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AN ECONOMIC ANALYSIS OF THE EFFECTS OF THE FRESH MILK SCHEME

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ABSTRACT

The *per capita* consumption of fresh milk has been declining steadily because of increasing substitution. The price discrimination scheme employed in the fresh milk industry is analysed using a demand and supply model. Prices are shown to have set well above the free market price, inducing an estimated cutback in consumption of 8 to 10 per cent and an increase in production of 2 to 4,5 per cent, resulting in an average surplus of 13,5 per cent of fresh milk sales. The transfer from consumers to producers is estimated at between 12,7 and 17,1 per cent of the value of fresh milk production. Approximately half of this transfer is absorbed by the Dairy Board as levies and occurs at a social cost. Price discrimination may be to the detriment of producers in the long term as artificially high prices may encourage the possible irreversible consumption of substitutes.

INTRODUCTION

There is concern about the falling consumption of fresh milk (Graph 1) and the increasing use of substitutes. Price discrimination is applied in the fresh milk industry through a two-price system on fresh and industrial milk. This paper focuses on the issues:

(a) How does the two-price system affect the consumption of fresh milk (have prices been set too high in the face of an increasing number of milk substitutes)?
(b) How does the pool-price system affect production, farm income and consumer cost?
(c) What are the social costs of such a scheme?

Research on the evaluation of dairy policies has been conducted in depth overseas. (Buxton, 1977, Christ, 1980, Dhalgran, 1980, Ippolito and Masson, 1978, Kessel, 1967 and Manchester, 1983).

THE DAIRY CONTROL SCHEME

The market for milk in South Africa is separated into a fresh and an industrial milk market. Control in the fresh milk market is by means of a single-channel pool scheme incorporating a quota applied during surplus periods. Producer prices for fresh and industrial milk are fixed. Fresh milk not sold to distributors at the fixed price is disposed of in the lower-priced industrial milk market. The proceeds are then pooled and paid to producers after the deduction of levies and transport costs etc. During surplus periods milk delivered over and above quota usually realises lower prices.

THE EFFECT OF THE DAIRY SCHEME IN A CLOSED ECONOMY

A graphical presentation

A model of the South African dairy industry assuming a closed economy (exports and imports ignored) is presented in Figures 1a and 1b. World export prices of dairy products are generally distorted because of export dumping by the EEC and in this particular model exports are not considered as a viable alternative. The model is similar to the Ippolito-Masson model of the US dairy industry. (Ippolito and Masson, 1978, p. 50). Even under perfect competition the price of fresh milk (PEF) is expected to be slightly higher than the price of industrial milk (PEI). In the long run this price difference would reflect stricter health requirements for fresh milk. In the short run it would be determined by demand and supply. This model takes into account the production cost differential (between fresh and industrial milk) as opposed to the Ippolito-Masson model.

In Figure 1a, D_I and S_I are the demand and supply functions for fresh milk at the farm level. AR is the average revenue received by fresh milk farmers because of pooling. D_{III} is the demand for surplus fresh milk. P_I and P_{II} are the fixed producer prices for fresh and industrial milk. Pb is the pool price received by fresh milk farmers. In Figure 1b, D_{II} and S_{II} are the demand and supply functions for industrial milk at the farm level.

Recent empirical research by the authors using national market data revealed that the price elasticity of demand for fresh milk lay between -0,45 and -0,65 at the farm level. As the supply of surplus fresh milk is small in relation to the supply of industrial milk, the demand for surplus fresh milk is depicted as being perfectly elastic at P_{II}. The elasticity of demand for surplus fresh milk implies a positive marginal revenue, while the inelasticity of demand for fresh milk implies a negative marginal revenue. It is therefore possible to increase producer revenues by raising P_I above the free market equilibrium and disposing of the surplus in the industrial milk market. Consequently the pool price received by fresh milk farmers must exceed the free market

