PRICE FORMATION IN DUAL CHAINS IN THE DUTCH FLOWER TRADE

Douwe-Frits Broens
Department of Marketing and Marketing Research
Wageningen Agricultural University

1. Introduction

For the marketing of a product, traditional marketing channel theory distinguishes different parallel flows within a distribution channel (Mallen 1977). One can, for instance, distinguish the flows of:
- physical goods,
- information,
- title.

The physical flow of products is the subject of physical distribution and supply chain research. This paper concentrates on the flow of title within the marketing channel. The chain consisting of consecutive title transfers could be defined as the *transaction chain* or *trade chain*. Transaction chains involving the same product and the same trading partners can still differ as to the transaction type and market conditions at any transaction stage.

In the Dutch flower and pot-plant trade, both transaction and supply chains traditionally run through cooperative auctions. Most products are marketed through chains running from the producer via a wholesaler and a retailer to the consumer. The terms wholesaler and trader will be used alternately. Some 70% of the trade between producers and wholesalers takes place at the auctions. For price discovery, all auctions use auction clocks according to the *Dutch auction* system. A concentration of wholesalers and retailers tends to weaken the price discovery function of the auctions. The traditional role of the auction cooperative is shifting from a price discovery instrument towards an autonomous marketing institute (Meulenberg 1989). This trend has weakened the near-monopoly position of the auction clock as a trading mechanism. Nowadays, even the mere continuation of the auction clock is under serious discussion. Alternative market places in- and outside the cooperatives, where bilateral negotiation between producers and traders plays an important role, have gained importance. Yet, the price discovery function of the clock seems to be of great relevance.

The objective of this paper is twofold. Using recent data on the pot-plant trade from the *United Flower Auctions Aalsmeer* (VBA), the largest Dutch flower auction, the present role of the auction clock will be investigated. The focus is upon the relation between price formation as regulated by the auction clock and as regulated in alternative trading places. Furthermore, inferences are made about pricing behaviour at different stages in the transaction chain for pot-plants.

2. Dual chain structure

The most important trading place beside the auction floor is the broker's office, connected to the auction cooperative. Producers present samples of their products and state an asking price. Every week they restate the asking price, having the opportunity to adjust it to the prices of the competitors. Traders can order directly from the producer or through the agency of the broker's office.

Although the broker's office price is fixed per producer during the week, the average price of the units traded through the broker's office can vary from day to day. When demand rises, traders may for instance develop a preference towards the more expensive, high quality products, whereas in a decreasing market, the less expensive products may become more popular.

The broker's office used by both producers and traders has some advantages and disadvantages over the auction floor. Through brokerage, unlike the auction clock, producers can rest assured about the selling price, but they are uncertain whether they will sell all their stock. Through brokerage, traders can specify the desired amount, specify the product, ripeness, packaging and moment of delivery. Furthermore, producers and traders have the opportunity to enter into long term relationships, which have a stabilising effect on prices. On the other hand, the burden of direct negotiation and delivering on order is an insuperable impediment to many producers (Broens and Meulenberg 1996).

Trade prices arranged through the broker's office are significantly higher than those realized on the auction clock. This might be due to quality differences or an unequal distribution of efficiencies over the trading parties.

3. Horizontal price relations

3.1. Hypothesis

Different traders face different situations, and as a result have different preferences for the most attractive channel. Especially the large and powerful traders prefer the broker's office for regular trade. Yet, in general, both producers and traders use the auction clock for reference. Apparently it provides superior trade information. Furthermore, it is claimed that trade shifts from the broker's office to the clock when clock prices go down. As a result, the broker's office prices should go down as well. Therefore it is conjectured that, for all products considered, the broker's office prices follow the auction clock prices.

3.2. Granger causality test

To test whether price movements in one market follow price movements in another, in the sense of time, the concept of Granger 'causality' (Granger 1969) can be applied. The Granger test of 'causality' implies testing the following two hypotheses:

> *The price of product x in the broker's office does not follow the price of product x on the clock* or: *If the broker's price is explained by past broker's prices, past clock prices do not add to this explanation* (H_0).
>
> *The price of product x on the clock does not follow the price of product x in the broker's office* or: *If the clock price is explained by past clock prices, past broker's prices do not add to this explanation* (H_1).

If H_0 is rejected, and H_1 is not, then the broker's office price is supposed to follow the clock price. If H_1 is rejected, and H_0 is not, then the clock price is supposed to follow the broker's office price. If neither one of them or both are rejected, the test is inconclusive. To test these hypotheses for every product separately, a two-step approach is chosen.

