The Long-run Impact of Different Exchange Rates on the Projected Agricultural Income of an Export Dependent Region of the UK.

by

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Working Paper, Agricultural and Food Economics, Queen's University Belfast.
December 2000.

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Abstract

This paper evaluates the effects of different exchange rate scenarios on projections for agricultural incomes and prices in a small highly export dependent region, NI. The modelling system used in the analysis is designed to capture the complexities of the relationship between exchange rates and agricultural prices and incomes. The system models not only the main agricultural sectors in NI but also the demand for and supply of agricultural commodities in the EU and beyond. This is important, given that NI is a price taker and the EU is the main export destination for its agricultural production. The analysis serves to underline the importance of exchange rates for the NI agricultural economy. When the euro is weak against sterling then agricultural sector incomes are substantially lower than when the euro is strong against sterling. Approximately, a one per cent weakening/strengthening of the euro against sterling is projected to reduce/increase aggregate net receipts in the dairy, beef and sheep sectors by one per cent. This means that exchange rate movements, which are outside the control of the agricultural community, have a dramatic affect on agricultural incomes in NI. This conclusion should be considered against the backdrop of a 28% drop (approx.) in the value of the euro against the pound that has occurred since 1995. The impact of exchange rate movements on producer prices appears to be less pronounced.

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1. Introduction

The aim of this paper is to measure the impact of exchange rates on agricultural producer prices and sector incomes in an export dependent region that can be effectively considered a price taker. It was Schuh (1974) who first emphasised the significant effects of exchange rate fluctuations on agriculture. Most studies agree that an appreciation (depreciation) of the exporting countries currency will hinder (improve) agricultural exports. Sadorsky (2000) states that "exchange rate movements may be an important stimulus for commodity price changes". Guzel and Kulshreshtha (1995) find that an appreciation of the Canadian dollar would harm agricultural households through decreased prices, outputs and incomes.

The agricultural sector in Northern Ireland (NI) is strongly orientated towards export markets. For example, in the case of beef, during the period 1990 to 1998, NI had five outlets for its beef: the local market; Great Britain (GB); other EU member states; third countries outside the EU; and EU market intervention outlets. The local market accounted for only about 20 per cent of production with a further 30 per cent of beef going to GB. The remaining 50 per cent of output was either exported or taken up by market support measures. Between May 1993 and March 1996 (the onset of the BSE crisis), all production in excess of GB and local demand, was exported to EU member states and third countries. A similar situation exists for dairy products and sheepmeat. The more a region is orientated towards export markets the more exposed it becomes to the impacts of exchange rate movements.

There has been a considerable decline in farm incomes in Northern Ireland since 1995 (see Figure 1). Many commentators point to exchange rate movements as a major reason for this decline. Indeed, the introduction of the EU agri-monetary compensation scheme was to some extent an official recognition of the problems that exchange rate movements cause for agricultural incomes. A strengthening of sterling (or increase in the value of the importing

countries currency against sterling), ceteris paribus, will hinder exports and can be expected to have an adverse effect on producer incomes. During the last five years there has been a continued decrease in the value of the euro[1] against sterling (or strengthening of sterling against the euro) as can be seen from Figure 2.

Figure 1.

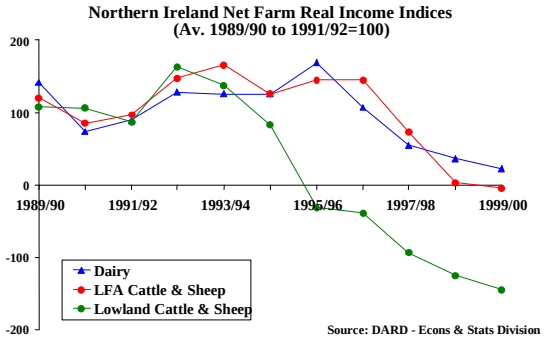
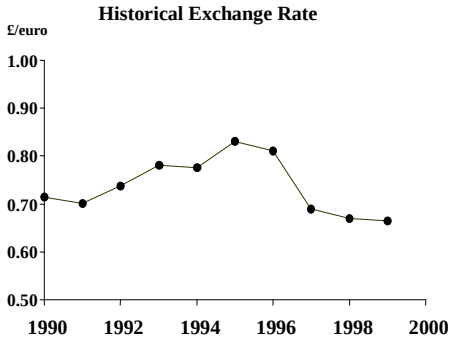


Figure 2.



In evaluating the effects of exchange rate movements on agricultural sector incomes, it is inappropriate simply to compare past exchange rate movements with movements in sectoral incomes because underlying demand and supply changes may be more important determinants. Furthermore, exchange rate movements that affect agricultural commodity prices may also affect agricultural input prices (Carter *et al.* 1990). Indeed, the impact of the latter may reduce or reverse the impact of the former on agricultural incomes. Another complicating factor is that producers in NI receive direct payments from the EU under the Common Agricultural Policy (CAP), which are set in euros and then converted into sterling upon payment. Therefore the £/euro exchange will influence the level of direct payments for these producers. The lower the value of the euro relative to sterling, the lower direct payments are when paid in the national currency. A further consideration is that when sterling is strong relative to the euro this pulls imports of agricultural products from other EU countries into the GB market. This puts downward pressure on GB market prices which in turn depresses producer prices in NI.

