ON MARKETING QUOTAS FOR FLUID MILK

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In this article I present a static economic analysis of the operation of milk marketing schemes (such as that administered by the New South Wales Milk Board) which employ marketing quotas for individual producers. This is a subject which has already received some attention in this *Journal*: I refer to the suggestion of Harris and Candler[1] that marketing quotas for fluid milk[2] should be freely traded among producers, and, more particularly, to Neutze's subsequent discussion of their proposal.[3] Some of the problems raised, and apparent paradoxes uncovered in that discussion, will be considered in the second part of this article.

The Supply and Demand for Milk

To set the stage for subsequent discussion, let us briefly consider the conditions of supply and demand for milk, as exhibited in Figure 1. In constructing this figure, I have made the following simplifying assumptions:—

1. The demand schedule for fluid milk (D_f) is stable throughout the year, *i.e.*, the demand does not fluctuate seasonally.
2. The demand for manufacturing milk is infinitely elastic at a comparatively low price, P_m.
3. There are only two seasons in the year, "summer" and "winter". The seasons are of equal duration. The production function for milk changes abruptly with the change in season. Costs of production are higher in winter than in summer. The summer and winter production functions are independent, *i.e.* the level of production attained in winter does not affect the costs of production in summer.
4. Apart from the seasonal shift, the supply schedules of individual producers (equivalent to their marginal cost schedules) are stable in time.
5. The aggregate supply functions for "summer" and "winter" milk (S_s and S_w, respectively) consist of the horizontal summation of the individual supply schedules (*i.e.* external economies and diseconomies are assumed to be absent).
6. Milk processing and distribution are costless.

As Harris and Candler point out[4], the "classical" (*i.e.* free market)

[1] Tom Harris and Wilfred Candler, "A Normative Approach to the Operation of the New South Wales Milk Board", *Australian Journal of Agricultural Economics*, Vol. 4, No. 2 (December, 1960), pp. 106-114.

[2] By "fluid" milk is meant milk intended for sale to consumers for domestic use. Milk sold for processing into other dairy products will be called "manufacturing" milk.

[3] G. M. Neutze, "Saleable City Milk Supply Quotas", *Australian Journal of Agricultural Economics*, Vol. 5, No. 2 (December 1961), pp. 136-137.

[4] Harris and Candler, *op. cit.* p. 113.

solution to the pricing problem is straightforward. Q_w of milk will be produced in winter, all of it sold for fluid use at price P_w. In summer, Q_s will be produced, Q_{fs} of it being sold for fluid use and the remainder sold for manufacture into dairy products. Both classes of milk will fetch the same price, P_m.

