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Do EU direct payments to beef producers belong in the 'blue box'?*

Seamus McErlean, Ziping Wu, Joan Moss, Jos IJpelaar and Andrew Doherty†

In the Uruguay Round Agreement on Agriculture, so-called 'blue box' support measures were exempted from reduction commitments, provided they were delivered under 'production-limiting' programs. Although classified as 'blue box', the EU system of direct payments (DP) to beef farmers imposes 'claim-limiting' restrictions rather than 'production-limiting' restrictions, allowing farmers to keep additional animals over and above the number upon which they are eligible to claim DP. The present paper provides empirical evidence that EU direct payments capitalise into the market prices of male calves and young steers in Ireland. It is also likely that DP capitalises into the prices of beef cows and heifers. Given this capitalisation process, some farmers can obtain 'capitalised' DP on animals produced over and above the 'claim-limiting' restrictions, by selling these animals through auction markets. Thus, 'capitalised' DP probably encourages production over and above the limiting measures.

1. Introduction

During the Uruguay Round negotiations, a 'traffic light' analogy was adopted to describe the various forms of domestic agricultural support and the extent to which this support was to be reduced or eliminated in line with the concept of trade liberalisation. Negotiators identified trade-distorting measures (such as market price support, direct payments and input subsidies) as 'amber box' and they agreed that these measures should be subjected to reduction commitments of 20 per cent by the end of the implementation period in 2000. 'Green box' programs were identified as non- or minimally-trade-distorting and were not subjected to reduction commitments. Green

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† Seamus McErlean, Ziping Wu and Joan Moss, Agricultural and Food Economics, Queen's University Belfast, UK. Jos IJpelaar, Department of Agricultural and Food Economics, University of Reading, UK. Andrew Doherty, Livestock and Meat Commission for Northern Ireland, Lisburn, UK.

support measures included research, food security stocks, infrastructure, disease control and a range of payments that meet conditions for being considered minimally market distorting, including decoupled income support, income insurance, disaster relief, environmental payments, investment aids and regional payments.

Near the conclusion of the Uruguay Round, as part of the Blair House Accord, the USA and the EU agreed on an additional support category, 'blue box', which was deemed to be transitional. Blue box subsidies were exempt from reduction commitments provided they were delivered under 'production-limiting' programs. The associated conditions where that payments should be based on fixed areas and yields, a fixed number of head (livestock), or made on 85 per cent or less of the base level of production (see the *Agreement on Agriculture*, Part IV, Article 6, Para. 5).

European Union direct payments to beef producers include Beef Special Premia (BSP), Suckler Cow Premia (SCP) and Extensification Payments (EP). It was argued that these payments to beef producers qualify as 'blue box' support because the livestock payments are quantitatively constrained. Significantly, it is the payments rather than production levels that are constrained. The system employs a number of 'limiting' measures which include suckler cow quotas (claims can only be made on cows for which the farmer has SCP quota), stock density rate limits on the livestock for which premiums are claimed, and ninety head (per farm) limits on BSP claims on each age group per year. Roberts *et al.* (1992) discussed the production effects of EU direct payments to beef producers and concluded that some elements may lead to an increase in total beef production, while others may lead to a reduction. Overall, they felt it was likely that there would be little impact on EU beef production, but that there would be significant reallocation of production from more intensive to less intensive operations. In their deliberations, however, Roberts *et al.* (1992) overlooked the possibility that some of the direct payments to beef producers may be capitalised into the prices of male calves and young steers. Should this capitalisation process occur, it would allow beef producers to claim direct payments up to the limits of the 'production-limiting' measures and, in addition, to obtain further (capitalised) direct payments on additional male calves and young steers by selling them in the market place before they are eligible for a direct payment. Consequently, there may be a mechanism whereby individual beef producers can obtain (capitalised) direct payments on animals produced over and above the 'claim-limiting' measures in the system of EU direct payments to beef producers. The existence of such a mechanism would put additional upward pressure on EU beef production, making it less likely that EU direct payments to beef farmers adhere to the 'blue box' definition of production-limiting measures.

Table 1 Republic of Ireland beef livestock numbers and producer prices

Year	1987	1989	1991	1994	1995	1996	1997	1998
Beef cows at June	533	655	817	1000	1025	1093	1177	1217
Beef cattle slaughtering	1344	1147	1497	1271	1363	1514	1631	1760
Finished steer prices (IR£ 100kg dw)	229.8	242.5	222.5	233.8	227.5	194.4	181.2	180.2

Source: Irish Agriculture in Figures, Teagasc, Agriculture and Food Development Authority, Republic of Ireland.

Table 2 European Union beef cow numbers at December

Year	1987	1989	1991	1992	1994	1995	1996
Beef cows	7566	8503	9358	10 149	10 584	10 911	11 124

Source: Agriculture Statistical Yearbook, Eurostat.

