintains EU tariff structure on trade with RoW • UK retains share of EU's existing TRQs based on historic trade volumes • UK adopts existing EU/RoW trade agreements	• UK adopts same common external schedule of tariffs as EU • UK retains share of existing WTO TRQs (including beef and lamb)^	• UK reduces its import tariffs for agricultural products to 0% within set tariff quotas • No change in tariff structure for UK exports to EU or RoW
Trade facilitation costs (i.e. extra 'administrative' costs of trade)	• 5% additional facilitation costs on UK-EU27 trade • Zero tariffs on UK-EU trade • Existing tariff rates on trade with RoW	• 8% additional facilitation costs on UK-EU27 trade • CCT tariffs on imports from EU and RoW	• 8% additional facilitation costs on UK-EU27 trade • Zero tariffs on imports from EU and RoW
Regulatory environment	• All existing EU regulations adopted into UK law • No change to costs	• All existing EU regulations adopted into UK law • No change to costs	• Possible reductions in regulatory burden to enhance competitiveness of UK agriculture • Possible reduction in production costs

^ 'AHDB' and 'ESRC' studies assumed retention of UK share of TRQs; 'NFU' study considered that UK loses its share of EU TRQs.

Table 3 Summary of trade (market) projections from three independent Brexit studies

	ESRC[1]			AHDB[2]			NFU[3]		
	FTA	WTO	LIB	FTA	WTO	LIB	FTA	WTO	LIB^
Prices									
Beef	+1.9%	+17.5%	-42.3%	+4.6%	+21.5%	-0.5%	+4.6%	+7.4%	-14.9%
Sheep	+4.3%	-23.0%	-18.8%	-5.0%	-25.4%	-20.0%	+2.3%	+8.8%	-4.7%
Wheat	+1.0%	+7.8%	-1.5%	+2.3%	+2.3%	+2.3%	+5.0%	+8.0%	+7.9%
Barley	+0.5%	-5.2%	-8.1%	-5.0%	-16.4%	-16.4%	+5.0%	+8.0%	+8.0%
Costs									
Rent Paid	-14.9%	-10.6%	-18.8%	*	*	*	*	*	*
Regular labour	+5.0%	+5.3%	+4.9%	0.0%	+50.0%	+50.0%	*	*	*
Casual labour costs	+5.0%	+5.3%	+4.9%	0.0%	+50.0%	0.0%	*	*	*
Variable costs (excl. purc'd feed)~	0.0%	-0.1%	-0.5%	0.0%	0.0%	-5.0%	*	*	*

Notes:

[1] Commodity price projections from Patton, M. (2017). FAPRI-UK modelling for 'Brexit: How might UK Agriculture Survive or Thrive?' ESRC Grant No. ES/R001928/1. Rent and labour cost projections from Phillipidis, G. (2017) CGE modelling of Brexit Scenarios in same ESRC project.

[2] Bradley, D. and Hill, B. (2017). Quantitative Modelling for Post-Brexit Scenarios. Final report for AHDB.

[3] van Berkum, S., Jongeneel, R.A., Vrolijk, H.C.J., van Leeuwen, M.G.A. and Jager, J.H. (2016). Implication of a UK Exit from the EU for British Agriculture. Study for the National Farmers' Union. Wageningen: LEI Wageningen UR.

^ van Berkum et al. study assumed 50% reduction in UK tariffs on imports of agricultural products while Patton et al. (2017) and Bradley & Hill (2017) assume elimination of UK import tariffs.

* No change indicated in the study report.

~ In our analysis, changes in purchased feed costs are assumed to equal the average of the price changes for wheat and barley.

3.2 Domestic support policy assumptions

Current support provided to farmers in England, under the framework of the Common Agricultural Policy (CAP), comprises two key elements:

- Pillar 1 – the Basic Payment Scheme (BPS) and associated greening provisions
- Pillar 2 – principally agri-environmental schemes

In 2016, the total amounts disbursed in England under Pillar 1 and Pillar 2 (agri-environmental payments) were £1.6 billon and £324 million, respectively (Defra, 2017).

Specific details of the future UK support policy to replace the CAP have not been confirmed at the time of preparation of this report. Consequently, the type and levels of support after 2021 remain uncertain. However, there appears to be consensus that overall direct support may be reduced with a greater emphasis placed on agri-environmental schemes. In particular, the prospect of farm support being rebalanced towards payment for public goods and enhancing the environment has been signalled in speeches by the Defra Secretary (Gove, 2018).

In this report we consider 5 sets of assumptions about future domestic support for farmers as outlined in Table 4.

Table 4 Assumptions tested regarding future direct payments

	'Pillar 1' Decoupled area payments (BPS)	'Pillar 2' Agri-Environmental Payments
1. Current	No change	No change
2. Transitional	-20%	No change
3. Rebalanced	-100%	+50%
4. Austere	-100%	No change
5. Bradley & Hill (AHDB)	FTA: No change WTO: -100% LIB: -100%	FTA: No change WTO: +130% LIB: +259%

The support policy conditions (1-4 above) are each evaluated under all three trade scenarios (FTA, WTO, LIB). We separately implement the Bradley and Hill (2017) scenarios which were applied in a different fashion. Specifically, Bradley and Hill (2017) used different assumptions about DPs under each trade scenario. Their FTA scenario which they label 'Evolution' assumed no change in DPs. Under their WTO ('Fortress UK') and LIB ('Unilateral Liberalisation') scenarios, Pillar 1 payments were reduced to zero with Pillar 2 payments increased by 130% and 259%, respectively[4].

[4] Bradley and Hill calculate these redistribution rates based on aggregate data for England. They assume that Pillar 2 payments are increased to a level necessary to disburse 25% and 50% of current total support under 'Fortress UK' (WTO) and 'Unilateral Liberalisation' (LIB), respectively.

4 Data and methods

The analysis uses population weighted averages of the farm management accounts for the sample LDNP holdings in Farm Business Survey for 2016. The physical and financial data were used in a budgetary simulation model that allows us to disaggregate the impacts of the scenarios at the levels of the individual enterprises and the whole business. It is noted that the simulation exercise models a synthetic or representative farm based on the average characteristics (land area, stocking, efficiency) and financial performance for the LDNP sample of farms in the FBS[5].