Two principle concerns arise in modelling the impact of different exchange rate scenarios on projected agricultural prices and incomes in Northern Ireland. Firstly, the complexities of the

[1] Against the ecu prior to 1 January 1999.

relationship between exchange rates and agricultural prices and incomes must be captured. This is particularly important given that the usual ceteris paribus assumptions will not be invoked. Secondly, NI agriculture cannot be modelled in isolation, since such a large proportion of agricultural production is exported and because of its size the region must be considered a 'price taker'.

Adopting a partial equilibrium modelling approach, which can capture the dynamics of underlying demand and supply, addresses the first of these concerns. In order to address the second issue the models developed must extend to the EU and beyond. Consequently, to assess the impact of exchange rate movements on NI agricultural incomes, we use econometrically estimated commodity models developed for the dairy, beef and sheep sectors in NI that are linked to a partial equilibrium model of EU agriculture developed by the Food and Agricultural Policy Research Institute (FAPRI)[2]. This EU model forms a constituent component of the FAPRI Global modelling system. The design of this combined modelling system permits simulation, which produces ten-year projections of key variables in the main agricultural sectors. These simulations are normally carried out under different policy scenarios/macro assumptions for the purpose of comparative economic analysis. In this paper the simulations are repeated for three different £/euro exchange rate (and associated $/euro exchange rate) scenarios to assess their impact on the dairy, beef and sheep sectors in NI.

In the next section the combined modelling system is described in greater detail and key assumptions are outlined, followed by a description of the exchange rate scenarios used in each simulation. The results of the model simulations are then discussed and their implications considered.

2. The Modelling System.

The modelling system described in this paper is composed of two elements. The first element is a partial equilibrium model of EU agriculture developed by FAPRI as part of their global modelling system. Sectoral models for NI agriculture, consisting of a set of econometrically estimated equations, form the second element which is linked to the first element through price transmission equations. The combined modelling system simulates agricultural markets

[2] A joint institute of the University of Missouri and Iowa State University.

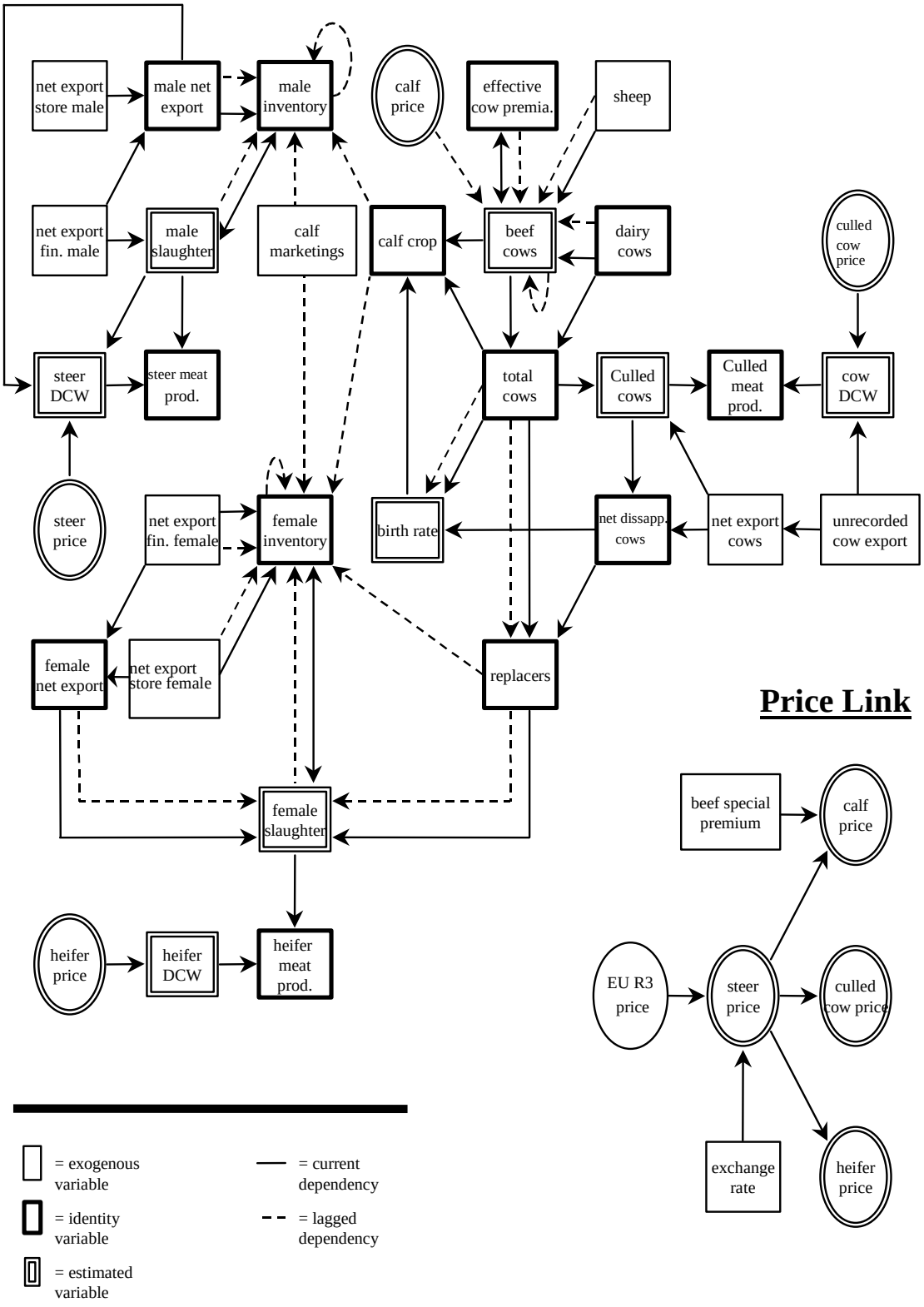
and produces estimates of key agricultural variables projected over a ten-year horizon. The system generates separate estimates for each policy/macro scenario and these are then used in a comparative analysis. The simulation process under each policy/macro scenario requires a two step procedure. Firstly, based on the policy/macro scenario of interest and a given set of exogenous variables (reflecting the different world economies, policy instruments, and other determinants of producer and consumer behaviour) the FAPRI global modelling system, including the EU component, is solved (Brandt *et al.* 1990). This process generates ten-year projections for key agricultural variables. In the second step the EU commodity prices are transmitted to the NI models (reflecting the fact that NI is a price taker) which are then used to generate estimated ten-year projections of key agricultural variables. The whole process is repeated for each policy/macro scenario. The results generated under these different policy/macro scenarios are compared to assess their comparative impacts. The two elements of the global modelling system are now described in greater detail beginning with the FAPRI EU and global models.