In the Republic of Ireland (ROI) between 1987 and 1998 there was a 128 per cent increase in beef cow numbers and a 31 per cent increase in beef cattle slaughtering, despite production-limiting measures being in place (see Table 1). Beef cow numbers in the EU (twelve) have also increased by 47 per cent over the period of analysis (see Table 2). However, finished beef producer prices fell during this period (see Table 1) and so the incentives that encouraged farmers to increase beef production are unclear.

The present paper uses a cointegrating vector autoregression (VAR) framework to assess whether or not BSP and associated EP are capitalised into the prices of young male cattle and, if so, to what extent. The results indicate that these direct payments do indeed capitalise into male calf and young steer prices. This is likely to put additional upward pressure on beef production. Given the trends in Irish and EU beef production since 1992, we question whether EU direct payments to beef producers really belong in the 'blue box'.

In the next section the EU direct payments to beef producers and their likely impact on the market value of steers are discussed. Section three discusses the methodological approach and section four examines the empirical findings. The paper finishes with discussion and conclusions in section five.

2. EU direct payments to beef producers and the market price of steers

The rationale for BSP is primarily to offset the effect on beef cattle prices of adjustments to the EU beef intervention scheme. A brief description of how the scheme operates in the ROI follows.[1] The year 1987 saw the introduction

[1] For the period between 1987 and 1998.

of a single BSP payment which was payable directly to Irish beef producers on application, once only for each male animal of at least nine months old and fattened on the claiming producer's holding. This payment had tripled in value by 1993 and continued to rise over the following 3 years. At this time, revised regulations came into force. The new BSP Scheme regulations offered a range of options from which the individual member states could choose. Under the new regulations the premium could be claimed no more than twice in the lifetime of each male bovine animal. The first premium (BSP1) can be claimed when the animal is between 7 months and 19 months old. The second premium (BSP2) can be claimed when the animal is at least 20 months old. To qualify for either BSP1 or BSP2, any animal upon which a claim is made must be held by the producer for a 2-month retention period. Premium claims are limited by several factors. Claims for BSP1 and BSP2 are limited to a maximum of 90 head per holding per year. The ROI also chose the regional ceiling option. Under this option, when annual BSP claims at any stage exceed the ceiling, all claims are then scaled back accordingly. In addition, claimants must fulfil 'policy' stocking rate criteria in order to qualify for premia.[2] Claimants of BSP can also qualify for an extra payment known as Extensification Premium if their 'policy' stocking density is less than 1.4 livestock units (LU) per hectare. Indeed, as many as 60 per cent of claimants in ROI could expect to qualify for this extra payment. The payment increases if the claimants stocking rate is below 1.0 LU per hectare (Agra-Europe 1998).

The limiting criteria associated with BSP and EP amount to a cap on the total amount of money paid out and while increases in the total number of these claims made at the regional level is not prevented, some attempt is made to limit claims at the farm level. Therefore, given that these limiting criteria relate to claims rather than actual production levels, it is easy to see that production increases are possible within this system. The EU system of direct payments also includes SCP, which is paid to farmers on the basis of strict quotas. Farmers can keep beef cows over and above the quota level but SCP is not payable on these animals. The return on over quota cows comes from the market price of suckler calves sold at auction. Few Irish farmers operate birth-to-slaughter beef production systems (Drennan *et al.* 1995) and how binding the 'claim-limiting' measures associated with the EU system of direct payments are, is dependent upon where in the production chain a farmer operates. For example, farmers involved in finishing

[2] The 'policy' stocking rate differs from the actual stocking rate in that it refers to the number of (equivalent) livestock units per hectare of forage area upon which premium is claimed. The policy stocking rate limit is 2 livestock units per hectare of forage area and no BSP is payable to farmers who are above this level.

beef cattle are less likely to find the constraints binding than those involved in breeding and rearing beef cattle (suckler herd owners). In all cases, farmers can keep more animals than they are eligible to make claims on if they wish.

For the remainder of the present paper direct payments (DP) refer to BSP and EP. Previous studies argue that these DP are being capitalised into male calf and young steer prices. Dunne *et al.* (1998), using an accounting approach, conclude that 'about 44 ECU to 50 ECU is "being bid into the cost (price)" of the male Friesian calf in Ireland'. As these authors state, the capitalisation process is of academic interest only when the animal is fattened for slaughter on the farm on which it is bred. However, they point out that when a male calf or young steer is sold at any stage in the production chain, the capitalised value of the direct payment is released to the seller and becomes a cost to the purchaser in the next stage of production.