This is a comparative static analysis where the projected annual farm management account under the scenario conditions is contrasted with the equivalent account under status quo (baseline) conditions. The structural characteristics (e.g. land area, stocking, enterprise) and efficiencies (e.g. stocking rate, input-output ratios) are held constant. Accordingly, estimates are first-order effects only. Faced with scenario price shocks farmers would be expected to respond by adjusting their production systems in order to mitigate those impacts. We briefly consider the implications of such adjustments in Section 5.6 below.

Our analysis constructs a reference scenario (or baseline) using the 2016 data for the LDNP sample in the Farm Business Survey. We initially considered using a three year (2014-2016) average for the baseline to control for inter-year variability. However, we decided against this approach for a number of reasons:

- Firstly, we observed quite modest variability in output prices and input costs over the period (see Table 5). Therefore averaging the data on this basis had limited utility.
- The tiered Pillar 1 payment rates by land type (lowland, SDA, Moorland) were revised in 2015 to redistribute more money to upland farms. This policy change resulted in respective increases of 25% and 88%[6] in the SDA and Moorland payment rates between 2014 and 2016. Consequently, averaging would under-estimate the level of Pillar 1 support currently being received by LDNP farms.
- The devaluation of the pound sterling after the Brexit referendum has inflated the value of Pillar 1 payments which are set in Euros. In addition, key output and input prices have been impacted by the exchange rate. Given projections for continuing weakness of sterling we argue that 2016 (which includes some of the effects of the recent devaluation) is more appropriate as the baseline from which to calculate the scenario impacts.
- Finally, there are clear merits in using the most up-to-date set of financial conditions as these are perceived to be the most pertinent reference point for farmers and other stakeholders.

We estimate that our choice of the 2016 reference point results in a baseline Farm Business Income that is approximately £15,200 higher than if we had used the 2014-2016 average. This difference is composed of higher direct payments (+£11,600) and higher livestock margins (+£3,600) in 2016 compared to the 3-year average. However, despite these differences in absolute (money) terms, the proportionate (%) impacts of scenarios are likely to be similar with either a 2014-16 or 2016 baseline.

[5] It would be insightful to evaluate scenario impacts on sub-groups according different farm sizes and levels of performance. However, further sub-division of our small sample of LDNP farms was not possible under FBS data reporting rules.

[6] For the payment rates in euro terms. Accounting for the effects of sterling devaluation the actual increases between 2014 and 2016 were 37% and 106% for SDA and Moorland payment rates, respectively.

Table 5 Comparison of LDNP farm data for 2014, 2015, 2016

	2014	2015	2016	Average*
Land and Livestock				
Land area (ha)	532	481	537	528
Beef cows (no.)	36	34	35	35
Breeding flock (no.)	933	1,074	1,131	1,112
Pillar 1 payment rates				
SDA (£/ha)	156.49	180.07	214.06	183.54
Moorland (£/ha)	27.41	47.58	56.56	43.85
Direct payments (£ total)				
Pillar 1 revenue (£)	38,705	50,312	63,364	52,524
Pillar 2 revenue (£)	58,060	57,544	60,709	59,949
Average prices received (£/hd):				
Finished cattle	1,228	1,259	1,289	1,264
Store cattle	870	912	856	878
Finished lambs	66	66	68	66
Store lambs	47	41	46	44
Financial performance				
Livestock output per GLU (£)^	543	552	603	571
Variable costs per GLU (£)	369	356	359	365
Fixed costs per GLU (£) $	722	727	747	734
Net Farm Income per GLU (£) ^	-548	-531	-503	-528

* Average for the farm survey data are the population weighted averages for the sub-sample of farms recorded in all three years.

^ Excluding revenue from direct payments.

$ includes imputed wages for farmer and spouse labour and imputed rent on owned land (i.e. NFI basis).

A summary of the simulated baseline for the representative LDNP farm modelled in this report is provided in Table 6.

Table 6 Summary of the baseline financial results from the farm model

Enterprise Output	**£**	**% of Output**
Beef cattle	28,039	13%
Sheep & wool	58,882	27%
Total	*86,921*	40%
Direct Payments + Other Revenue		
Environmental schemes~	60,709	28%
Basic payment	63,364	29%
Other revenue (e.g. diversification)	4,261	2%
Total	128,334	60%
Total output	*215,255*	100%
Variable costs		
Concentrates & purch'd fodder	26,410	12%
Vet, med, other livestock costs	20,443	9%
Fertiliser & other crop costs	4,872	2%
Total variable costs	*51,725*	24%
Farm Gross Margin	163,530	76%
Fixed Costs		
Labour - paid	16,235	8%
Machinery - contract	10,871	5%
Machinery - repairs, fuel, oil	8,449	4%
Machinery - depreciation	10,664	5%
Building - depreciation	5,574	3%
Rent - paid	13,937	6%
Occupiers repairs	4,375	2%
General overheads	13,291	6%
Interest	7,999	4%
Total Fixed costs	*91,395*	42%
Farm Business Income[1]	72,135	34%
Cash Income[2]	88,357	41%
Net Farm Income[3]	55,795	26%
Beef gross margin per GLU[4]	210	
Sheep gross margin per GLU[4]	262	

~ of which Higher Level Stewardship Scheme accounted for £37,230; remainder from Uplands ELS and ELS schemes.

[1] Farm Business Income (FBI) is equivalent to financial net profit according to standard management accounting conventions. It is the headline measure of farm performance used by Defra. FBI is the return to all unpaid labour (farmer, spouses and others with an entrepreneurial interest in the farm business) and to their capital invested in the farm business which includes land and buildings.

[2] Cash income is simply cash receipts less expenditure. This measure excludes notional items such as depreciation and the effects of livestock and crop valuation changes.

[3] Net Farm Income (NFI) is a former headline measure of farm income used by Defra. It represents the return to the farmer and spouse for their manual and managerial labour and tenant-type capital invested in the farm business. A notional deduction is made for any unpaid labour that is provided in addition to that of the farmer or spouse. Also an imputed rent is deducted for owner occupied land and buildings and for landlord-type improvements made by the tenant. However, it excludes interest paid on any farming loans, overdrafts or mortgages or any interest earned on financial assets.

[4] GLU (Grazing Livestock Unit) is the reference unit used in calculating grassland stocking rates. It is based on the relative energy requirements of each type of animal. One GLU (cow equivalent) is defined in terms of annual metabolizable energy requirements to maintain a 625 kg Friesian cow, produce 4,500 litres of milk and a 45 kg calf.