FAPRI EU and global models.

Over the last twenty years FAPRI have developed multi-market, structural, dynamic, non-spatial, partial equilibrium models of international agricultural markets for use in preparing ten-year market projections for the purpose of conducting policy analysis (Westhoff and Young, 2000). The modelling system covers world markets for wheat, maize, soybeans, rice, cotton, sorghum, sugar, meats and dairy products. For most commodities, the system generates supply, demand and trade estimates for the United States, the European Union, Japan, Canada, Australia, Russia, China, Argentina, Brazil and Mexico. The modelling system is dynamic, reflecting investment behaviour and lags resulting from biological processes. The models generate estimates of each country's net trade in each agricultural commodity, but do not trace bilateral trade flows. A key feature is the integrated nature of the models both across countries and commodities. Where trade in agricultural commodities exists, prices in one country cannot be determined without reference to demand and supply in the other countries nor for other commodities.

Figure 3.

Diagrammatic Schema for NI Beef Model.



Price Link

Due to the extensiveness of this modelling system, there is no single document describing it in its entirety. However, the US crops models are documented in Westhoff *et al*. (1990) and the US livestock models are described in Brandt *et al*. (1990) along with a listing of documentation setting out individual equations. The models are renewed and reviewed on an annual basis and the most recent developments in the EU commodity models are described in Westhoff and Young (2000).

Sectoral models for Agriculture in NI.

A set of NI agricultural commodity models have been developed which are compatible with, and linked through a series of price transmission equations (for example, Equation 2 in Appendix A) to the FAPRI EU partial equilibrium model. In using this linkage the small-country assumption concerning price formation in NI is made, i.e. due to its small size and the large proportion of agricultural production that is exported to other EU countries, NI is be assumed to be a price taker (Moss et al., 2000). Individual models, consisting of a set of econometrically estimated equations based on time series data, have been developed for the dairy, beef and sheep sectors. An agricultural inputs model has also been developed. There are approximately 125 equations in the (NI) system, of which 40% are behavioural while the remainder are identities. The models aim to capture the biological nature, as well as the economics, of production. Four equations from the beef model are presented in Appendix A, in order to give the reader some idea of the nature of the econometric simulation modelling system. For illustrative purposes, the internal and external linkages of the NI beef model are described in Figure 3 using a flowchart.

3. Exchange rate scenarios and assumptions used in the model simulations.

The combined modelling system, outlined above, simulates agricultural markets and in this instance generates estimates of key agricultural variables projected over a ten-year horizon under three different exchange rate scenarios. Each scenario represents a different ten-year projection for the UK pound/euro (£/euro) exchange rate (see Figure 4). For each scenario there is an associated ten-year projection (2000-2009) for the US dollar/euro ($/euro) exchange rate. The FAPRI-EU modelling system is directly affected by $/euro exchange rate movements. The NI Agricultural modelling system is directly affected by £/euro exchange

rate movements and indirectly affected by $/euro exchange rate movements (via price transmission from EU prices). The three scenarios are as follows:

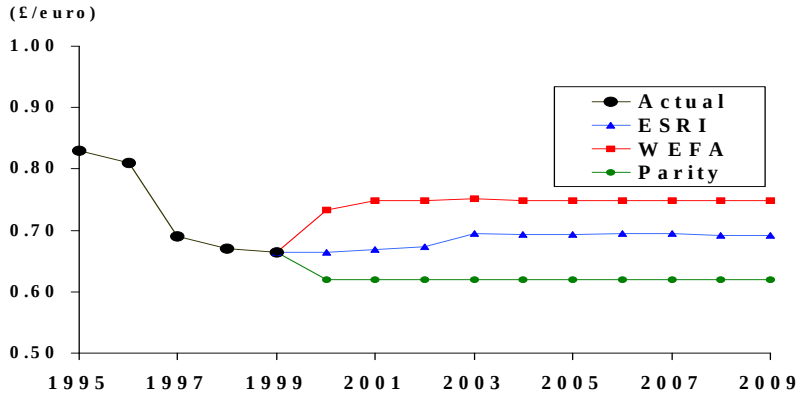
- The first £/euro exchange rate scenario is based on projections produced by the Economic and Social Research Institute (Dublin) and is referred to as the ESRI scenario. Under the ESRI scenario projections for the £/euro exchange rate in 2000 is the same as in 1999 and then moves to 1 euro equal to 69 pence by the end of the projection period (2009) (see Figure 4). In the associated exchange rate scenario for the $/euro the euro depreciates against the US dollar in 2000 and then gradually recovers to 1 euro equal to 1.14 dollars by the end of the projection period.