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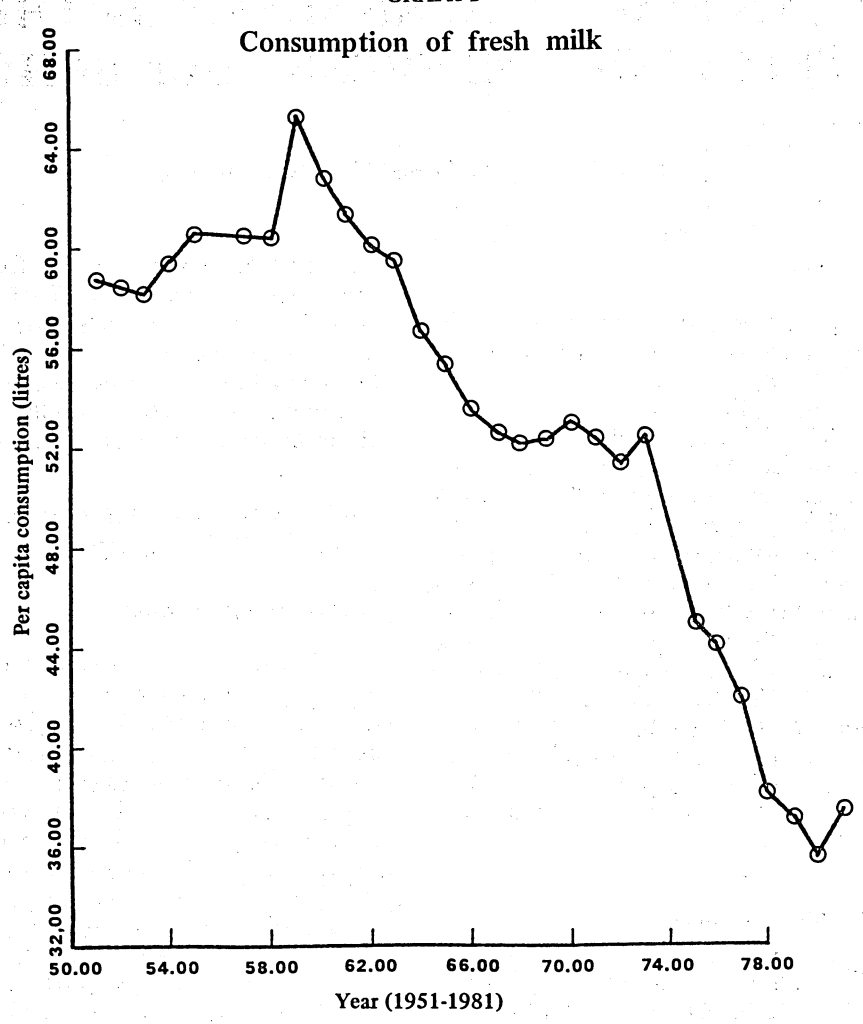
GRAPH 1