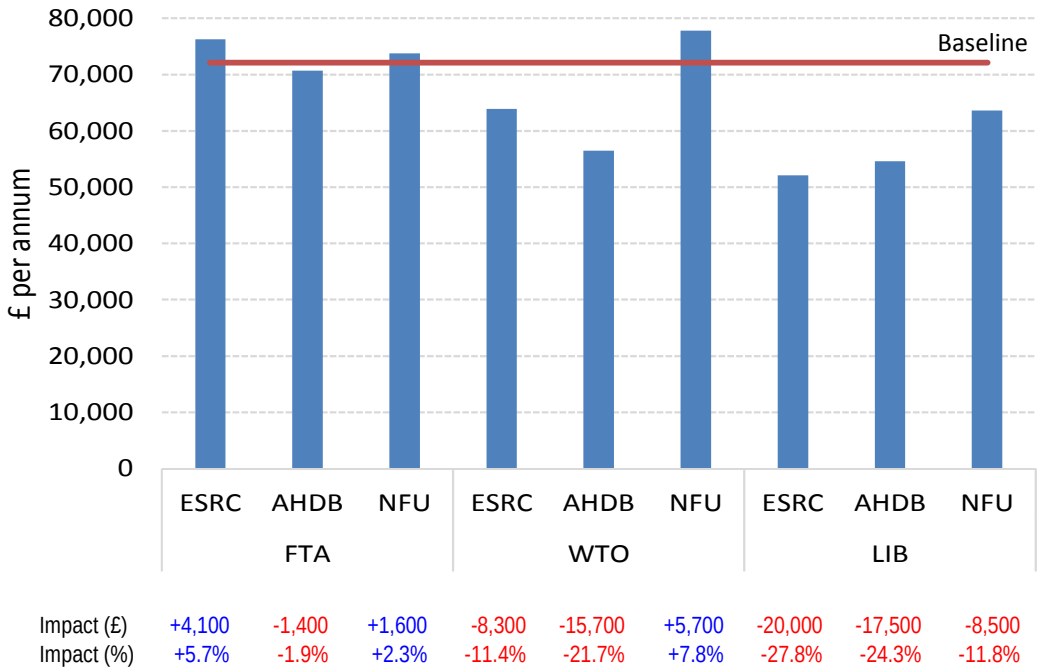
5 Results

We utilise three sets of independent projections ('ESRC', 'AHDB', 'NFU') for three established trade scenarios ('FTA', 'WTO', 'LIB'). The use of three sets of projections provides a form of sensitivity analysis allowing us to evaluate consistencies and divergences in estimated impacts between studies. In the following sections (5.1 – 5.5) we apply these trade scenario projections under 5 different sets of assumptions regarding future domestic support to farmers. All scenario impacts are calculated relative to a status quo (2016) baseline (as detailed in Table 6) with a reference Farm Business Income (FBI) of £72,135.

5.1 Trade scenarios with 'current' direct payments

Figure 1 shows the estimates of FBI under the projections for FTA, WTO and LIB scenarios with direct payments (DPs) unchanged relative to their 2016 levels. Accordingly, this chart demonstrates the impacts of the market (trade) projections alone. Under the 'soft' Brexit FTA scenario, Farm Business Income for the average LDNP farm would remain similar to baseline level if DPs remain unchanged. The estimated impacts of the FTA scenario are similar between the studies.

Figure 1 Farm Business Income under the trade scenarios with 'Current' DPs



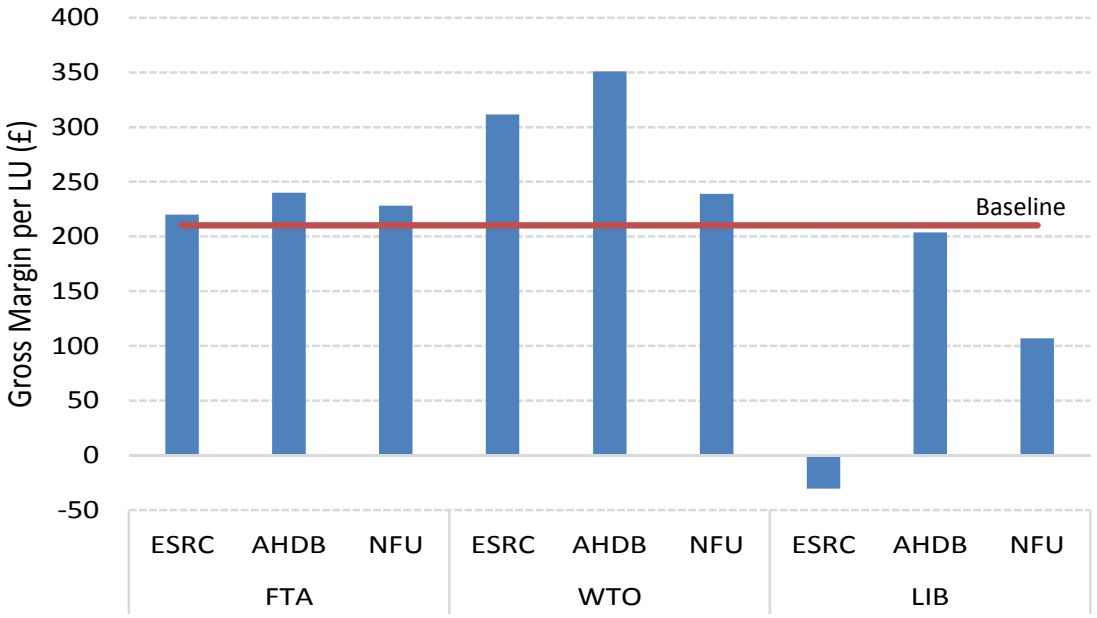
However, there is less consistency in estimates for the WTO scenario with impacts ranging from -22% ('AHDB') to +8% ('NFU')[7]. The 'ESRC' WTO projections suggest an intermediate impact, reducing FBI by 11% (£8,300) relative to the baseline. Under the LIB scenario FBI declines by about a quarter under the 'ESRC' and 'AHDB' market projections. The 'NFU' projections result in a smaller impact (12%) but

[7] An important explanation for the divergence here is that the 'NFU' study assumed that the UK foregoes tariff free imports of beef and lamb under the EU's Tariff Rate Quotas (TRQ). This would reduce the competitiveness of imported products that previously benefited from the TRQ regime, thereby elevating domestic beef and lamb prices (and farm incomes) in the UK. The 'ESRC' and 'AHDB' assumed that the UK retains its share of the EU TRQs and this seems a likely outcome based on the status of the negotiations at the time of writing.

it is important to recall that the 'NFU' study assumed a 50% reduction in UK import tariffs compared to 100% reduction in 'AHDB' and 'ESRC'.