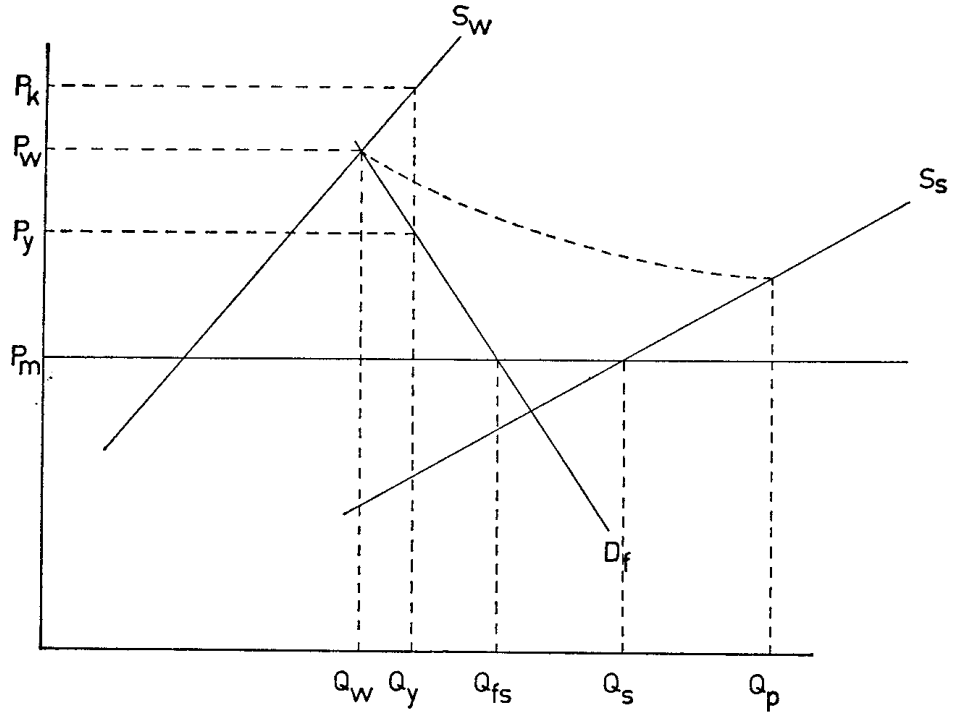

Fig. 1.

Assume that milk marketing is entrusted to a statutory board, which is unwilling to vary the price seasonally, either to producers or consumers. According to Harris and Candler, "some form of Quota scheme is [then] almost inevitable."[5] The qualification "almost" is necessary, for the Board *could* fix the price at P_w, throughout the year, and be able to satisfy demand at all times. Of course, some form of rationing of access to the more lucrative fluid market would be needed in summer, but this could be accomplished by the payment of a pooled price, and not necessarily by means of quotas for individual producers or processing plants. With payment of a pooled price, equilibrium summer production would be the amount Q_p, where the equalized price schedule (dotted in the diagram) intersects the summer supply curve.

However, if the constant year-round price is set at any level less than P_w, "the only way" (as Harris and Candler observe) to ensure that winter production is maintained is to say that "maintenance of winter production entitles the producer to a share of the windfall gains of the following summer; that is a quota scheme"[6].

The administrative details of such schemes can and do vary, but two main types of scheme can be distinguished—open-quota and closed-quota schemes. These will be considered in turn.

[5] *Ibid.*
[6] *Ibid.*

Open-quota Schemes

The essential features of an open-quota scheme are (a) the fixing of the year-round price at some level above the manufacturing milk price, and (b) the granting of a quota to each producer based on his winter production. Farmers are thus allowed to determine their own quota rights. For such a scheme to work successfully—both in the sense of bringing forth sufficient, but not excessive, winter supplies to satisfy the demand for fluid milk, and in the sense of being able to retain its open-base character—great care must be exercised in setting the year-round price. If set too low, winter demand for fluid milk will remain unsatisfied; if set too high, producers will seek to establish quota rights to supply quantities of fluid milk in excess of the quantity demanded, and quota rights will have to be rationed in some arbitrary way, thus destroying the open-base nature of the scheme.

If we assume that each farmer is granted a quota equal to his winter production, and if conditions of supply and demand resemble those illustrated in Figure 1, we can say, as a first approximation, that the only price which will guarantee the scheme's success is that indicated by the point on the fluid milk demand curve which lies mid-way in the vertical plane between the demand schedule for manufacturing milk and the supply schedule for winter milk. In the diagram, P_y is this price. P_y is the *equilibrium* price for the scheme since it ensures winter supplies equal to but not greater than the quantity demanded (Q_y) at that price. This is so because at a winter production level Q_y, the marginal cost to producers of acquiring a quota gallon (which is equal to the difference between the producer's winter marginal cost and the price received) is equal to the marginal revenue from quota acquisition (which is equal to the difference between the fluid milk price and the manufacturing milk price).

Strictly speaking, the equilibrium price will be that which equates the marginal cost of acquiring a quota gallon to the *present value* of the marginal revenue from holding a quota gallon. This qualification is necessary because the quota pay-off lags the quota pay-out by six months. Hence the definition of the equilibrium price in the preceding paragraph is approximate only; in fact, the equilibrium price will be somewhat higher than P_y.

On reflection, it will be apparent that a workable open-quota scheme is in many respects equivalent to paying producers P_k for winter milk and P_m for summer milk, but charging consumers an average of these two prices throughout the year. It differs from the free market solution only in that consumption is stabilized, rather than allowed to fluctuate seasonally. Given the decision to stabilize consumption, the pricing arrangement is optimal, in that it brings forth the desired volume of production at least cost.

Closed-quota Schemes

Closed-quota schemes differ from the open variety in that the allotment of quotas among producers is done in some arbitrary way—say by herd size or according to production in some base period—rather than being determined by producers themselves. Some penalty for non-fulfilment of quota production in winter is also an essential feature: for the present discussion, it will be assumed that the penalty consists of the loss of quota rights equal to the production deficiency. It will also be

assumed that quota rights forfeited for non-fulfilment are distributed among all producers in proportion to their existing quota rights.