There are two ways to view the equilibrium market price per head of a male calf or young steer, prior to the introduction of DP. First, this price can be viewed as reflecting the value of the meat ultimately derivable from the animal (less future production, marketing and processing costs). Second, in equilibrium, the market price per head of a male calf or young steer reflects the production costs associated with the animal plus its purchase cost, if not reared on the producer's own farm. In the present paper we adopt the second specification (although either could be used in the subsequent analysis without altering the conclusions), which is represented by the following equation:

$$P^i = P^j - C^{ij} \quad \text{or} \quad P^j - P^i = C^{ij} \tag{1}$$

where P^i and P^j are steer prices (per head) for different weight categories (i and j) such that $i < j$. C^{ij} represents the cost (including normal profits) of rearing a steer from weight category i to weight category j. Following the introduction of DP, the price of these animals reflects purchase and production costs and possibly a (capitalised) proportion of the value of DP available to producers. If DP are capitalised into the market prices of male calves and steers then Equation (1) becomes Equation (2):

$$P^i = P^j - C^{ij} \pm \phi_{ij} DP \tag{2}$$

The parameter, ϕ_{ij}, measures the (difference in the) relative impact of DP on the two prices. If this parameter is not significant in a range of cases then it suggests that DP do not capitalise into the market prices of male calves and steers. In other words, Equation (1) rather than Equation (2) more adequately describes the relationship between the prices of different weight categories of male calves and steers. In contrast, the significance of the parameter, ϕ_{ij}, across a range of cases, would indicate that DP do capitalise into the market prices of male calves and young steers.

It is further hypothesised that the parameter, ϕ_{ij}, in Equation (2) may be positive or negative, depending on which categories of male calves and steers are compared in the price pair equation. This can be demonstrated by considering equilibrium price pair equations for dropped calves, light store steers (200–250kg steers) and finished steers.[3] Dropped calves and finished steers are chosen as the youngest and oldest steers, respectively, for which market prices are published. Light steers (200–250kg steers) is the highest weight category of steer that can be guaranteed not to include animals upon which premia has been claimed. If DP does capitalise into male calf and steer prices then it is likely that a larger proportion will capitalise into light store steers compared to other weight categories. The reason for this is that all light store steers (200–250kg) have still to receive premia and all are close to the age when the claim can be made. The relevant price equations are as follows:

$$P^d = C^d + \phi_d DP \tag{3}$$

$$P^s = C^s + \phi_s DP \tag{4}$$

$$P^f = C^f + \phi_f DP \tag{5}$$

where C^d, C^s and C^f are all the costs associated with rearing to the dropped calf, light store steer and finished steer stages of production, respectively. It follows that $C^d < C^s < C^f$. The parameters, ϕ_d, ϕ_s and ϕ_f, which each take a value between 0 and 1, measure the proportion of DP that is capitalised into the price of dropped calves, light store steers and finished steers, respectively. It is clear that $\phi_f = 0$ because a finished steer that is sold and slaughtered can no longer be eligible for DP. Beef animals in the dropped calf and light store steer (200–250kg) weight categories are eligible for future BSP1 and BSP2 (and associated EP) payments because they are less than 10 months old. It might be expected that a higher proportion of DP would capitalise into the market price of light store steers compared to dropped calves, but that in both cases the capitalised proportion is less than one. These expectations are based on several factors. First, there are costs

[3] Direct payment is an age related payment, while much of the available data for male calves and steers is published for a range of weight categories rather than age categories. However, the reasonably close correlation between the age and weight of beef cattle should ensure that it is still possible to observe any capitalisation of DP into market prices that is likely to occur.

associated with claiming DP, which means the full value of DP will not capitalise into market prices. Second, there is the possibility that the animal could die before it reaches the age when DP can be claimed. This risk increases for younger animals. Third, as with all transactions that involve a payment in the future, the present value of a future payment should be discounted. The degree of discount should increase for younger animals, signifying the longer length of time that must elapse before these animals reach the age when DP can be claimed. Fourth, farmers who propose selling steers on which some or all premia have still to be claimed are signalling a preference for not keeping the animal until it reaches the age when premia can be claimed. Buyers at this stage of production are providing a service by keeping the animal until it reaches the age when premia can be claimed. Consequently, it would be expected that sellers should pay a premium equal to the market value of this service in the form of a discount on the proportion of the DP that capitalises into the per head steer price. Once again, the degree of this discount should increase for younger animals. Finally, the value of DP that can be claimed on an animal in the future is not known with certainty because the scale-back mechanism is invoked if the total number of claims exceed the regional ceiling. Given, the foregoing discussion it is expected that $\phi_d < \phi_s > \phi_f$. Therefore the sign of ϕ_{ij} in Equation (2) varies depending on the price relationships examined, as can be seen in Equations (6) and (7).

$$P^d = P^s - C^{ds} - \phi_{ds}DP \tag{6}$$

$$P^s = P^f - C^{sf} + \phi_{sf}DP \tag{7}$$

where $\phi_{ds} = (\phi_d - \phi_s)$, $\phi_{sf} = (\phi_s - \phi_f)$, $C^{ds} = (C^d - C^s)$ and $C^{sf} = (C^s - C^f)$. The relationships in Equations (6) and (7) indicate that an increase in DP will tend to move store prices closer to finished prices and further away from dropped calf prices. In other words, the proportion of DP capitalising into market price varies across the different weight categories of male calves and steers.