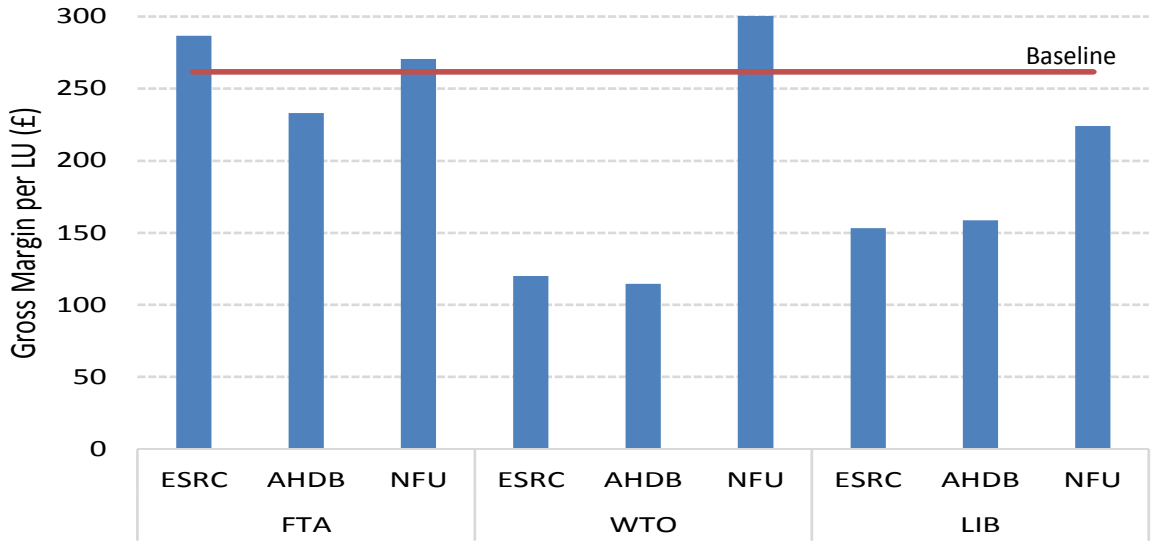
Figures 2 and 3 show the impacts of the scenarios on the gross margins per Grazing Livestock Unit (i.e. cow equivalent) for beef and sheep enterprises, respectively.

Figure 2 Beef Gross Margin per Grazing Livestock Unit



Impact (£)	+10	+30	+18	+101	+141	+29	-241	-7	-104
Impact (%)	+4.6%	+14.0%	+8.4%	+48.1%	+66.8%	+13.6%	-114.6%	-3.2%	-49.2%

Figure 3 Sheep Gross Margin per Grazing Livestock Unit



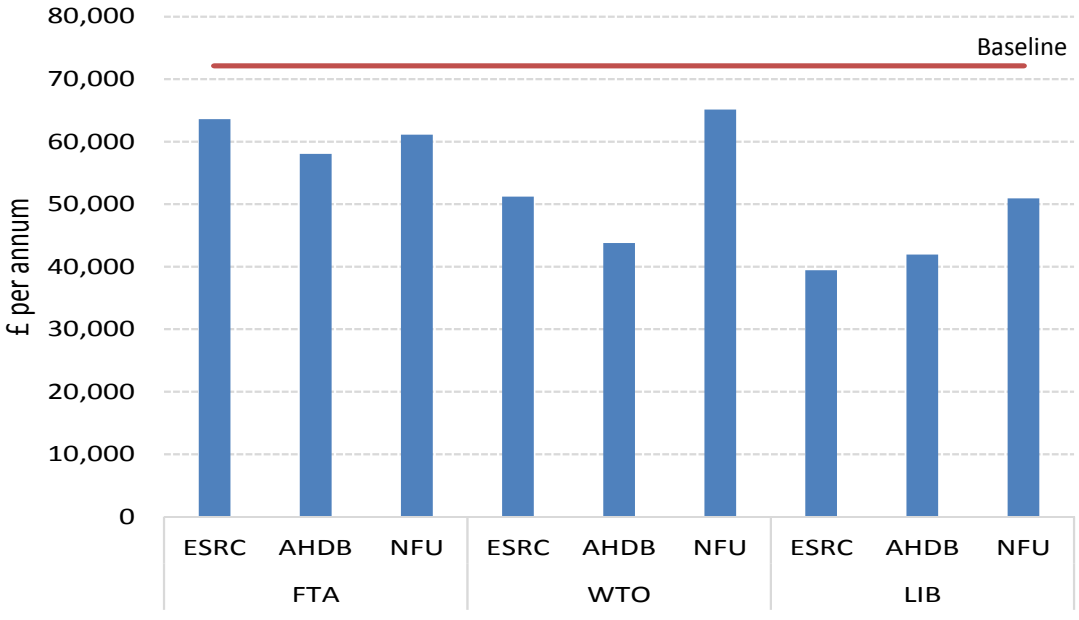
Impact (£)	+25	-29	+9	-142	-147	+45	-108	-103	-38
Impact (%)	+9.6%	-11.0%	+3.4%	-54.1%	-56.2%	+17.1%	-41.4%	-39.4%	-14.4%

These charts highlight that under some scenarios the relative margins of beef versus sheep production enterprises is substantially altered due to diverging price effects. For example, under the WTO scenarios the 'ESRC' and 'AHDB' projections suggest increased beef gross margins while sheep margins decline sharply. Under the LIB scenario, projected impacts on beef gross margins are substantially more negative under 'ESRC' projections compared to 'AHDB.' Possible enterprise substitution effects that could arise from such shifts in relative cattle and sheep margins are considered in Section 5.6.