For any given allocation of quotas among producers, there will be some minimum price for fluid milk which will be just sufficient to induce all farmers to retain their quota rights, and hence to ensure sufficient winter supplies. If the price is set lower than this minimum, some farmers will forfeit part of their quota rights, so that for no producers will the marginal cost of winter production exceed the fluid milk price by more than the discounted difference between the fluid milk price and the manufacturing milk price. However, many producers may find their quotas too small: their marginal costs of winter production will exceed the fluid milk price by less than the discounted difference between the prices of the two classes of milk. These producers will be willing to accept the quotas forfeited by other producers. Provided that the marketing authority is willing to tolerate an initial deficiency of winter supplies, the process of quota forfeiture and reallocation may eventually result in quotas sufficient to ensure adequate winter supplies being voluntarily held by producers at a milk price lower than the initial minimum. Thus the minimum price necessary to ensure the workability of a closed-quota scheme will depend upon (a) how "efficient" the initial allocation of quotas is (b) the arrangements which exist for the reallocation of forfeited quotas, and (c) the length of run being considered (since quota reallocation takes time). The lowest minimum price—the *minimum minimorum*, or as I shall call it, *the* minimum price—which is the minimum price in the long run, after all necessary reallocation of quotas has taken place, is the same as the equilibrium price for an open-quota scheme. Only at this price will there be an optimal allocation of quotas and complete efficiency of winter production. For any more arbitrary allotment of quotas, the minimum price necessary to induce adequate winter supplies will be higher than *the* minimum; and, of course, price can exceed *the* minimum without upper limit, without impairing the workability of the scheme, since access to the lucrative fluid milk market is limited by the fixed total supply of quotas.

Trading in Quota Rights

Suppose that a workable closed quota scheme had been established, and that the fluid milk price exceeded *the* minimum level. If voluntary transfers of quotas among producers were permitted, farmers whose quotas were smaller than they would voluntarily hold at the established fluid milk price would offer a positive price for additional quotas. Similarly, farmers whose quota rights were optimal would find it profitable to sell part of their quotas, since the holding of quota rights would now entail an opportunity cost equal to the market price for quota units. With perfection in the quota rights market, such transfers would take place until the net marginal return from holding a quota unit was equal, for all farmers, to its market price. This in turn would imply equality of marginal costs of winter production among all farmers, and the optimal allocation of production among farms.

If, in equilibrium, quota units exchange at a positive price throughout the year, the price of fluid milk is obviously too high since producers are willing to pay for the privilege of sharing in its market. The marketing authority could therefore reduce the fluid milk price, and at the same

time increase the supply of quotas to the extent necessary to meet the anticipated increase in demand. It could continue to do this until it reached the point where any further reductions in price would result in the voluntary forfeiture of some quota units by farmers, and the failure of winter milk supply to equal the quantity demanded. This, of course, would correspond to *the* minimum price for the scheme. It would also correspond to the point where the price of quotas fell to zero at the beginning of winter. That this relation between *the* minimum price of milk and the market price of quotas exists is evident from the definition of *the* minimum price, i.e. that price which is just sufficient to induce all farmers to retain their quota rights through the winter.

The permitting of quota transfers among farmers is thus seen to have three advantages. First, voluntary transfer is a much more efficient and speedy method of reallocating quotas than is forfeiture plus arbitrary reallocation. Second, voluntary transfer ensures an optimal allocation of production among farms even if the price of milk is set too high. Third, the existence of a market in quota rights provides, in the going quota price, an indicator of the extent to which the price of milk exceeds the minimum level necessary to ensure winter supplies.

Interseasonal Transfers of Quotas

Some of the conclusions reached above require modification if an assumption, implicit in the earlier analysis, is dropped. This assumption is, that in the vicinity of the quota level of output, the marginal cost of summer production, *for each producer,* is less than the manufacturing milk price. The usefulness and importance of this assumption will be apparent: it ensures that the marginal revenue obtained by acquiring or retaining quota rights (which is equal to the difference between the fluid milk price and the manufacturing milk price, or the marginal cost of producing milk at quota volume in summer, *whichever is higher*) is the same for all producers. This equality in turn generates equality of marginal costs of winter production for all producers, in the case of an open-quota plan. If the assumption is dropped, it can no longer be asserted that the allocation of production among farms, with an open quota plan, will be completely optimal; also, the equilibrium price for such a scheme will be somewhat higher than was indicated earlier.