In the first step, ARMA models of the following form are estimated for every product separately:

$$\begin{aligned} p_{b,t} &= p_{b0} + \sum_{i=1}^{T} \alpha_i \, p_{c,t-i} + \sum_{i=1}^{T} \beta_i \, p_{b,t-i} + \epsilon_{b,t} \\ p_{c,t} &= p_{c0} + \sum_{i=1}^{T} \gamma_i \, p_{c,t-i} + \sum_{i=1}^{T} \delta_i \, p_{b,t-i} + \epsilon_{c,t} \end{aligned} \qquad (1)$$

where ϵ_t is a normally distributed error term with expected value 0, and $p_{c,t}$ and $p_{b,t}$ are the daily average prices on day t of the product under consideration on the clock and in the broker's office, respectively. The hypotheses translate to:

$$H_0: \alpha_1 = \ldots = \alpha_T = 0$$
$$H_1: \delta_1 = \ldots = \delta_T = 0$$

Both hypotheses are tested using the relevant F-statistic value. The value of T can be varied. Normally, the higher the value of T, the more reliable the conclusions. Conclusions which are consistent over a complete range of T are of course most robust.

In the second step a refinement is made by applying error-correction models for the prices in both markets, using the Engle-Granger procedure (Engle and Granger 1987). The error-correction model is defined as:

$$\Delta p_{b,t} = \alpha_{b0} + \alpha_{b1}\Delta p_{c,t-1} + \alpha_{b2}\Delta p_{b,t-1} - \beta_b\hat{\eta}_{t-1} + \epsilon_{b,t}$$
$$\Delta p_{c,t} = \alpha_{c0} + \alpha_{c1}\Delta p_{c,t-1} + \alpha_{c2}\Delta p_{b,t-1} - \beta_c\hat{\eta}_{t-1} + \epsilon_{c,t} \quad (2)$$

The 'error' term $\hat{\eta}_t$ is the ordinary least squares estimate of the error in the 'long term' price relation:

$$p_{b,t} = \gamma_0 + \gamma_1 p_{c,t} + \eta_t \quad (3)$$

T-tests are applied to the estimated values of β_b and β_c. If the hypothesis $\beta_c = 0$ is not rejected, but $\beta_b = 0$ is, the auction clock price is weakly exogeneous and the broker's office price is not. If, in addition, the hypothesis $\alpha_{c2} = 0$ is not rejected either, the broker's office price can be concluded to be 'caused', in the Granger sense, by the clock price.

3.3. Test results

To test the hypotheses, trade data from the *VBA* are used. The data consist of the daily average prices of many products over the period January 1 1993 to June 23 1995, both clock prices and broker's office prices. The analysis is restricted to 8 different products, which are listed in Table I, and to the prime quality class.

The hypotheses are tested according to the two-step procedure described above. The Granger causality test values of the ARMA model (1), repeated for the values $T = 1$, $T = 5$ and $T = 10$ are given in Table I.

In the model with one lag, for most pot-plants both hypotheses are rejected. For the larger Kalanchoe however, both hypotheses are accepted. For both sizes of the Cyclamen, Granger causality is indicated: the broker's office seems to follow the auction clock price in the short run.

If time lags up to five working days (i.e. one working week) are included in the ARMA model, a totally different picture arises. For the larger Kalanchoe and the smaller Begonia, the tests are indecisive. For both Saintpaulias, the smaller Kalanchoe and the larger Begonia (the most important trading items), the broker's office follows the clock price. This is no surprise, because most growers set their broker's office prices as a function of auction clock prices from the week before. However, for both Cyclamen the clock price now seems to follow the broker's office. There is no obvious explanation for this result.

Table I Granger causality test values, model (1)

Product	Pot size		F-statistic value (p-value)		
			1 lag	5 lags	10 lags
Saintpaulia	9 cm	H_0	5.146 (.0238)	.511 (.7680)	.723 (.7009)
		H_1	77.865 (.0000)	4.021 (.0017)	2.455 (.0114)
	12 cm	H_0	13.860 (.0002)	1.049 (.3883)	1.914 (.0415)
		H_1	54.137 (.0000)	2.746 (.0184)	2.633 (.0040)
Kalanchoe	10 cm	H_0	5.205 (.0229)	1.581 (.1635)	1.515 (.1308)
		H_1	73.645 (.0006)	7.741 (.0000)	6.620 (.0000)
	12 cm	H_0	.039 (.8443)	.511 (.7680)	.248 (.9904)
		H_1	2.954 (.0861)	1.437 (.2112)	1.634 (.1042)
Begonia	9 cm	H_0	7.004 (.0086)	1.787 (.1269)	.585 (.7727)
		H_1	47.263 (.0000)	.556 (.7329)	1.167 (.3907)
	13 cm	H_0	8.362 (.0040)	1.249 (.2847)	1.562 (.1145)
		H_1	110.06 (.0000)	9.560 (.0000)	4.687 (.0000)
Cyclamen	10 cm	H_0	.215 (.6434)	4.067 (.0097)	2.080 (.1774)
		H_1	16.533 (.0001)	1.585 (.2078)	4.129 (.0405)
	12 cm	H_0	.634 (.4230)	3.468 (.0046)	2.244 (.0162)
		H_1	23.445 (.0000)	1.859 (.1012)	.883 (.5500)