3. Methodology

The hypothesis that DP do capitalise into the market prices of male calves and steers could be assessed by carrying out an ordinary least squares (OLS) regression on Equation (2) and testing whether $\phi_{ij} = 0$ can be rejected. However, this approach is susceptible to the problems associated with the probable presence of unit roots in the variables within the test equation. Inference based on parameters estimated using OLS regression analysis may be misleading, when some or all of the variables in the regression contain unit roots (which means they are non-stationary). This is not the case when all the variables in the regression are stationary (as long as certain other assumptions hold). For a variable to be stationary it must have a constant mean and variance. Variables that contain a unit root (for example, are integrated of order one) are non-stationary. Differencing offers an approach whereby a variable with a unit root can be rendered stationary. However, in the process of differencing, important long run information may be lost. Cointegration offers a solution to the problems created by differencing. Cointegration between non-stationary variables implies that there is a linear combination of the variables that is stationary. Valid inference can be made based on the parameters of a cointegrating regression between two variables. Many previous studies of agricultural prices have used cointegration techniques (see Ardeni 1989; Larue and Babula 1994; Chang and Griffith 1998).

In order to avoid the problems associated with the probable non-stationarity of the variables in Equation (2), the hypothesis that DP do capitalise into the market prices of male calves and steers is best tested using the Johansen (cointegrating Vector Auto-Regressive (VAR) modelling) procedure (Johansen 1988; Johansen and Juselius 1990). The first step is to use unit root testing procedures (such as the Dickey-Fuller test) to test the order of integration of the variables to be included in the test equation (Equation 2). If, as expected, they are integrated of order one (non-stationary because of the presence of a unit root), then the next step is to test for cointegration among the variables in Equation 2 (the variables in this equation are treated as endogenous variables). This step is repeated for all the price pair combinations relating to the different weight categories of male calves and steers. However, before the test for cointegration can be carried out, the lag length for the VAR must be determined. Paired comparisons using adjusted Likelihood ratio (LR) tests are made between VAR's of different lag lengths, in order to determine the appropriate lag length. Once the lag length has been established the presence or absence of cointegration is determined using maximum eigen value and Trace test statistics. If cointegration is found, the hypothesis that direct payments do capitalise into the per head prices of steers can be (validly) accepted if ϕ_{i}, = 0 is rejected.

3.1 Data

The analysis in the present paper uses monthly steer beef prices per head in the Republic of Ireland (obtained from the Central Statistical Office) for the period January 1987 to December 1996 (a total of 120 observations). The end date for the data set was chosen so that the worst impact of the BSE crisis is avoided, particularly in terms of its affect on prices. The data set includes nine series of average steer prices. Eight of these price series relate to store steers in a range of weight categories at 50kg intervals beginning with a 200–249kg weight category and ending with an over 550kg category. Average prices were also obtained for dropped calves, which make up the ninth category.[4] Prices for finished steers on a per head basis were not available so in the analysis that follows, heavy store prices are to some extent used as a proxy for finished steer prices. In each of the weight categories there will be steers of different ages. In the 200–249kg category it is probable that all the steers will be less than 10 months old. Therefore, in terms of eligibility, almost all steers in this weight category will still be eligible for both direct payments. Going through higher weight categories the proportions of steers eligible for one or both of the BSP payments should decrease. It is probable that even in the highest weight category of store steers there will be a few upon which BSP2 has still to be claimed.

In addition to prices the analysis also involves DP. Farmers receive EP automatically when they apply for the BSP, if they meet the required stocking density criteria. The premia are converted from ECU to national currency using the green exchange rate as of the first of January in that year (Agra Europe 1998).

3.2 Seasonality

The use of monthly data creates an additional complication because of the likely presence of seasonality. Seasonality is likely to take one of two forms. These are (i) deterministic seasonality, and (ii) seasonality represented by the presence of seasonal unit roots. If seasonality is deterministic then the methodological procedures outlined above can be adapted to deal with seasonality simply by including seasonal dummy variables in the cointegrating VAR modelling approach. If the seasonality in the monthly calf and steer prices is represented by the presence of seasonal unit roots then seasonal cointegration procedures such as those described by Engle *et al.* (1993) must be adopted.

Hylleberg *et al.* (1990) (HEGY) propose a Dickey-Fuller-type test for the presence of unit roots at seasonal frequencies as well as at the zero frequency. The HEGY procedure, developed for quarterly data, has been extended for use with data observed at monthly intervals by Franses (1990).

[4] Dropped calf prices were not published separately for male and female animals. The dropped calf price series used in this paper is therefore an average price for both males and females. However, the majority of dropped calves are male since 30–50% of female calves are kept as dairy herd replacements. The average weight for dropped calves is 35kg.