As might be expected, this defect of a quota scheme could be remedied by voluntary transfers of quotas, or of milk, among producers. Mutually profitable arrangements could be made whereby producers with a comparative disadvantage in summer production leased some of their quota rights to, or purchased milk supplies from other producers during the summer season. Note that, unlike the quota transfers considered earlier, which represent *steps toward* an equilibrium allocation of production among farms, these interseasonal transfers would persist *as part of* the equilibrium allocation of production, *i.e.* they would be a permanent feature of the quota scheme's operation.

Summary

With centralized marketing of fluid milk, an individual marketing quota scheme may be necessary for either, or both, of two reasons:

(i) If the marketing authority is determined to maintain the price of fluid milk at a constant level throughout the year, a quota scheme may simply, in effect, serve to convert the stable price to the producer

into a fluctuating price, which is necessary in order to obtain stable supplies in the face of seasonally changing costs of production.

(ii) Quotas may be necessary in order to limit access to the fluid milk market because the price of milk exceeds the level necessary to induce adequate supplies of milk.

A workable open-quota scheme (which is equivalent to a closed-quota scheme with the price set at *the minimum level*) is an example of a scheme where quotas serve the first purpose only. Given the decision to sell milk to consumers at a constant price throughout the year, such a scheme involves payments to producers no greater than would be necessary if producers competed freely to supply the marketing authority's requirements, and prices to producers were allowed to fluctuate freely. (This conclusion is subject to those qualifications mentioned above under the heading of *interseasonal quota transfers.*)

A quota scheme in which the fluid milk price was set at the level P_w (see Figure 1) or higher, would be an example of the use of quotas solely as a rationing device. For quota schemes in which the fluid milk price lies between P_w and P_y, quotas serve both to convert a stable price into a fluctuating one, and to ration access to the fluid milk market.

At the equilibrium, or minimum price for a quota scheme—provided only that under such a scheme's fluctuating price analogue, all producers would wish to supply at least as much milk in summer as in winter—it does not matter whether quotas are allowed to be freely traded or not. If the provisio mentioned in the preceding sentence is not met, then it would be desirable to invest the quotas with transferability.

At any price above the equilibrium or minimum level—that is, whenever quotas have a rationing purpose—free trading in quota rights is necessary in order to ensure efficient production. The establishment of a market in quota rights has the added advantage of providing a guide to the extent to which the price of milk is excessive.

II.

In the light of the preceding analysis we can consider the earlier discussions of the quota problem.

Harris and Candler clearly had in mind a closed-quota scheme, since they state that the quota "tends to become associated with [determined by] what the resource [man, herd, or area of land] did several years previously."[7] Their proposal that quotas should be freely traded is therefore appropriate, since this would tend to bring about an optimal allocation of winter production among farms.

It seems equally clear that Neutze was dealing with an open-quota scheme. He writes of a quota scheme which "is used to maintain a constant price throughought the year", and under which the "optimal price" is "equal to the average marginal cost of producing the required quantity of milk in each (say) month of the year."[8] If we substitute "season" for month in the preceding sentence, and bear in mind that the cost of production of fluid milk cannot fall below the price of manufacturing milk (*i.e.* the manufacturing milk price is the opportunity cost of supplying the fluid milk market), then Neutze's "optimal" price is the same as my approximate "equilibrium" price for an open-quota scheme (which is equal to the approximate minimum price for a transferable quota

[7] Harris and Candler, *op. cit.* p. 113.
[8] Neutze, *op. cit.* p. 136.

scheme). But, having (almost) correctly defined the equilibrium price, Neutze goes on to argue that the scheme would be unworkable at that price, so that "it is necessary that the price for quota milk should be somewhat above the optimal price." Neutze reaches this conclusion by the following steps—

(a) ". . . with such a price there are no privileges of production for which producers would be willing to pay."

(b) In that case, why should producers "accept such an obligation from which they reap no benefits."