McKenz. 84/07/03 10: 29: 26 COMPUTER CENTRE UNIVERSITY OF NATAL

SOURCE: *ABSTRACT OF AGRICULTURAL STATISTICS* – 1978, 1983

FIGURE 1

The milk market

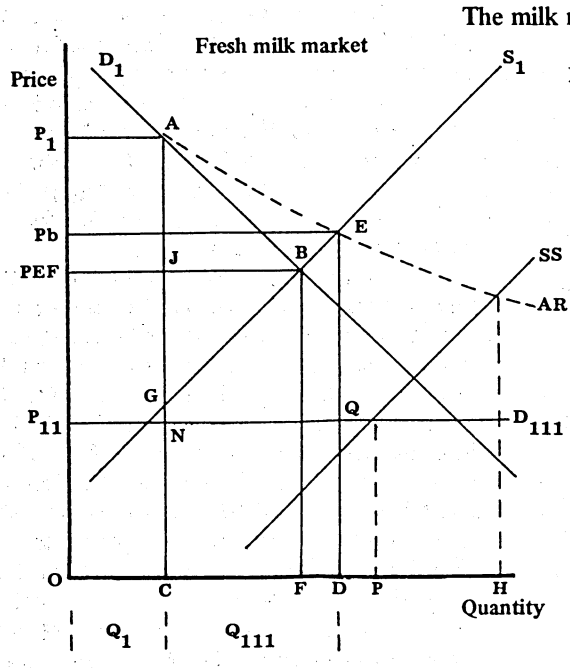


Figure 1a

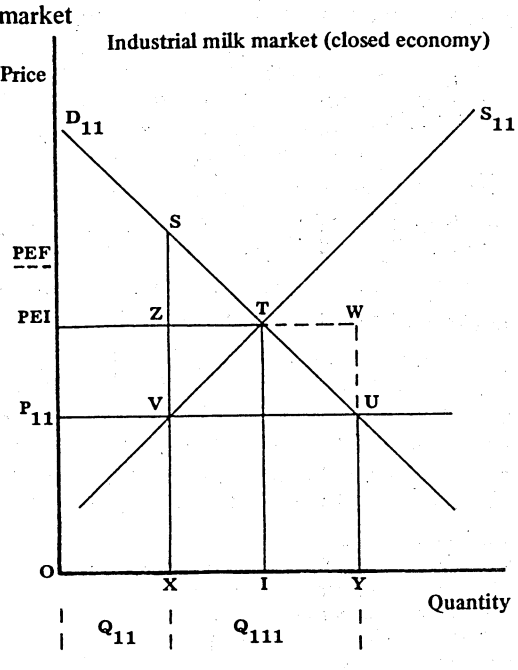


Figure 1b

equilibrium. Fresh milk surpluses in controlled areas that were diverted into the manufacturing sector averaged 13,5 per cent of full price sales between 1979/80 and 1982/83 (Dairy Board Annual Reports). This is evidence that the price of fresh milk (P_I) has been set above the free market equilibrium. Knowing the quantity of fresh milk sold (Q_I) and the quantity of surplus fresh milk sold (Q_{III}) the pool price or average revenue can be determined as follows (Ippolito and Masson, 1978, p. 39):

$$Pb = \frac{P_I Q_I + P_{II} Q_{III}}{Q_I + Q_{III}}$$

The equilibrium pool price is determined by the condition that the pool price must equal marginal costs (Kessel, 1967, p. 59). In the absence of price control the competitive equilibrium would be the price quantity vector (PEF, PEI, OF, OI). Using this as a reference, the effects of the two-price system are:

Fresh milk production is increased from OF to OD and fresh milk consumption is decreased from OF to OC. In order to absorb all surplus fresh milk in the industrial milk market the Dairy Board must set the industrial milk price below the free market equilibrium at P_{II}. The fall in price will cause an increase in industrial milk consumption from OI to OY and a decrease in primary industrial milk production from OI to OX.

Social costs and income tranfers

It is assumed that the area under the demand curve is a measure of the total value placed upon a commodity in terms of other goods and the area under the supply curve represents the opportunity cost of resources used to produce the commodity. Both areas are given equal weight in this analysis.

In Figure 1 social costs stem from under-comsumption of fresh milk and production of surplus fresh milk that could have been produced at industrial milk costs. The value lost owing to under-consumption in the fresh milk market is represented by area CABF less the cost of recources used to supply this fresh milk OGBF. The net loss is represented by triangle GAB. The cost of supplying surplus fresh milk is CGED and the revenue earned from it is represented by CNQD. This net cost is represented by NGEQ. The net social cost in the fresh milk industry is therefore GAB + NGEQ.

In the industrial milk market the fall in output by primary producers causes a loss in value XSTI, while resources XVTI are released. Surplus fresh milk has value XSUY in the industrial milk market. However, the cost of obtaiing it is XVUY. The net gain in the industrial milk market from surplus fresh milk is represented by VTU.

The total net social cost in Figure 1 is measured as GAB + NGEQ - VTU.