In extending the HEGY test, Franses (1990) separates the 12 monthly difference filter, ($1\text{-}B^{12}$), into its twelve component unit roots, namely, one non-seasonal unit root and eleven seasonal unit roots. In the Franses (1990) test procedure for non-seasonal and seasonal unit roots, the variable of interest is difference filtered in twelve different ways so that in each case one of the twelve component unit roots is removed. The twelve difference filtered versions of the variable of interest are included in an auxiliary regression which may include a deterministic element consisting of a constant, seasonal dummies and a trend. Estimates of the twelve parameters ($\pi_1,\pi_2,\ldots,\pi_{12}$) associated with the difference filtered versions of the variable of interest are obtained using OLS (Franses 1990). If all π_i are equal to zero, then all twelve unit roots exist. There will be no seasonal unit roots if π_2 through to π_{12} are unequal to zero which, in addition, suggests that the seasonality in the variable is deterministic and can be modelled using seasonal dummy variables. This hypothesis is assessed using a *t-test* for $\pi_2 = 0$, and a joint F-test for $\pi_3 = \pi_4 = \ldots = \pi_{12} = 0$. If π_1 is significantly different from zero then the presence of the non-seasonal unit root can be rejected. As is the case with the Dickey-Fuller test, the normal critical values of the t-tests and F-tests do not apply. Tables containing critical values for the t-tests of the separate π's, and for a joint F-test of $\pi_3 = \pi_4 = \ldots = \pi_{12} = 0$ can be found in Franses (1990, 1991). As with all DF-type tests it is important to augment the test equation with sufficient autoregressive lags so that any serial correlation in the error term is corrected. The choice of lag length was based on Hall's sequential specific-to-general rule (Hall 1994) with the additional requirement that satisfactory results were obtained from Lagrange multiplier (LM) tests for residual normality, heteroskedasticity and serial correlation (of order 1 and 12) as described in Pesaran and Pesaran (1997).

Ghysels *et al.* (1994) show that for practical use one can still apply the usual Dickey-Fuller (DF) test for a zero frequency root even in the presence of seasonal unit roots, provided the test equation is augmented with the appropriate autoregressive lags. In doing so the researcher is faced with two strategies. First, the data series can be seasonally adjusted before applying the Dickey-Fuller test, although Ghysels and Perron (1993) show that the power of the test is adversely affected. Second, unadjusted data can be used in the DF test. Seasonal dummies can be included in this test equation and, following the results in Dickey *et al.* (1986), the critical values of DF tests with a constant term can be used. However, the problem with this strategy is that it results in size distortions in the test statistic. Therefore, neither strategy is particularly satisfactory. Consequently, in the present paper we use the Franses test for seasonal and non-seasonal unit roots. The DF test is also applied to the unadjusted data (with seasonal dummies included in the test regression) although the problems with this approach need to be borne in mind when interpreting the results.

4. Empirical results

The testing procedure for seasonal integration outlined by Frances (1990) was applied to the logged monthly steer prices and the DP variable. The auxiliary regressions included an intercept, eleven seasonal dummies and a time trend. These test regressions passed residual tests for serial correlation, normality and heteroskedasticity. The values of the 't' and '*F*' tests used in the seasonal unit root testing of the variables are shown in Table 3.

The t-statistic for π_1 in Table 3 is smaller than the 5 per cent critical value in all cases, suggesting acceptance of the null hypothesis $\pi_1 = 0$ and the presence of the non-seasonal unit root in all nine steer prices and the DP variable. The t-statistic for π_2 and the F-statistic for the joint null of $\pi_3 = \pi_4 = \ldots = \pi_{12}$ are larger than their respective 5 per cent critical values, suggesting that the presence of seasonal unit roots may be rejected (suggesting the seasonality present is deterministic). Therefore, the variables of interest each contain a non-seasonal unit root but no seasonal unit roots. In other words, the monthly calf/steer prices and DP are integrated of order one with seasonality that can be modelled using seasonal dummy variables. Thus, the VAR models estimated should include seasonal dummy variables. Augmented DF test results, not shown here, also indicate that all nine beef price series are integrated of order one and trend stationariness is rejected.

Table 3 Seasonal and non-seasonal unit root test results[1]

Steer prices per head	t-statistics		F-statistics	Autoregressive lags
	$\pi_1 = 0$	$\pi_2 = 0$	$\pi_3 = \pi_4 = \ldots = \pi_{12} = 0$	
over 550kg	–2.60	–4.28 *	77.01 *	0
500–549kg	–2.93	–3.72 *	63.69 *	0
450–499kg	–2.75	–4.72 *	69.53 *	0
400–449kg	–2.57	–3.34 *	53.06 *	1–6
350–399kg	–3.09	–3.09 *	50.38 *	1–6
300–349kg	–3.03	–3.30 *	46.26 *	1–6
250–299kg	–3.03	–3.42 *	32.88 *	1–6
200–249kg	–2.56	–3.74 *	57.44 *	0
Dropped calves	–2.45	–4.21 *	81.09 *	0
Direct Payments	–1.24	–3.00 *	34.23 *	0

[1] The critical values for the t-test of $\pi_1 = 0$ and $\pi_2 = 0$ at the 5 per cent level of significance are –3.24 and –2.65, respectively. For the joint F-test of $\pi_3 = \pi_4 = \ldots = \pi_{12} = 0$ at the 95 per cent level of significance the critical value is 4.45.
* Significance at the 5 per cent level.