5.2 Trade scenarios with 'transitional' direct payments

Figure 4 shows the estimated FBI under the trade scenario projections and the 'transitional' DP assumptions of a 20% reduction in Pillar 1 and no change in Pillar 2 revenues. Under these conditions the FTA projections reduced FBI by between 12% ('NFU') and 20% ('AHDB'). THE WTO scenario resulted in reductions in FBI of between 10% ('NFU') and 39% ('AHDB') while income reduction under LIB ranged from 29% ('NFU') to 45% ('ESRC').

Figure 4 Farm Business Income under the trade scenarios with 'Transitional' DPs



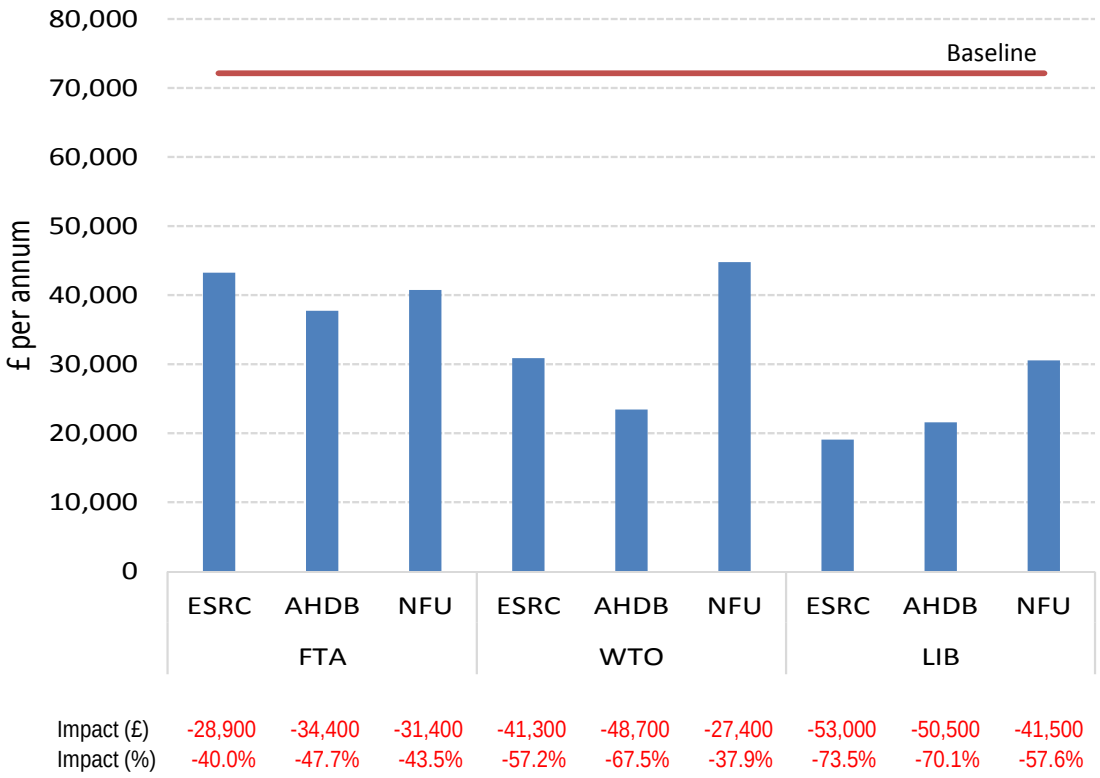
Impact (£)	-8,500	-14,100	-11,000	-20,900	-28,300	-7,000	-32,700	-30,200	-21,200
Impact (%)	-11.8%	-19.5%	-15.3%	-29.0%	-39.3%	-9.7%	-45.3%	-41.9%	-29.4%

5.3 Trade scenarios with 'rebalanced' direct payments

Figure 5 shows the estimated FBI under the trade scenario projections and the 'rebalanced' DP assumptions comprising removal of Pillar 1 and expansion of Pillar 2 revenues by 50%. The Pillar 2 (agri-environmental) revenues would increase to £91,000 (i.e. +£30,400 cf. baseline) but overall DP revenues decline by £33,000 due to elimination of Pillar 1 support. Given this reduction in DPs, FBI is reduced by between 40% and 48% under the evolutionary FTA scenario. However, FBI could decline

by more than 70% under the LIB scenario projections and as much as two-thirds under the WTO scenario, mostly due to the assumed change in DPs.

Figure 5 Farm Business Income under the trade scenarios with 'Rebalanced' DPs

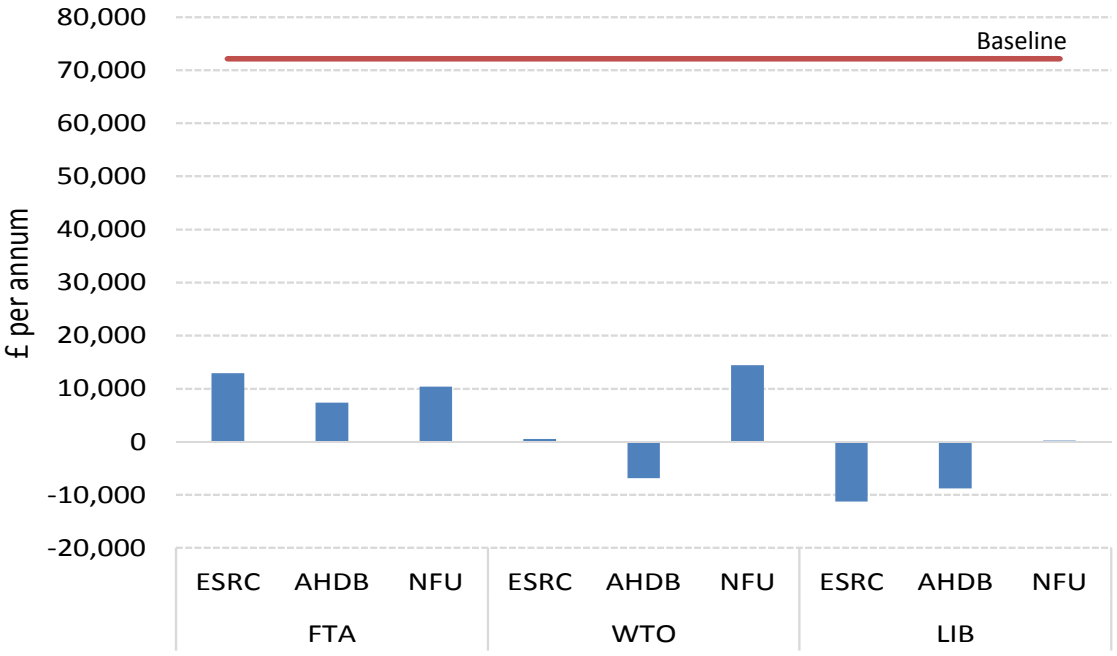


Impact (£)	-28,900	-34,400	-31,400	-41,300	-48,700	-27,400	-53,000	-50,500	-41,500
Impact (%)	-40.0%	-47.7%	-43.5%	-57.2%	-67.5%	-37.9%	-73.5%	-70.1%	-57.6%