If the explanatory power of the model is increased by inserting more lags, up to two weeks or ten working days, the picture changes only slightly from the one-week model. That is, all results remain unchanged, apart from the fact that the direction of the Granger causality is reversed for the smaller Cyclamen.

The results of these tests as to the relation between both markets in the short run, on the basis of the model with a one--day lag, show no clear indications. A more refined way to analyse short run relations is by applying an error-correction model, the second step of our model. For all products, except the smaller Cyclamen, the 'long term' price relation (3) is cointegrated (Versantvoort 1995). The coefficient values of the error-correction model (2), relating the short term dynamics in both price series, are given in Table II, along with their t-statistic values.

For all products, except the larger Saintpaulia and Begonia, the clock price is weakly exogeneous, the broker's office price is not weakly exogeneous, and the hypothesis $\alpha_{c2} = 0$ is not rejected. For these products, the Granger causality is assumed: the broker's office price movements follow clock price movements. For the larger Saintpaulia and Begonia, this test is indecisive.

Table II Error-correction model coefficients for different products

Product	**Pot size**		**Coefficient estimate (t-statistic)**		
			α_{*1}	α_{*2}	β_*
Saintpaulia	9 cm	b	-.0564 (-1.79)	-.382 (-8.63)	-.287 (-7.12)
		c	-.244 (-5.20)	-.0439 (-.755)	.095 (1.63)
	12 cm	b	-.0362 (-1.57)	-.323 (-8.31)	-.378 (-9.27)
		c	-.334 (-8.42)	-.129 (-1.92)	.193 (2.74)
Kalanchoe	10 cm	b	.0027 (.201)	.113 (2.13)	-1.09 (-12.6)
		c	-.542 (-9.93)	-.0211 (-.109)	.0005 (.002)
	12 cm	b	-.0421 (-.505)	-.0983 (-1.97)	--.704 (-11.2)
		c	-.402 (-.330)	.00836 (.330)	-.005 (-.154)
Begonia	9 cm	b	.0041 (.120)	-.308 (-8.04)	-.338 (-9.12)
		c	-.302 (-7.41)	-.0121 (-.261)	.0331 (.749)
	13 cm	b	-.100 (-2.90)	-.146 (-3.62)	-.631 (-13.0)
		c	-.301 (-7.24)	-.122 (-2.55)	.136 (2.35)
Cyclamen	10 cm	b	.181 (1.99)	-.0124 (-.199)	-.228 (-4.51)
		c	-.0715 (-.948)	-.0022 (-.045)	-.014 (-.365)
	12 cm	b	-.0778 (-1.65)	-.119 (-2.40)	-.877 (-12.8)
		c	-.398 (-8.54)	-.0040 (-.083)	-.026 (-.380)

3.4. Conclusion

The straight ARMA model (1) is greatly indecisive about the short term interdependencies. If lags up to two weeks are included, the model then indicates a causal relation, in the Granger sense, for five of the eight products: the broker's office prices follow the auction clock prices, and not the other way around. For two products, the tests are indecisive, and for one product, the larger Cyclamen, causality is indicated, but in the counterintuitive direction.

A second test on short term dynamics, involving the error-correction model (2), showed that, for six out of eight products, broker's office prices follow the clock prices in the short term as well.

Apparently, both in the short and in the long run, broker's office prices largely follow clock prices. This may indicate that nowadays, the auction clock still offers superior market information to both producers and traders. The price discovery function of the auction clock is still very important.

4. Vertical price relations

4.1. Wholesalers' versus retailers' pricing behaviour

Most wholesalers who buy pot-plants at the auction clock prices, bill their clients a fixed percentage above purchase price. Oddly enough, their interests are the same as the producer's. They would be gladly willing to pay more for the product, provided that their direct competitors did the same. It is particularly the price competition among the wholesalers which determines price volatility.

For an individual wholesaler with a fixed mark-up percentage, facing a fixed demand curve, optimal revenue is attained at exactly the same price and quantity that marks the revenue optimum to his supplier.