Cointegration tests were carried out for each of the 36 different price pair relationships. Centred (orthogonalised) seasonal dummy variables were included in the vector error correction model during the cointegration testing procedure and in the unrestricted VAR model in the VAR length testing procedures. The DP variable was also included as an I(1) endogenous variable when testing for cointegration between the 36 price pairs. A case could be made for treating DP as an exogenous variable, however, part of the reason for introducing DP was as compensation for intervention price cuts, and as such DP is likely to be at least partly endogenous in these price relationships. Cointegration was found in almost all of these 36 relationships. Using the maximum eigen value and Trace tests, only one cointegrating relationship was found (rank = 1) between the three variables in each case. In slightly less than half of these cases, the estimated parameter for the DP variable was significant within the cointegration equation. The lag length of the estimated VAR fell within the range of one to five lags. Making use of the Akaike Information Criteria and the Schwarz Criteria (the latter was allowed to dominate the decision made where inconsistencies arose) available within Eviews (Eviews 4.0 User's Guide 2000), a choice was made between the five (options regarding) deterministic trend assumptions considered by Johansen (1995). In all cases either option 2 (the I(1) variables in the cointegrating equations have no deterministic trends and the cointegrating equations have intercepts) or option 3 (the I(1) variables in the cointegrating equations have linear trends and the cointegrating equations have only intercepts) was chosen as a consequence of the criteria used.

Using the Johansen approach to cointegration, as is the case here, means that the cointegrating vector is not identified unless some arbitrary normalisation (restriction) is imposed. We decided to impose an additional restriction. Under this additional restriction the transmission rate between the price pair in each equation is restricted to equal one (as would be expected in an efficient market). In each case this restriction is tested using the LR test. The estimated cointegrating equations for dropped calves are reported in Table 4 and those for 200–250kg (light store) steers are reported in Table 5. The LR test statistics presented in the second columns in Tables 4 and 5 indicate whether the restrictions imposed on each cointegrating vector are valid or not. In most cases these restrictions do appear to be valid. The third columns in Tables 4 and 5 indicates which estimation option was chosen with regard to the deterministic trend assumptions made.

Cointegration was found between dropped calf prices and each of the eight adjacent weight categories of steers (see Table 4). For example, the restricted cointegrating relationship between dropped calf price and the 200–249kg steer price (which is the relationship depicted in Equation 6) can be written as:

Table 4 Cointegrating vectors containing the dropped calf price

Steer price	LR Statistic	Estimation Option[2]		Dropped Calf price	Premium (DP)[1]	Intercept
550+kg	5.05**	2	1	–1	0.142 (0.86)	–543.77
500–549kg	2.77*	2	1	–1	0.010 (0.08)	–458.68
450–499kg	1.43	2	1	–1	–0.015 (–0.13)	–408.74
400–449kg	0.45	2	1	–1	–0.055 (–0.47)	–355.82
350–399kg	0.06	2	1	–1	–0.112 (–1.04)	–305.16
300–349kg	2.66	3	1	–1	–0.224 (–2.52)**	–260.89
250–299kg	2.16	3	1	–1	–0.273 (–3.81)**	–211.51
200–249kg	1.24	3	1	–1	–0.207 (–2.07)**	–172.39

** and * indicate 5 per cent and 10 per cent levels of significance, respectively.
[1] The t-test values for the parameter estimates are in parenthesis. DP, direct payments.
[2] Estimation option 2 means that with regard to the deterministic trend assumptions, the I(1) variables in the cointegrating equations have no deterministic trends and the cointegrating equations have intercepts, while estimation option 3 assumes that the I(1) variables in the cointegrating equations have linear trends and the cointegrating equations have only intercepts.

Table 5 Cointegrating vectors containing the 200–249kg store steer price

Steer price	LR Statistic	Estimation Option[2]		200–249kg Store Price	Premium[1]	Intercept
550+kg	4.86**	2	1	–1	0.582 (2.49)**	–371.44
500–549kg	2.79*	2	1	–1	0.559 (2.90)**	–287.55
450–499kg	1.90	2	1	–1	0.601 (2.91)**	–236.64
400–449kg	0.12	2	1	–1	0.115 (1.27)	–196.93
350–399kg	0.02	3	1	–1	0.069 (0.96)	–144.09
300–349kg	0.20	3	1	–1	–0.071 (–1.03)	–86.61
250–299kg	0.0001	3	1	–1	–0.022 (–0.41)	–41.32

** and * indicate 5 per cent and 10 per cent levels of significance, respectively.
[1] The t-test values for the parameter estimates are in parenthesis.
[2] Estimation option 2 means that with regard to the deterministic trend assumptions, the I(1) variables in the cointegrating equations have no deterministic trends and the cointegrating equations have intercepts, while estimation option 3 assumes that the I(1) variables in the cointegrating equations have linear trends and the cointegrating equations have only intercepts.

$$-1P^{dropped} + 1P^{200-249kg} - 0.207DP - 172.39 = 0 \tag{8}$$

The coefficient of DP is significantly different from zero in three of the eight cointegrating relationships involving dropped calf prices that are presented in Table 4. Thus, the hypothesis that DP do capitalise into the market prices of male calves and steers cannot be rejected. The negative sign of the coefficient of DP agrees with that predicted by Equation (6). This indicates that a greater proportion of DP capitalises into light steer prices than into dropped calf prices. The intercept terms in each of the eight cointegrating vectors in Table 4 reflect both transaction costs and the costs (including normal profits) of rearing a steer from one stage of production to another. The values of the intercept terms increase as the prices of steers from weight categories that are increasingly far apart in the production chain are included in the cointegrating vector.