Income transfers in Figures 1a and 1b are represented by areas:

PEF P_I AJ	:	Transfer from fresh milk consumers to fresh milk producers (and the Dairy Board). (Figure 1a)
P_{II} PEI ZV	:	Transfer from industrial milk producers to industrial milk consumers. (Figure 1b)
VZWU	:	Subsidy from fresh milk producers to industrial milk consumers (Figure 1b)

The effect of the summer fresh milk quota

During the summer the relative abundance of cheap fodder shifts the supply function to the right (SS). The resulting increase in surplus fresh milk causes the pool price to fall. In order to prevent the pool price from falling too low a quota on fresh milk is introduced. In Figure 1a, if the supply function remained static and farmers received P_{II} for their milk in excess of quota, there would be no surplus produced as marginal costs would exceed marginal revenue. In practice the supply function shifts to the right (SS) and surplus fresh milk CP is produced under quota. This, however, is still less than the surplus, CH, that would be produced under the pool system.

Social costs associated with excess production under the pool scheme can be reduced if P_{II} is set low enough. The costs arising from under-consumption in the fresh milk market are, however, still present. Quotas protect the marginal high cost producer from the falling pool price, thus entrenching inefficiency in the industry. Income transfers remain essentially the same as under the pool system with the last two varying with the size of the surplus produced. Note, however, the quota system treats the effect and not the cause of overproduction. The primary cause is that P_I has been set too high.

MEASUREMENTS OF TRANSFERS AND SOCIAL COSTS INHERENT IN THE MILK SCHEME

Critical parameters used in calculating income transfers and social costs are presented in the appendix.

Empirical research by the authors in 1984, using time series data, indicated that on average the elasticity of demand for fresh milk at the farm level lay at -0,51, but the best estimate for industrial milk was -0,47. Research also revealed that the elasticity of fresh milk demand had increased over time. The elasticity of fresh milk demand at the farm level was estimated at approximately -0,65 during the later years of the study.

The supply elasticity for industrial milk was estimated at 0,55. No significant supply elasticity was calculated for fresh milk. A range of elasticities from 0,3 to 0,7 were used. This falls within the range of estimates presented by Askari and Cummings, 1976, from world-wide studies on aggregate milk supply. It is felt, however, that the supply elasticity should be smaller than that of industrial milk, estimated at 0,55.

Since the industrial milk market is national in scope, the demand for surplus fresh milk facing the

Board in controlled areas is regarded as an excess demand curve. This approach is also used by Ippolito and Masson, 1978.

If Q_{111} is the quantity of surplus fresh milk demanded in the industrial milk sector and Q_{11} is supplied by industrial milk producers then: (for derivation see Johnson, 1969, p. 6):

$$EdS = \frac{Q_{111} + Q_{11}}{Q_{111}} \times EdI - \frac{Q_{11}}{Q_{111}} \times ESI$$

Where EdS = elasticity of demand for surplus fresh milk
EdI = elasticity of demand for industrial milk
ESI = elasticity of supply of industrial milk by primary producers

Using EdI = -0,47 and EdS = 0,55 the price elasticity of the excess demand curve (for surplus fresh milk) is -10,93.

In the calculation of social costs EdS was taken as perfectly elastic. The effect of this simplication on results is negligible in view of the highly elastic excess demand curve.

Table 1 presents the average price and quantity effects of the fresh milk scheme for the period 1979/80 to 1982/83. Different elasticities of demand (Ed) and supply (Es) are used to gauge the sensitivity of the above estimates to elasticity changes.

In calculating the above effects the demand functions of the indicated elasticities were fitted through point A (Figure 1a) and the supply functions of the indicated elasticities were fitted through point E (Figure 1a).

In a perfectly competitive market during the period 1979/80 to 1982/83 the consumer price of fresh milk would have been 14,3 to 19,4 per cent lower (at the farm level), producer prices would have been 5,2 to 10,8 per cent lower, production (Qs) would have been 2,3 to 4,5 per cent lower and consumption would have been 8,0 to 10,3 per cent higher.

Transfers from consumers to the Dairy Board and producers as a percentage of the total value of fresh milk production (including surplus fresh milk) are presented in Table 2.