For the wholesale sector as a whole, the optimum can be different from that of the producers as a whole. Recent research on the price behaviour of Dutch flower exporters (van Dalen and Thurik 1995) indicates that both demand elasticities and the margin policy of Dutch wholesalers differ among different export markets. If the bidding and pricing behaviour of wholesalers in one market is homogenous and independent of the bidding behaviour of wholesalers in other markets, they can be considered separately. Then the overall wholesale optimum is equal to the overall producers' optimum. But if the bidding behaviour of different markets is interdependent, for instance because different markets compete for the same restricted amount of produce, it is easy to deduce that the overall wholesale pricing optimum is different from the overall producers' optimum. It depends on the different demand elasticities and the margin policies in the different markets, whether the wholesalers' bids will be too low or too high. Further research is needed on this point.

Retailers are known not to stick to fixed percentage margins. Retail prices are less flexible than wholesale prices (Veltman and La Crois 1992). For an isolated transaction chain, this means that the optimal trade level to the retailer is higher, and the trade price lower than is optimal for both the fixed-percentage mark-up wholesaler and for the producer. Direct negotiation through the broker's office would lead to a compromised deal. It is not clear how far this difference of interest influences the prices on the clock: prices are set through a horizontal coordination mechanism. Furthermore, in the preceding section it was shown that the broker's office process follows the clock prices, and not vice versa. Yet, on the clock, some retail chains give their wholesaler's *price ceilings*: they order an amount of produce, with some freedom as to the moment of delivery and the product specification, but with a clear ceiling to the price it should attain.

4.2. Price elasticities at different levels in the transaction chain

Whereas the last section considered transaction chains on a micro level, this section considers the sector level by comparing price elasticities at different levels of the chain. Unfortunately, there are no consistent results available about relations between prices at different transaction levels for the flower trade. Present evidence is rather fragmentary, so this leaves another opportunity for future research.

Both on the auction clock (Broens and Meulenberg 1994) as well as in the broker's office (Versantvoort 1995) price*flexibilities*, that is, percentage changes in daily average price as a result of a 1% change in daily supply, are negative but well below 1 in absolute value for pot-plants. Since supply is fixed per day, and usually the entire supply is used up, the daily average price is the main indicator of demand. There is no clear cut relation between price flexibilities in both market places. Although the translation to price elasticities of demand is not straightforward, the small absolute values of price flexibilities are an indication that demand at auction level is very price elastic.

A recent cross-sectional study on the price behaviour of Dutch flower exporters (van Dalen and Thurik 1995) used annual figures. The price elasticity of demand *for wholesale services*, defined as the percentage change of annual volume traded resulting from a 1% change in the annual average wholesale margin, is estimated to be about -1.2. The price elasticity of retailer demand for flowers and plants then depends on the assumptions on the relation between the wholesalers' purchasing and selling price. If there is no relation at all, the price elasticity of retailer demand is some -6.5, which is very extreme. If the wholesalers' selling price is assumed to be a fixed mark-up percentage above the purchasing price, and the mark-up percentage is assumed constant to all wholesalers, price elasticity of retailer demand is about -0.9 (average mark-up is about 33%). Yet, since mark-up percentages differ over companies depending on the market served and the service delivered (van Dalen and Thurik 1995), this price elasticity might be expected to be well below -1.

Finally, consumer research in the past has indicated that the price elasticity of consumer demand for both flowers and pot-plants in the Netherlands varies around -1 (van Tilburg 1984, Tap and van Gaasbeek 1985).

Although the data can hardly be compared as to the period of investigation, the time base or the models used, some conjectures can be formulated. It seems that the retailer does not primarily buy flowers or plants from the wholesaler, but, instead, he buys wholesale services. Price competition among the wholesalers leads to a bidding behaviour at auction level which is only slightly influenced by the quantity supplied.

5. Conclusion

Data analysis shows that in the long run prices in the broker's office follow the prices on the auction clock. The role of the auction clock as a price discovery instrument is apparently still very strong, despite the large volume traded through other trade channels bypassing the clock.

Despite the consistently higher prices in the broker's office, the bidding behaviour of the traders in the broker's office and on the clock, expressed by the price flexibilities, seems to be comparable in both trading places. The higher prices in the broker's office might be an indication of transaction cost savings on the part of the traders. Yet, referring to the price discovery function of the auction clock, it is to be doubted if all transaction cost savings would be available in the absence of an auction clock. Apparently, both trading places are co-dependent. The price discovery function of the auction clock in particular requires a minimum quotum of trade through the clock.

There is no consistent difference in price flexibility of wholesalers' demand on the auction clock and in the broker's office. It seems that in an absolute sense, price elasticities decrease, along the path from producer to consumer.

Objects for future research can be pointed out. The relation between price formation in the trading places will be further detailed by distinguishing different relations for specific situations. A model of the traders' bidding behaviour, including cost aspects, may indicate a proper hypotheses and a research approach for investigating vertical price relations.

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