Cointegration was found between 200–249kg store steer prices and seven other store steer prices (see Table 5). The cointegrating relationship between the 200–249kg steer price and the 550+kg steer price can be written as:

$$-1P^{200-249kg} + 1P^{550+kg} + 0.582DP - 371.44 = 0 \quad (9)$$

This equation can be considered an approximation to Equation (7) if the 550+kg steer price can be assumed to be a proxy for finished steer price per head. The sign of the estimated coefficient for DP agrees with that predicted in Equation (7).

Using the estimates of the parameters (ϕ_{ds} and ϕ_{sf}) in Equations (6) and (7) that are given in Equations (8) and (9), it is possible to estimate the impact of direct payments on prices of dropped calves and light steers. However, it is estimates of the parameters ϕ_d, ϕ_s and ϕ_f (from Equations 3, 4 and 5) that are needed in order to measure the impact of direct payments on prices for each category of steer. It can be assumed that if $\phi_f = 0$ (direct payments have no direct effect on finished prices) then $\phi_s = \phi_{sf}$ and $\phi_d = \phi_s - \phi_{ds}$. The parameter ϕ_s represents the category of steer for which the impact of premia on price is greatest, namely 200–250kg steers. Thus the estimate of ϕ_{sf} will come from the estimation of the price relationship between 200–249kg and finished steer prices. Table 5 gives the estimated price relationships between the 200–249kg and other store steer categories. Unfortunately, finished steers are not one of these categories. However, if the 550+kg steer category is used as a proxy for finished steers then from Equation (9) ϕ_s is 0.58 (thus 58 per cent of direct payments capitalise into light store prices).[5] From Equation (8) $\phi_{ds} = -0.21$, implying $\phi_d = 0.37$ (0.58–0.21), which in 1996 is equivalent to 85 ECU (approximately) being capitalised into the price of dropped calves in ROI. This figure is slightly higher than that calculated by Dunne *et al.* (1998).

These estimates for ϕ_s and ϕ_d (0.58 and 0.37) are significantly different from zero and, therefore, the hypothesis that DP do capitalise into the market prices of male calves and steers cannot be rejected. The results also indicate that a higher proportion of DP capitalises into light steer prices than into dropped calf prices.

[5] This seems to be a reasonably safe assumption, see Jack *et al.* (2000).

5. Discussion and conclusions

Currently, the EU system of direct payments to beef producers is classified as a 'blue box' subsidy. These subsidies were exempted from reduction commitments in the Uruguay Round Agreement on agriculture because they are delivered under 'production-limiting' programs. However, the EU system of direct payments to beef producers does not impose strict production limits. Restrictions are imposed on the number of suckler cows for which SCP can be claimed and in the case of the BSP scheme the payment per steer is reduced (as the number of claims goes above a given point) so that the total amount paid remains within a predetermined budget. Furthermore, stocking density limits on payments do not relate to all animals held on the farm of a claiming producer, but to the number of animals per hectare on which claims are made. Therefore, the EU system of direct payments to beef producers is 'claim-limiting' rather than 'production-limiting'. All beef farmers are free to keep (produce) animals over and above the number for which they are eligible to make valid claims. Policy makers would argue that given low market prices beef producers are unlikely to keep animals for which they are ineligible to claim DP.

Few Irish farmers operate birth-to-slaughter beef production systems, and how binding the 'claim-limiting' constraints are is dependent upon where in the production chain a farmer operates. For example, farmers involved in finishing beef cattle (down the production chain) are less likely to find the 'claim-limiting' constraints binding compared to those involved in breeding and rearing beef cattle (suckler herd owners up the production chain). This is because beef finishers are not constrained by SCP quota, many are unaffected by the 90 head limit on claims, and the stocking rate density criteria can be circumvented by renting additional land. Indeed, nationally the number of steers upon which claims can be made is unlimited, although a reduction in the payment may occur if the number of claims goes above a certain level (under the regional ceiling option). Thus, farmers up the production chain constrained by 'claim-limiting' measures may be unable to claim DP on certain young steers but can sell these animals to farmers down the chain. The farmers down the chain are unlikely to be constrained by the 'claim-limiting' measures and can claim the DP on the animals in question. Therefore, we might expect that DP capitalise into the prices of steers for which DP have not been claimed.

Using techniques that help to ensure valid inference, the present paper has shown that DP to beef farmers do capitalise into the average prices of male calves and young steers. Economic theory and intuition would suggest that DP also capitalises into the market prices of beef cows and heifers.