Relative to a perfectly competitive market the milk scheme taxes the consumer between 12,7 and 17,0 per cent of the total value of fresh milk production. Levies to the Dairy Board absorb 7,6 per cent and producers receive between 5,1 and 9,5 per cent. On average, producers receive 48 per cent of the consumer transfer and the Board absorbs 52 per cent as levies.

The social costs of the fresh milk scheme are presented in Table 3 as a percentage of the total value of production, as a percentage of the transfer received by the producer and in millions of rand at 1982/83 prices.

Social costs, when measured in terms of total production, are negligible. However, if the aim of the scheme is to transfer income from consumers to producers (Gardner, 1983), the social costs become significant in terms of this aim. Table 3 reports social costs in terms of income transfers received by producers, ranging from 7,03 to 14,02 per cent.

Figure 1a assumed that the Dairy Board would have to fix the producer price below the free market equilibrium in order to absorb surplus fresh milk locally. This would result in an income transfer from producers to consumers. This is an over-simplification as in practice there have been shortages and surpluses in the past. This has been

TABLE 1 - Average price and quantity effects of the fresh milk scheme (1979/80 - 1982/83) (Percentage change at the farm level)

	Ed = -0,51			Ed = -0,65		
Variable	Es = 0,3	Es = 0,5	Es = 0,7	Es = 0,3	Es = 0,5	Es = 0,7
P_1	19,4	17,1	15,7	16,6	15,3	14,3
Pb	10,8	8,3	6,5	7,8	6,3	5,2
Q_1	(9,8)	(8,1)	(8,0)	(10,79)	(9,9)	(9,3)
Qs	3,2	4,2	4,5	2,3	3,2	(3,6)

Source: (See Appendix)

TABLE 2 - Average transfers inherent in the fresh milk scheme as a percentage of the value of total output (1979/80 to 1982/83)

	Ed = -0,51			Ed = -0,65		
	Es = 0,3	Es = 0,5	Es = 0,7	Es = 0,3	Es = 0,4	Es = 0,5
Transfer from consumers	17,1	15,2	14,0	14,8	13,5	12,7
Absorbed by levies	7,6	7,6	7,6	7,6	7,6	7,6
Received by producers	9,5	7,6	6,4	7,2	6,3	5,1

Source: (See Appendix)

TABLE 3 - Average social cost of the milk scheme (1979/80 to 1982/83)

	As a percentage of total value			As a percentage of transfer received by producer			Million rand (1982/83 prices)		
	Es,3	Es,5	Es,7	Es,3	Es,5	Es,7	Es,3	Es,5	Es,7
Ed -0,51	0,67	0,74	0,80	7,03	9,77	11,71	1,60	1,76	1,91
Ed -0,65	0,73	0,81	0,85	8,10	11,86	14,02	1,74	1,93	2,03

Source: (See Appendix)

dealt with more fully by the authors (McKenzie and Nieuwoudt, 1984).

POLICY IMPLICATIONS

The preceding analysis showed that the two-price system led to a substantial increase in the consumer price of fresh milk. This led to a fairly large cut back in consumption ranging from 8 to 10,7 per cent. Prices received by producers were not increased to the same extent because of levies absorbed by the Dairy Board. The price increase led to an increase in supply ranging from 2,3 to 4,5 per cent. The resulting surplus of fresh milk was significant, averaging 13,5 per cent of fresh milk sales. Transfers from consumers are large, ranging from 12,7 to 17,1 per cent of the value of fresh milk consumption. Less than half of this was received by producers and the remainder was levied by the Board. Fairly small social costs are estimated at between 0,65 and 0,85 per cent of total output value.

The preceding results use a perfectly competitive market as a reference. In the absence of monopoly controls by the Dairy Board, it is optimistic to assume a truly competitive market would result. Producer co-operatives or distributors could administer their own quotas, as was done in Natal before Dairy Board controls were instituted. Reversal of consumer transfers and other market distortions would be reduced to the extent that producer co-operatives, distributors or processing firms could obtain monopoly power.