- The second scenario is based on estimates from Wharton Econometric Forecasting Associates (WEFA) and is referred to as the WEFA scenario. In this scenario the euro appreciates against sterling to 1 euro equal to 75 pence by the end of the projection period (see Figure 4). In the associated $/euro exchange rate for this scenario the euro appreciates against the US dollar and 1 euro equals 1.23 dollars by the end of the projection period.

- The third scenario is referred to as the 'parity' scenario and it should be noted that the name derives from the associated $/euro exchange rate. In this scenario the £/euro exchange rate is maintained at 1 euro equal to 62 pence over the projection period (see Figure 4). In the associated $/euro exchange rate for this scenario 1 euro equal to 1 dollar throughout the projection period (2000-2009).

The FAPRI Global and EU models produce ten-year projections under each exchange rate scenario and the resultant prices transmitted to the NI Agricultural modelling system, which is the used to produce ten-year projections for NI. Both elements of the system are solved sequentially on a year by year basis and this involves an iterative process among the sector models. The ten-year projection period is chosen to allow sufficient time for most biological lags to reach equilibrium.

Figure 4: Historical Exchange Rate & Projection (£/euro)



Many of the behavioural equations in the FAPRI global modelling system contain exogenous variables. The key exogenous variables in the demand side, in addition to exchange rates, are oil prices, GDP and population growth. Ten-year projections for these exogenous variables must be obtained prior to running the models. The sources for these variables are organisations such as Wharton Econometric Forecasting Associates and Project Link (United Nations). The other key macro assumptions used in the FAPRI modelling system are outlined in Young and Westhoff (2000). The main exogenous impact on the supply side equations stems from CAP policies. All projections are produced on the basis that current policies remain in place throughout the projection period. It is also assumed that no further EU enlargement occurs during the period. In the simulation of the NI Agricultural Modelling system the following assumptions are made:

- the Berlin Agreement on Agenda 2000 policies is fully implemented. This includes planned changes to current policy instruments;
- there is no new agri-monetary compensation for exchange rate movements in 2000;
- producers in NI continue to be net importers of dairy quota from GB, although the amount of dairy quota imported gradually diminishes over the period;
- the Over Thirty Months Scheme (OTMS) continues to operate.

The same assumptions and projections for exogenous variables (other than exchange rates) are used in each model simulation.

4. Scenario Projections

In this section the projections for NI under each scenario are presented and compared. In all cases the projection period is from 2000 to 2009. The projections relating to the world and EU agriculture are not presented, but can be found in Young and Westhoff (2000) and Binfield *et al*. (2000). The ESRI exchange rate scenario projections for NI agriculture, presented in Table 1a, form a benchmark against which the other projections are compared. The projections under the WEFA and Parity exchange rate scenarios are compared against the ESRI scenario results and are presented as percentage deviations in Tables 1b and 1c, respectively. The volume of output from the models is such that only the projections for key variables under each scenario are provided. The discussion focuses on the impact of the different exchange rate scenarios on projections for producer prices and sectoral incomes.

Table 1a. Model Projections based on ESRI exchange rate forecasts.

		1999	2000	2001	2002	2003	2005	2007	2009
Dairy cow numbers	('000 head)	286	291	295	296	296	296	294	290
Producer's milk price	(ppl)	18.5	18.3	18.2	18.2	18.6	18.1	17.5	17.5
Value of milk sales	(£m)	290.0	293.0	298.2	302.7	312.9	310.3	303.7	305.1
Direct payments (Dairy)	(£m)	0.0	0.0	0.0	0.0	0.0	9.8	29.7	29.6
Total Dairy receipts	(£m)	290.0	293.0	298.2	302.7	312.9	320.1	333.3	334.6
Beef Cow Numbers	('000 Head)	332.2	318.1	309.6	306.9	306.2	305.3	304.1	303.0
Quantity of Beef output	('000 tonnes)	114.6	113.9	119.4	121.1	121.5	121.0	120.4	119.4
Ave. Beef producer price	(p/kg dwt)	145.5	150.2	151.4	151.5	152.3	146.6	144.9	141.7
Beef Market Receipts	(£m)	201.3	202.8	211.1	212.8	214.1	205.6	202.6	196.6
Direct Payments (Beef)	(£m)	125.6	136.7	154.4	180.2	183.4	185.6	182.1	181.4
Total Beef Receipts	(£m)	326.9	339.4	365.5	393.0	397.5	391.2	384.6	378.0
Breeding ewes	('000 head)	1404.9	1380.7	1358.3	1345.7	1335.7	1311.6	1295.0	1280.6
Lamb/sheep Marketings	('000 head)	1516.8	1423.4	1404.1	1380.8	1370.7	1343.7	1324.4	1309.0
Average lamb/sheep price	(p/kg dwt)	175.3	188.1	192.4	187.9	192.3	196.3	195.4	196.8
Sheep Market Receipts	(£m)	54.6	54.8	55.7	53.6	54.3	54.2	53.0	52.6
Direct Payments (Sheep)	(£m)	33.0	30.9	28.9	28.7	29.5	28.3	28.3	27.5
Total Sheep Receipts	(£m)	87.6	85.7	84.6	82.3	83.8	82.5	81.3	80.1
Aggregate Market Receipts	(£m)	545.9	550.6	564.9	569.1	581.4	570.1	559.2	554.3
Aggregate Direct Payments	(£m)	158.6	167.6	183.3	208.9	212.9	223.8	240.1	238.5
Agg. Receipts	**(£m)**	**704.5**	**718.2**	**748.2**	**778.0**	**794.3**	**793.9**	**799.3**	**792.8**
Aggregate Inputs	(£m)	241.2	241.9	243.8	245.1	248.3	250.3	250.8	251.3
Agg Net Receipts	**(£m)**	**463.3**	**476.2**	**504.5**	**532.9**	**546.0**	**543.5**	**548.3**	**541.5**