(c) "In fact, there is no reason [why they should]."

Neutze's argument is erroneous. Producers will accept the obligation to produce winter milk because, in return, they will receive the privilege of supplying summer milk at a much higher price than they could obtain if they did not participate in the scheme. Farmers are obviously much better off under a scheme which, in effect, offers them a winter price equal to P_k, and a summer price of P_m, than they would be if they received P_m all the year round—which is the alternative to not participating in the scheme: producers generally prefer higher prices to lower prices, even though their *marginal* costs equal price.

It is possible that, in suggesting that producers would not accept the obligation to supply winter milk inherent in a quota scheme, Neutze had in mind, not the choice faced by a farmer after implementation of the scheme, but rather a collective decision by farmers as to whether they would prefer a quota scheme to the free market. However, the argument cannot be saved in this way, since, in fact, farmers are better-off with a workable open-quota scheme than under the free market—except in the limiting case of an absolutely inelastic demand for fluid milk, in which case they are neither better nor worse off. That producers are better off, provided the demand schedule is downward sloping, is perhaps most readily seen by recalling that the open-base quota scheme is formally equivalent to an arrangement whereby the winter price is set at a level *higher than* the free-market winter equilibrium price, with the summer price set at the same level as the free market summer price. Producers' surplus is clearly greater under such a scheme than in the free market situation.

Harris and Candler argue that fluid milk prices "would need to be set so that quotas should have some value at all times of the year", on the grounds that otherwise producers would not have sufficient incentive to maintain production in winter.[9] Neutze asserts that this requirement "certainly implies a [fluid milk] price considerably above the optimum". At the optimum price, according to Neutze, quotas "will have a positive value in spring . . . while in autumn the value will be negative". He agrees with Harris and Candler that "saleable quotas would appear to have considerable advantages," but sees the existence of seasonal negative quota price as a barrier to their saleability. He then suggests that one way out of the difficulty would be to impose some penalty—additional to the loss of an equivalent gallonage of quota milk during summer—for the forfeiture of quota rights.[10]

I have argued above that at the equilibrium milk price for an open-quota scheme (equivalent to *the* minimum price for a closed quota scheme), the value of quota rights will fall to zero at the commence-

[9] Harris and Candler, *op. cit.* p. 114.
[10] Neutze, *op. cit.* p. 137.

ment of the "winter" season, for at that time the discounted present value of holding a quota gallon will be equal, at the margin, to the present cost of doing so. It follows that as the season progresses, quotas will acquire some positive value, reaching a maximum at the beginning of the "summer" season. Harris and Candler's definition of the minimum milk price (in terms of its effect on the price of quotas) is thus valid, if rephrased to the effect that quota prices need to be non-negative at all times. Neutze's belief that, at the optimal milk price, the value of quotas will be periodically negative, is invalid; if the value of quotas ever becomes negative, the price of milk is below the optimum level. It follows that his concern with methods of overcoming the problem of the seasonally negative price is misplaced.

Let us suppose, however, that the price of milk was set below the equilibrium or minimum level, so that less than the required volume of quotas would be voluntarily held on a year-round basis. Would Neutze's suggestion—that under-fulfilment of quota production entails the loss of quota rights equal to twice the production deficiency—in fact remedy the situation? The answer would clearly seem to be, that, on the contrary, it would worsen it. A farmer would think twice before acquiring (in the case of an open-quota scheme) or retaining (in the case of a closed quota scheme) quota rights whose value to him was marginal, if he knew that any subsequent, inadvertent, failure to meet his quota obligation would entail an additional penalty. In the case of a closed-quota scheme, this could be very substantial, since it would consist of the permanent loss of quota rights.

Neutze's "penalty-clause" suggestion has merit as a device for ensuring that farmers take their quota responsibilities seriously, and voluntarily preserve production safety margins in winter. But they would have to be paid for performing this service, *i.e.* the minimum or equilibrium milk price would have to be higher under such a scheme than would otherwise be needed.

In summary, the problems which Neutze raised in connection with the transferable quota proposal of Harris and Candler are non-problems. In all cases where there is a *need* for quota transferability, quotas will have a potential positive market price. If the potential market value of quotas is very low on the average over a year, transferability is not required. If the value of quotas is negative at any time of the year, there is a need to raise the price of milk.