5.4 Trade scenarios with 'austere' direct payments

In Figure 6 we show the estimated impacts of an 'austere' policy where Pillar 1 payments are eliminated with Pillar 2 (agri-environmental) payments held constant at their 2016 level. Given the high share of FBI accounted for by Pillar 1 payments it is not surprising that this policy would decimate farm income under all of the trade scenarios. While famers could mitigate these reductions through business reorganisation and efficiency improvements it is doubtful that such production changes would be sufficient to fully replace the Pillar 1 revenue foregone. Under 2016 conditions, farm production output would need to increase by 73% (through better technical efficiency and/or higher prices) in order to maintain FBI at baseline level in the absence of Pillar 1 payments. Alternatively, increases in non-farm income sources (e.g. diversification) could offset some of the reduction. However, average diversification revenues for the FBS sample of LDNP farms was less than £5,000 in 2016.

Figure 6 Farm Business Income under the trade scenarios with 'Austere' DPs



Impact (£)	-59,200	-64,800	-61,700	-71,600	-79,000	-57,700	-83,400	-80,900	-71,900
Impact (%)	-82.1%	-89.8%	-85.6%	-99.3%	-109.6%	-80.0%	-115.6%	-112.2%	-99.7%

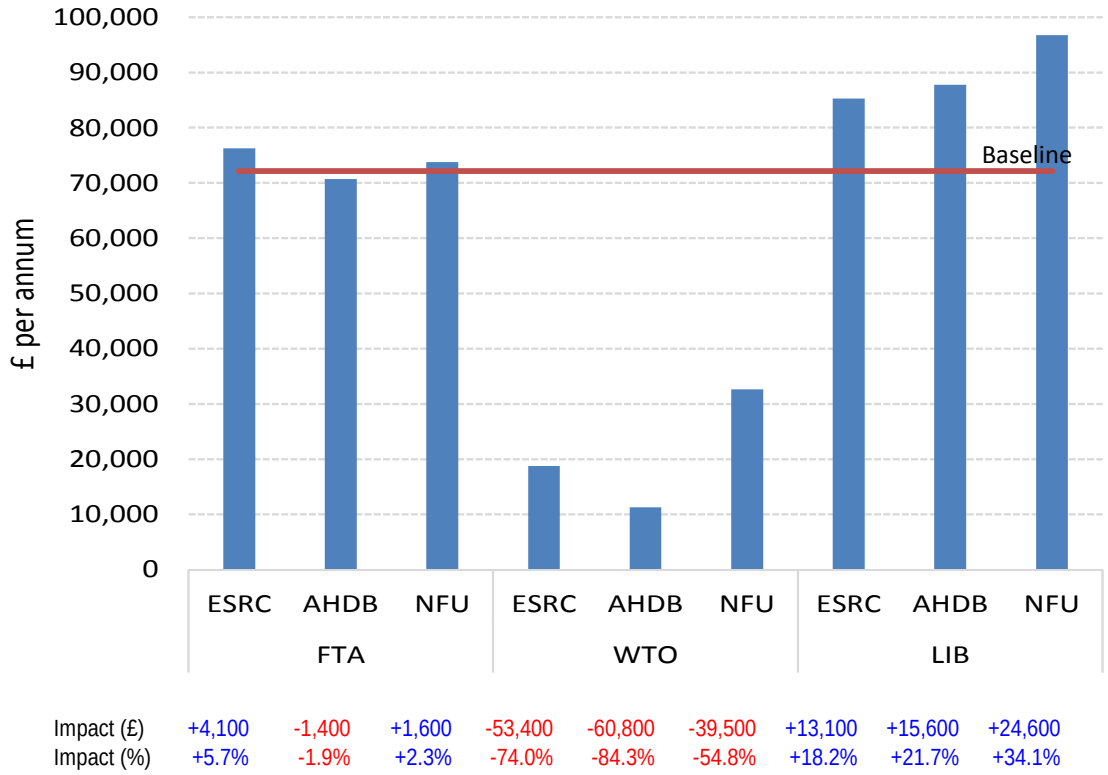
5.5 Trade scenarios with Bradley & Hill ('AHDB') direct payment assumptions

Figure 7 shows the FBI estimates using the DP assumptions employed by Bradley and Hill (2017) in their study for AHDB. Recall that Bradley and Hill (2017) applied different support policy assumptions under each trade scenario. Under their 'Evolution' scenario FTA projections are combined with no change in DPs. However, in their 'Fortress UK' (WTO) and 'Unilateral Liberalisation' (LIB) scenarios, Pillar 1 payments are reduced to zero with Pillar 2 (agri-environmental) payments increased, respectively to account for 25% and 50% of baseline total support disbursed nationally. This corresponded to an increase of 130% and 259% in the Pillar 2 revenues under WTO and LIB, respectively (see AHDB, 2017)[8]. In each case the Pillar 2 expansion was treated as additional FBI and additional compliance costs were not considered.

As observed in Figure 7, the consequence of these assumptions are that FBI is substantially reduced under 'Fortress UK' (WTO), increases markedly under 'Unilateral Liberalisation' (LIB) while it remains virtually unchanged under 'Evolution' (FTA). However, a possible weakness of the Bradley and Hill (2017) approach is that the use of different DP assumptions under each trade scenario tends to mask important underlying impacts of the market (price) changes projected.

[8] This increases Pillar 2 revenue for the LDNP farm to £78,900 and £157,200 under WTO and LIB, respectively, compared to a baseline (2016) level of £60,700.