Table 6 Republic of Ireland SCP quota levels and beef cow numbers

Year	94	95	96	97	98	99
Beef Cows at June	1000	1025	1093	1177	1217	1178
SCP Quota levels	1114	1114	1114	1114	1114	1114

SCP, suckler cow premia.
Source: Irish Agriculture in Figures, Teagasc, Agriculture and Food Development Authority, Republic of Ireland.

This particular proposition has not been tested in the present paper because it would require specifying and estimating a full (inverted) supply function for these animals for which the necessary data are not available.

The existence of this capitalisation process, together with the fact that farmers are not prohibited from keeping animals over and above 'claim-limiting' measures, probably means that the EU system of DP is flawed. The mechanism whereby beef producers can obtain (capitalised) DP on animals sold in the market place may encourage farmers to maintain actual stocking densities at higher levels than 'policy' stocking densities. In other words, they may be encouraged by 'capitalised DP' to keep animals over and above 'claim-limiting' measures. For example, a farmer can claim DP on steers up to the limits of the 'policy' stocking rate while keeping additional steers upon which (capitalised) DP can be obtained when they are sold in the market place. Thus, 'capitalised' DP encourage farmers to produce animals over and above the 'claim-limiting' measures associated with the program. In another example, a beef producer may keep beef cows over and above his/her suckler cow quota and, although premia are not directly payable on these animals, their male off-spring can earn the farmer capitalised DP (which is fundamentally a return to the 'above quota' beef cows). Indeed, this may explain why Irish beef farmers have been keeping considerable numbers of 'above quota' beef cows. The data in Table 6 indicates that during the period 1997 to 1999 the number of Irish beef cows was over quota by between 5.7 and 9.2 per cent.[6] It might be expected that beef cow numbers would be slightly over quota as farmers seek to ensure that they have enough animals to fill their quota and cover any death loss etc. so that they can maximise their claims. However, it is unlikely that this would explain why Irish beef cow numbers are 9 per cent over quota.

The fact that EU beef producers can obtain (capitalised) DP on animals produced over and above the EU 'claim limiting' measures very probably

[6] Unpublished data available from Teagasc, Dublin, Ireland, indicates that the number of beef cows in Ireland continued to be over quota in 2000 and 2001.

puts upward pressure on beef production.[7] Over the period of analysis beef production and beef cow numbers in Ireland and the EU increased considerably despite falling real-finished beef producer prices.[8] It may be inferred that increases in DP, and the fact that DP capitalises into steer prices, contributed to some of this increase. Certainly, it appears to be the case that, although the link between the capitalisation of DP into young steer prices and increased beef production is not proved in this paper, support from the published literature in this area can be found (Adams *et al*. 2001; Young *et al*. 2001; Dewbre *et al*. 2001). Adams *et al*. (2001) provide weak evidence that the payments associated with the production flexibility contract and market loss assistance schemes in the USA do affect the total area devoted to crop production. The USA authorities have declared that the production flexibility contract is a 'green box' subsidy. Two main explanations are put forward by Adams *et al*. (2001) for their finding. First, risk-averse farmers may be encouraged to take risky decisions (acreage decisions) because of these payments and second, farmers may hold the view that 'there is a nonzero probability that future payments may depend on current production decisions'. Young *et al*. (2001) conclude that USA Government crop insurance policies influence production decisions and therefore prices. Dewbre *et al*. (2001) consider the transfer efficiency and trade distorting effects of various types of DP. They conclude that DP based on output or on variable input use are more inefficient and trade distorting than DP based on area. The general conclusions to be drawn from these studies are that all types of DP to farmers are likely to affect production levels and prices to some extent. Complete decoupling is difficult to achieve. Direct payments made on the basis of output (e.g., BSP and SCP) are likely to be more trade distorting than other types of payments.

In summary, we feel that the conditions and limits associated with the EU system of DP have been insufficient to prevent increases in cattle numbers as a result of the provision of DP to EU beef producers. Moreover, we argue that the EU system of DP to beef producers has resulted in higher demand and prices for beef calves, which has translated into increased levels of beef production. If the capitalisation of DP into the prices of young steers (and possibly beef cows and heifers) has impacted positively on EU beef

[7] It should be noted that as the number of BSP claims exceeds the regional ceiling, the amount paid per steer is reduced. Under these circumstances the amount of DP capitalising into the prices of male calves and young steers will also be reducing, as would be the effect on production levels.

[8] The fact that SCP quota was set, originally, at levels well below actual beef cow numbers in Ireland, meant that there was a lot of scope for increases in beef cow numbers.

production then it is difficult to argue that EU direct payments to beef farmers adhere to the 'blue box' definition of quantitatively constrained measures. Clearly increases in EU beef production has implications for world beef prices. It is likely that the 'blue box' category will not survive the next WTO round. Future reform of the system of EU direct payments to beef producers needs to go beyond making the system more 'blue box' compatible. Indeed, as argued by Swinbank and Tangermann (2001), there is a case for further decoupling these payments to reduce the supply response linked to their capitalisation into market prices. Such a move is likely to enable the EU system of DP to beef farmers to survive the next WTO round. However, the long-term political acceptability of DP is not clear.

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