Note: Figures presented for 1999 are actual figures, while all other figures are projections.

Table 1b. The percentage difference between the WEFA scenario projections and the ESRI scenario results

		1999	2000	2001	2002	2003	2005	2007	2009
Dairy cow numbers	('000 head)	0.0%	-0.4%	-0.6%	-0.6%	-0.5%	-0.5%	-0.4%	-0.4%
Producer's milk price	(ppl)	0.0%	7.7%	8.6%	7.7%	5.3%	5.3%	4.7%	5.1%
Value of milk sales	(£m)	0.0%	7.7%	8.6%	7.8%	5.3%	5.3%	4.7%	5.1%
Direct payments (Dairy)	(£m)	0.0%	0.0%	0.0%	0.0%	0.0%	8.0%	7.8%	8.3%
Total Dairy receipts	(£m)	0.0%	7.7%	8.6%	7.8%	5.3%	5.3%	5.0%	5.4%
Beef Cow Numbers	('000 Head)	0.0%	-0.1%	0.4%	0.8%	1.0%	0.7%	0.6%	0.6%
Quantity of Beef output	('000 tonnes)	0.0%	0.7%	0.7%	0.5%	0.2%	0.3%	0.3%	0.4%
Ave. Beef producer price	(p/kg dwt)	0.0%	6.7%	8.3%	7.4%	3.9%	3.1%	3.7%	4.2%
Beef Market Receipts	(£m)	0.0%	7.4%	8.7%	7.6%	4.0%	3.5%	4.0%	4.5%
Direct Payments (Beef)	(£m)	0.0%	0.2%	9.5%	10.1%	8.3%	6.9%	6.7%	7.2%
Total Beef Receipts	(£m)	0.0%	4.5%	9.0%	8.7%	6.0%	5.1%	5.2%	5.8%
Breeding ewes	('000 head)	0.0%	0.0%	0.7%	1.5%	2.3%	3.7%	4.9%	6.0%
Lamb/sheep Marketings	('000 head)	0.0%	0.0%	0.1%	1.1%	2.1%	3.6%	5.1%	6.3%
Average lamb/sheep price	(p/kg dwt)	0.0%	8.1%	10.1%	7.9%	4.8%	5.5%	5.3%	5.7%
Sheep Market Receipts	(£m)	0.0%	8.2%	10.4%	9.4%	7.5%	10.2%	11.7%	13.4%
Direct Payments (Sheep)	(£m)	0.0%	10.2%	11.7%	14.2%	12.4%	12.7%	13.6%	15.0%
Total Sheep Receipts	(£m)	0.0%	8.9%	10.8%	11.1%	9.2%	11.0%	12.3%	14.0%
Aggregate Market Receipts	(£m)	0.0%	7.6%	8.8%	7.9%	5.0%	5.1%	5.1%	5.7%
Aggregate Direct Payments	(£m)	0.0%	2.0%	9.8%	10.6%	8.9%	7.7%	7.6%	8.2%
Agg. Receipts	**(£m)**	**0.0%**	**6.3%**	**9.0%**	**8.6%**	**6.1%**	**5.8%**	**5.9%**	**6.3%**
Aggregate Inputs	(£m)	0.0%	2.0%	2.6%	2.4%	1.8%	1.6%	1.9%	2.2%
Agg Net Receipts	**(£m)**	**0.0%**	**8.5%**	**12.2%**	**11.5%**	**8.0%**	**7.7%**	**7.7%**	**8.4%**

Table 1c. The percentage difference between the Parity scenario projections and the ESRI scenario results