Figure 7 Farm Business Income under the trade scenarios and Bradley & Hill DP assumptions



5.6 Scope to mitigate impacts through farm management

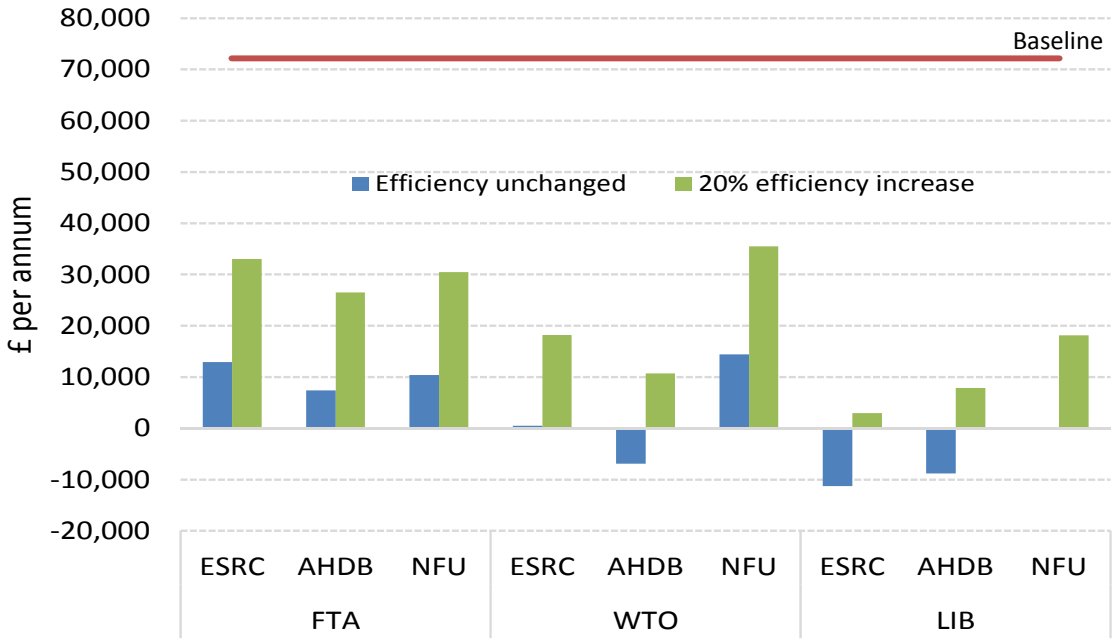
Recall that the comparative static analysis reported in the previous sections estimates first order effects under the assumption that there are no changes in farm structure (e.g. enterprise mix) or technical efficiency. In Figure 8 we evaluate a 20% improvement in technical efficiency, assessing the extent to which this could offset foregone revenue from reduced DPs under the 'austere' policy. In this assessment lambs reared per ewe were increased from 1.15 to 1.38[9] and weaned calf output was increased from 216 kg/cow to 260 kg/cow, with input levels held constant. Figure 8 highlights that this efficiency improvement would enhance FBI by between £14,300 and £20,100 across the range of scenarios. However, this very substantial increase in technical performance would not be sufficient to fully offset the loss of DP revenue under the 'austere' policy assumptions.

Farmers may also mitigate some of the scenario impacts through enterprise substitution. The changes in relative gross margins of sheep versus beef production were previously shown in Figures 2 and 3. For example, under the 'ESRC' LIB scenario the beef enterprise gross margin declined dramatically to -£31 per GLU while sheep margin declined by a smaller extent to £153 per GLU. Under these conditions a rational farm manager can be expected to alter his/her enterprise mix, diverting resources from the activity that has become relatively less profitable. Taking the 'ESRC' LIB scenario we tested the impact of exiting beef production and expanding sheep on the released land. This option produced an improvement in FBI under the scenario of £8,500.

[9] The proportions of sales as finished lambs, store lamb, and ewe lambs was kept constant at baseline levels of 45%, 32% and 23%, respectively. We also assume no change in lamb weights.

A converse situation is noted in the 'AHDB' WTO scenario where sheep margin declines more substantially than beef margins. Again it may be possible to offset some of the scenario impact through enterprise substitution. However, the scope for such changes will be more limited by natural constraints faced by upland farms given that certain land is generally only suitable for grazing sheep.

Figure 8 Impact of 20% increase in technical efficiency on Farm Business Income under trade scenarios with 'Austere' assumptions for DPs



Efficiency gain (£)	+20,100	+19,100	+20,100	+17,700	+17,600	+21,100	+14,300	+16,600	+17,900

It is also noted that farmers may be able to further reduce costs (especially overheads) when faced with dramatic revenue loss under some of the scenarios. This could include reducing certain discretionary expenditures (esp. capital items), renegotiation of rental agreements, lower hired labour use, etc. A plausible saving of say 10% would reduce overhead costs by some £9,000 relative to baseline.

Finally, some holdings may be able to enhance earnings from on-farm diversification and/or off-farm sources. Income from farm diversification currently accounts for a very small (<£5,000) component of average FBI for the LDNP farms in our sample. Clearly, this also varies considerably across farms but the low base suggests that there is scope for further enhancement in this area.

Taken in combination it may be possible for the LDNP farm to offset a significant share of lost revenue through efficiency improvement, changes to enterprise mix, cost reductions and diversification. Success would require decisive, skilled and focussed managerial actions and such adaptations would be dependent on the capabilities of individual farmers and their families.

6 Conclusion

Dependency of LFA grazing farms on direct support payments

The high dependency of LFA beef and sheep farms on direct payments (DPs) through the Common Agricultural Policy is well recognised. This dependency is reflected in data for the LDNP farms where total direct payments (Pillar 1 and Pillar 2) accounted for almost 60% of gross farm output and 170% of Farm Business Income. The LDNP farms in our sample were substantially larger than the national average for LFA grazing farms. Reflecting their larger size, revenue from direct payments contributed over £120,000 on average for farms in our LDNP sample in 2016. These revenues were split almost evenly between Pillar 1 (BPS) and Pillar 2 (agri-environmental) schemes. We also noted that the share of output and income accounted for by direct payments among the LDNP farms was much higher than the national average for LFA grazing farms. Most of the difference was due to substantially higher receipts of agri-environmental payments by the LDNP farms amounting to some 28% of output compared to 15% for SDA grazing farms, nationally.

Largest impacts from potential reductions in CAP-related DPs

The high dependence on DPs means that LDNP farms, like other LFA grazing farms, are heavily exposed to possible reductions in CAP direct support arising from Brexit. In particular, assumptions we tested concerning reductions in DPs had a notably greater impact on Farm Business Income than the market-related effects of the Brexit trade scenarios evaluated. With competing demands for exchequer resources coupled with the Government's critical stance on Pillar 1 subsidies, farmers need to prepare for a future where DPs are likely to be reduced. The critical impacts of such changes on farming livelihoods mean that transitional (phasing) arrangements are important to give farmers time to adapt their businesses to the new conditions. Moreover, from the perspective of stakeholder organisations there are grounds for a basic level of direct income support to be maintained for LFA farms according to the natural constraints that impose limitations on their productivity and enterprise choice. Such support will also reflect the desire of society to maintain farming in upland areas in order to preserve rural communities and landscapes.

Expansion of agri-environmental schemes

The analysis evaluated situations where support was redistributed from Pillar 1 to Pillar 2, reflecting a 'direction of travel' signalled by the Government (Gove, 2018). It is important to emphasise that this assumed that any increase in Pillar 2 payments would not incur additional compliance costs and would therefore contribute directly to Farm Business Income (FBI). However, this is a tenuous assumption since agri-environmental schemes operate on the principle that they compensate farmers for the costs of providing public goods. The measures implemented by farmers under these schemes impose reductions in productivity and/or additional costs associated with providing the environmental outputs in stewardship agreements. Consequently, our assumption of the expansion in Pillar 2 corresponding fully as new income requires caution. If additional Pillar 2 subsidies are disbursed through expansion of current agri-environmental schemes then their contribution to actual FBI would be considerably less than suggested, i.e. their contribution to income would be reduced by the direct and indirect costs of agreed measures. Moreover, the scope for further expansion in public good outputs from LDNP farms is unclear given their already high level of engagement with current agri-environmental programmes (especially Higher Level Stewardship).

Trade scenarios

Our analysis focussed on three trade scenarios that have been examined in Brexit impact studies. These scenarios encompassed a spectrum from the evolutionary (FTA) to more substantial changes such as the UK defaulting to WTO rules or implementing unilateral trade liberalisation. The scenarios

should be viewed as illustrative of a range of possible trade arrangements rather than speculative of the possible outcome of the negotiations. They are deemed to represent the 'boundary points' within which a final agreement may occur. Clearly, the future outcome will represent a compromise that may be intermediate between some of these 'boundary' scenarios and indeed may include variation by sector.

Market projections from three independent studies

As a form of sensitivity analysis we evaluated the specified trade scenarios using projections derived from three independent studies. Reassuringly, there was a relatively high level of consensus in the overall estimated impacts of the trade scenarios under the three sets of market projections. However, there were notable differences in the composition of estimated impacts based on some divergences between studies in projections for beef and lamb prices as well as wage and rent costs. These differences reflect some of the inherent ambiguities in modelling complex trade scenarios that diverge substantially from the current order.

Market–related impacts: consensus between studies

The consensus between studies was highest in the case of the evolutionary FTA scenario where future trade arrangements remain closest to the status quo. The projections from the three studies indicated that the market-related impacts of the FTA scenario would be fairly neutral, resulting in little change to Farm Business Incomes when DPs are unchanged. In contrast, projections for the unilateral liberalisation (LIB) scenario would be unambiguously negative for beef and sheep producers in the UK. This scenario would sharply expose British farmers to extra competition from low-cost exporters in countries such as Australia, New Zealand, USA and Brazil. For the LDNP farm, the resulting impact could be a reduction in FBI of around 25% (c. £18,000 p.a.) relative to the 2016 baseline, assuming no change in the level of direct support payments.

The implications of the WTO scenario are less clear-cut as market projections are sensitive to modelling assumptions about UK tariff rates and levels of tariff rate quotas. Each of our studies had moderately different modelling specifications and projected impacts on FBI for the WTO scenario ranged from -22% to +8%, assuming DPs remain unchanged. Moreover, results for the WTO scenario indicated opposing effects on margins from beef relative to sheep enterprises. Therefore, the financial impact on individual farms would be sensitive to their degrees of specialisation in either activity. The diverging impacts are a consequence of the balance of trade between the UK and EU in each sector. Since the UK is a net importer of beef from the EU, extra import tariffs under the WTO scenario would shield the sector from competition and increase prices for UK beef producers. The opposite would occur for sheep enterprises; since the UK is a net exporter of lamb to the EU, high EU tariffs under the WTO scenario would shrink exports and depress UK sheep prices. On balance the effect of the WTO scenario is likely to be negative for the LDNP farms, given their focus on sheep production.

Impacts on wider rural economy need to be considered

The sizeable reductions in Farm Business Incomes under specific scenarios would have notable implications for the wider rural economy of the LDNP. While farming accounts for a modest proportion of total rural employment, the interconnected nature of the regional economy means that impacts on the farming sector would cascade through related sectors by the loss in spending power. Consequently, rural employment and economic output in sectors outside primary agriculture could be significantly affected.

Farm-level adjustment

Our analysis focussed on first-order impacts of the scenarios using a comparative static framework for an average LDNP farm. In practice, there will be variation in impacts across farms (by size and

efficiency for instance) and reflecting the varying abilities of farmers to adapt their management in order to mitigate potentially adverse outcomes. This could in some situations mean changes in land use with some fells rewilded or converted to commercial forestry. It is anticipated that structural change would accelerate but the potential upheaval for some farmers may create expansion opportunities for others. As highlighted in our analysis, there is scope for farmers to mitigate some of the financial impacts through efficiency improvement, enterprise substitution, cost management and diversification. However, the potential of such strategies will be business specific and dependent on the entrepreneurial and management skills of farmers and their families. In the context of such change, improved access to advisory and training resources would support farmers in necessary business re-planning and restructuring. In addition, provision of targeted capital grants focussed on business transformation and enhancing resilience could also merit consideration.

Finally, we note that our analysis is limited by its focus on a static, annual time horizon and a single measure of financial performance. The dynamics of longer term impacts of Brexit on farm households particularly in relation to business adaptation, investment, build-up or depletion of resources and other viability indicators merit consideration in further analysis.

7 References

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