		1999	2000	2001	2002	2003	2005	2007	2009
Dairy cow numbers	('000 head)	0.0%	0.3%	0.4%	0.5%	0.7%	0.6%	0.6%	0.7%
Producer's milk price	(ppl)	0.0%	-5.1%	-5.3%	-5.7%	-7.9%	-7.5%	-7.0%	-6.6%
Value of milk sales	(£m)	0.0%	-5.2%	-5.3%	-5.7%	-7.8%	-7.5%	-7.0%	-6.6%
Direct payments (Dairy)	(£m)	0.0%	0.0%	0.0%	0.0%	0.0%	-10.7%	-10.8%	-10.4%
Total Dairy receipts	(£m)	0.0%	-5.2%	-5.3%	-5.7%	-7.8%	-7.6%	-7.4%	-7.0%
Beef Cow Numbers	('000 Head)	0.0%	0.1%	-0.3%	-0.5%	-0.7%	-0.8%	-0.8%	-0.7%
Quantity of Beef output	('000 tonnes)	0.0%	-0.5%	-0.4%	-0.3%	-0.5%	-0.4%	-0.5%	-0.4%
Ave. Beef producer price	(p/kg dwt)	0.0%	-4.8%	-5.3%	-4.9%	-6.4%	-6.3%	-6.3%	-5.3%
Beef Market Receipts	(£m)	0.0%	-5.2%	-5.4%	-5.0%	-6.7%	-6.6%	-6.7%	-5.7%
Direct Payments (Beef)	(£m)	0.0%	-0.1%	-5.8%	-6.6%	-8.2%	-9.2%	-9.4%	-9.1%
Total Beef Receipts	(£m)	0.0%	-3.2%	-5.6%	-5.7%	-7.4%	-7.8%	-8.0%	-7.3%
Breeding ewes	('000 head)	0.0%	0.0%	-0.6%	-1.4%	-2.3%	-4.6%	-6.4%	-7.9%
Lamb/sheep Marketings	('000 head)	0.0%	0.0%	-0.1%	-1.0%	-1.9%	-4.4%	-6.5%	-8.1%
Average lamb/sheep price	(p/kg dwt)	0.0%	-5.5%	-5.8%	-5.5%	-7.9%	-8.0%	-8.1%	-7.6%
Sheep Market Receipts	(£m)	0.0%	-5.6%	-6.1%	-6.7%	-10.2%	-12.8%	-14.9%	-16.1%
Direct Payments (Sheep)	(£m)	0.0%	-6.1%	-7.5%	-10.2%	-13.4%	-14.9%	-16.4%	-17.2%
Total Sheep Receipts	(£m)	0.0%	-5.8%	-6.6%	-7.9%	-11.3%	-13.5%	-15.4%	-16.5%
Aggregate Market Receipts	(£m)	0.0%	-5.2%	-5.4%	-5.5%	-7.6%	-7.7%	-7.6%	-7.2%
Aggregate Direct Payments	(£m)	0.0%	-1.2%	-6.1%	-7.1%	-8.9%	-10.0%	-10.4%	-10.2%
Agg. Receipts	**(£m)**	**0.0%**	**-4.3%**	**-5.6%**	**-5.9%**	**-8.0%**	**-8.3%**	**-8.5%**	**-7.9%**
Aggregate Inputs	(£m)	0.0%	-1.2%	-1.5%	-1.5%	-2.0%	-2.7%	-3.1%	-2.4%
Agg Net Receipts	**(£m)**	**0.0%**	**-5.9%**	**-7.6%**	**-8.0%**	**-10.7%**	**-10.9%**	**-11.0%**	**-10.4%**

Under all three scenarios producer prices are projected to remain at, or around, the very low levels experienced in 1999. Under the Parity scenario, deterioration in producer prices is projected, particularly in the dairy sector because of the combined pressures of reducing support prices for dairy products and increasing milk quotas planned under the Berlin agreement. Even under the most optimistic exchange rate forecast the projections in this paper suggest a return to the relatively high producer prices experienced in 1995/96 is unlikely.

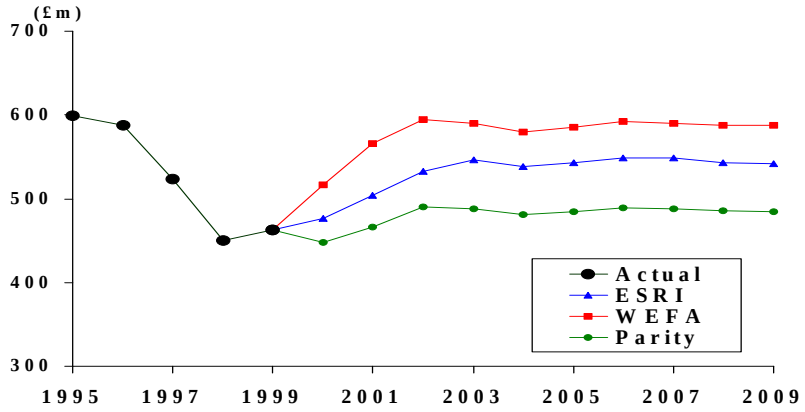
Breeding livestock numbers are projected to fall over the period (less so in the case of dairy cow numbers) under all three scenarios implying a contraction of agriculture in NI. Ewe numbers are the most volatile under the different exchange rate scenarios reflecting the fact that sheep are to some extent the residual enterprise in NI agriculture.

Over the projection period total producer receipts are projected to increase under two of the three scenarios in the case of the dairy sector; increase in the short-run under all three scenarios in the beef sector; and, decrease under all three scenarios in the case of the sheep sector. Most of the observed increases in projected aggregate producer receipts are attributed to the increases in direct payments planned under the Berlin Agreement.

Projected aggregate net receipts[3] (total receipts minus variable costs), which can be thought of as a measure of income for the three main agricultural sectors in the NI economy, are presented in Figure 5. Under the ESRI scenario, aggregate net receipts are projected to grow until 2003 and then remain relatively stable through to 2009. There are two main factors contributing to the projected growth prior to 2003. The first is increasing dairy sector receipts due to increased sales (see Table 1a) facilitated by quota increases in 2000/2001 stemming from the Berlin Agreement and continued quota imports from the UK. The second reason is the increase in direct payments to producers, particularly in the beef sector (see Table 1a).

[3] This term is one of many possible measures of sector income and can be thought of as primary contribution to fixed costs and profit. It is defined as total receipts minus total inputs. Total receipts are those from primary production excluding such items as income from agricultural contract work and quota leasing. Total inputs are essentially variable costs.

Figure 5: Aggregate Net Receipts for Dairy, Beef and Sheep Sectors in NI (£m)



The WEFA scenario projections for aggregate net receipts are higher across the period than those of the ESRI scenario. The higher levels of market prices and direct payments, which are projected under the WEFA scenario (see Table 1b), explain this difference. Under the WEFA scenario sterling is projected to have a lower value against the euro over the period compared with the ESRI exchange rate projections. When a *price taking* exporting country devalues its currency relative to the currency in the export market the effect is an increase in the price obtained when converted back to the exporters domestic currency. A devaluation of sterling against the euro also means that direct CAP payments from the EU, initially denominated in euros, are higher when converted into sterling (see Table 1b). In addition, a devaluation of sterling against the euro leads to higher agricultural input prices. However, these input price increases are less than the increases in direct payments and output prices projected under the WEFA scenario. Consequently, the WEFA scenario projections for aggregate net receipts are higher than those of the ESRI scenario (see Table 1b).

An appreciation of sterling has the opposite effect. Under the Parity scenario sterling has a higher value against the euro over the projection period when compared with the ESRI exchange rate projections (Table 1c). Therefore, the Parity scenario projections for aggregate net receipts are expected to be lower than those of the ESRI scenario across the projection period. An examination of Figure 5 reveals this to be the case. It can also be noted from Figure 5 that it is only under the most optimistic £/euro exchange rate projection (WEFA), that aggregate net receipts are expected to reach levels close to those of 1995/96.

In summary, agricultural incomes in NI are projected to be lower when the value of sterling against the euro is higher and vice versa. With regard to the magnitude of this exchange rate impact it is instructive to compare the projections for each exchange rate scenario for a specific year. For this purpose the year 2007 is chosen, because by then the Berlin agreement on CAP reform will have been fully implemented. Comparisons of projections for the key variables under each exchange rate scenario are presented for 2007 in Table 2.

Table 2. Comparison of the NI Projections for Key Variables in 2007

	WEFA vs. ESRI	Parity vs. ESRI
Exchange Rate Projections (£/euro)	+7.8 %	-10.8 %
Aggregate Net Receipts	+7.7 %	-11.0 %
Milk Producer Price per litre	+4.7 %	-7.0 %
Net Dairy Sector Receipts	+7.0 %	-10.2 %
Ave. Beef Producer Price (p/kg dwt)	+3.7 %	-6.3 %
Net Beef Sector Receipts	+6.8 %	-10.3 %
Ave. Sheep Producer Price (p/kg dwt)	+5.3 %	-8.1 %
Net Sheep Sector Receipts	+15.3 %	-18.4 %

Comparison the WEFA scenario against the ESRI scenario for 2007 indicates that the euro is higher in value against sterling by 7.8 % (see Table 2). The 2007 projections for milk, beef and sheep producer prices in NI are 4.7 %, 3.7 % and 5.3 % higher, respectively, under the WEFA scenario when compared to the ESRI scenario. Conversely, the euro is lower in value against sterling by 10.8 % in 2007 under the Parity projection when compared to the ESRI projection. Comparison of the 2007 projections indicates that milk, beef and sheep producer prices are 7.0 %, 6.3 % and 8.1 % lower, respectively, under the Parity scenario when compared to the ESRI scenario. These results suggest that the full impact of the difference in exchange rates does not feed through to producer prices. However, this result is not a simple case of incomplete exchange rate pass through, which is a phenomenon widely recognised in the literature and usually attributed to imperfect competition (Dornbusch, 1987; Gross and Schmitt, 2000). Rather, it is explained by the new equilibrium prices generated for each scenario at the EU and global level, given the associated £/euro and $/euro exchange rate projections and after taking account of feedback effects.

Table 2 indicates that projections for aggregate net receipts in 2007 are 7.7 % higher under the WEFA scenario compared to the ESRI scenario. When the Parity scenario is compared to the ESRI scenario projected aggregate net receipts are 11.0 % lower in 2007. These results indicate that the full impact of the difference in exchange rates does feed through to agricultural incomes. A one per cent increase/decrease in the value of the euro against sterling leads to a similar increase/decrease in the aggregate net receipts of the dairy, beef and sheep sectors in NI. Several factors come together to explain this finding. Aggregate net receipts are affected by changes in exchange rates mainly through agricultural commodity prices, which are discussed above, direct payments and agricultural input costs. Changes in exchange rates have a very direct affect on direct payments. It was for this reason that the EU agri-monetary compensation scheme was introduced, although the scheme is designed to compensate for unfavourable movements in exchange rates and not the persistence of unfavourable exchange rates. By the year 2007, direct payments make up over 43% of projected aggregate net receipts under the ESRI scenario. Changes in exchange rates have a less pronounced affect on agricultural input costs in NI, than might be the case in many other regions of the EU, because of the grass based nature of beef, sheep and dairy production in this region. Agricultural input costs in NI are not immune from exchange rate movements because of their affects on artificial fertiliser costs and imported concentrates used for supplementary feeding. However, the main input to a grass based production system is land, the cost of which is not significantly affected by exchange rate movements.

5. Conclusions.

The modelling system presented in this paper is used to evaluate the effects of different exchange rate scenarios on projections for agricultural incomes and prices in a small highly export dependent region, NI. The main advantage of the modelling approach used is that it captures the complexities of the relationship between exchange rates and agricultural prices and incomes, without requiring that the usual ‘ceteris paribus’ assumption be invoked. The system models not only the main agricultural sectors in NI but also the demand for and supply of agricultural commodities in the EU and beyond. This is important, given that NI is a price taker and the EU is the main export destination for its agricultural production.

The analysis presented in this paper serves to underline the importance of exchange rates for the NI agricultural economy. When the euro is weak against sterling (as in the Parity

scenario) then agricultural sector incomes are substantially lower than when the euro is strong against sterling (as in the WEFA scenario). Approximately, a one per cent weakening/strengthening of the euro against sterling is projected to reduce/increase aggregate net receipts in the dairy, beef and sheep sectors by one per cent. This means that exchange rate movements, which are outside the control of the agricultural community, have a dramatic affect on agricultural incomes in NI. This conclusion should be considered against the backdrop of a 28% drop (approx.) in the value of the euro against the pound that has occurred since 1995. The impact of exchange rate movements on producer prices appears to be less pronounced.

It is important to recognise that the projections presented in this paper are based on a given set of assumptions and consequently should not be treated as forecasts. However, based on the assumptions made, the projections suggest a variable outlook for agriculture in NI. Under all three scenarios producer prices are projected to remain well below mid 1990's levels. Given the range of exchange rates considered, breeding livestock numbers are projected to fall in the long run under all three scenarios implying contraction of agriculture in NI. Aggregate net producer receipts are expected to have increased by 2002 under all three scenarios. Most of the observed increases in projected aggregate producer receipts can be attributed to the increases in direct payments initiated by the Berlin Agreement. However, it is only under the most optimistic £/euro exchange rate projection, that agricultural sector incomes are expected to reach the levels enjoyed in the mid 1990's. The analysis in this paper was carried out early in the year 2000, since which time the euro has weakened further against both US$ and sterling. However, the authors do not consider current exchange rates sustainable given the ten-year projection period. Nonetheless, recent evidence would indicate that the most pessimistic of our exchange rate scenarios may be the most likely. With the additional prospect of further trade liberalisation arising from pending WTO negotiations and the eastward enlargement of the EU likely to curtail EU compensation levels the future of farming incomes does not look optimistic.

Appendix A.

A Selection of Equations from the Beef Sector model for Northern Ireland.

1. NI June Beef Cow Numbers

$$X_{1,t} = \underset{(1.08)}{13841} + \underset{(19.9)}{0.802}\, X_{1,t-1} + \underset{(5.46)}{10884.6}\, X_{2,t} - \underset{(-2.69)}{48131.6}\, X_{3,t} + \underset{(5.51)}{17722.5}\, X_{4,t} - \underset{(-2.97)}{8873.1}\, X_{5,t} + \underset{(4.43)}{25225.4}\, X_{6,t}$$

R-Squared = 0.995 Durbin's h-statistic = 0.814 Estimation period 1979-1999

2. NI Steer Price Linkage Equation

$$Y_{1,t} = \underset{(-10.16)}{-129.9} + \underset{(19.8)}{0.903}\, Y_{2,t} + \underset{(7.52)}{119.96}\, Y_{3,t} - \underset{(-4.91)}{27.16}\, Y_{4,t}$$

R-Squared = 0.987 DW statistic = 1.79 Estimation period 1973-1995

3. NI Calf Price Linkage Equation

$$Z_{1,t} = \underset{(0.85)}{4.03} + \underset{(9.53)}{1.41}\, Y_{1,t} + \underset{(2.74)}{0.68}\, Z_{2,t} + \underset{(2.55)}{83.97}\, Z_{3,t}$$

R-Squared = 0.912 DW statistic = 1.68 Estimation period 1973-1997

4. NI Steer Slaughter Weight Equation

$$W_{1,t} = \underset{(2.98)}{43.33} + \underset{(5.93)}{0.49}\, W_{1,t-1} + \underset{(4.32)}{24.78}\, W_{2,t} + \underset{(3.95)}{86.96}\, W_{3,t} - \underset{(-3.35)}{15.76}\, W_{4,t}$$

R-Squared = 0.959 Durbin's h-statistic = 0.69 Estimation period 1974-1998

Definition of Variables

X_1 = June Beef Cow Numbers.
X_2 = Net returns per beef cow (deflated by cost indices).
X_3 = SCP multiplied by switch mechanism which takes account of suckler cow quota.
X_4, X_5 and X_6 = Dummy variables representing changes in policy instruments.
Y_1 = Price per kg of Dressed Steers in NI.
Y_2 = Price per kg of R3 Steers in EU.
Y_3 = Ratio of green exch. rate for beef and nom. exch. rate.
Y_4 = Dummy variable.
Z_1 = Suckler calf price per head.
Z_2 = Beef Special Premium per head.
Z_3 = Dummy variable relating to Calf premium.
W_1 = Dressed Carcass Weight of steers in NI (kg).
W_2 = Price per kg of finished Steers (deflated by cost indices).
W_3 = No. of steers slaughtered as a share of total sales of male animals.
W_4 = Dummy variable for deseasonalisation payments.

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