Today there are many substitutes for fresh milk products which have already made serious inroads into consumption, especially in the case of fresh milk. In the controlled areas (excluding Natal) the consumption of fresh milk in 1983 was only 6 per cent higher than in 1973, (National Marketing Council, 1983, Table 3) whereas the population was roughly 29 per cent larger. Fresh milk has exceptional nutritional qualities so why has it been unable to compete effectively against substitutes? Although the price discrimination system may benefit producers in the short term, artificially high prices encourage substitution. Market erosion by subsittutes could eventually lead to a decrease in producer revenue. At present, aggressive price competition is impossible because of price fixing.

"Blends and substitutes have come to stay and when one studies feedback ... consumers have valid reasons such as easy storage, better control of stock, price, etc. So however good our product is we must relate our price to what the market can pay rather than what it is costing us to produce .... Better quality roughage could cut our biggest input i.e. concentrates." (Natal Fresh Milk Producers' Union).

Because of excessive administration procedures producer groups and distributors are often frustrated by the time-lag when calling for a change in policy in response to changing market conditions. Most substitute products are, however, receiving competitive promotion of their efficiency and flexibility.

According to the National Marketing Council (1983, p. 22), prices of inputs such as feed and breeding animals have increased in response to greater demand, induced by increases in the producer price of milk over the past four years. High producer prices encourage intensive feeding. In July 1983 the levy rate on fresh milk was increased by 2 cents a litre in order to subsidise abnormal dairy stocks. Unfortunately the preceding empirical analysis did not cover this event as it uses a split year from February to March. It is interesting that the fresh milk model predicted producer prices would be roughly 2 cents per litre above the free market equilibrium (see Appendix). The levy will place extreme pressure on intensive fresh milk producers.

Dairy Board officials argue that surpluses of fresh milk inherent in the two-price system are needed to insure against shortages and quotas are needed to control surpluses because of shifts in demand and supply. In perspective, uncertainty of demand and supply makes it impossible for the authorities to fix an exact market clearing price. In order to adjust to the prevailing situation, premiums, levies or quotas are used. In a competitive market the price would adjust to alleviate shortages and surpluses. At present many people regard shortages and surpluses as naturally inherent in the milk industry. This, however, is partially a product of the rigid price fixing policies.

Milk production exhibits cyclical, seasonal and short run variations in supply which are quite different from variations in demand. (Manchester, 1983, p. 287). Proponents of control point out that, because of the inelasticity of demand and supply, price fluctuations in the dairy industry would be excessive without controls. The resulting risk would cause a backward shift in the supply function resulting in the loss of producer and consumer surplus. This is possibly one of the strongest arguments for control. It is felt, however, that forward contracting in fresh milk marketing can provide a marked degree of stability in the absence of controls. The preceding analysis indicates that the fresh milk supply function would have to shift back between 8 and 10,3 per cent in the absence of government regulation to place consumers at their present level of surplus. In the case of industrial milk the ability to store dairy products should dampen price fluctuations.

The rigid price fixing policy is seen as the root cause of the market distortions discussed. "The fixing of the selling price of fresh milk to distributors and the administration of fresh milk pools for the various controlled areas are not indispensible for the orderly marketing of fresh milk in the opinion of the Marketing Council. In such areas as Port Elizabeth, Kimberley, East London and the Orange Free State Goldfields, the fixing of prices to be paid by fresh milk distributors has been lifted without disrupting marketing". (National Marketing Council, 1983, p. 30). The Marketing Council is also of the opinion that serious consideration should be given to the discontinuance of the fixing of producer prices for industrial milk and the Council proposes the fixing of a minimum price floor (National Marketing Council, 1983, p. 31).

CONCLUSION

The two-price system for fresh milk induces over-supply and under-comsumption. This results in an income transfer from consumers to producers of which roughly half is levied by the Dairy Board so that it can perform its operations. Artificially high prices encourage substitution and the price fixing policy inhibits effective price competition. This could lead to a serious decrease in producer revenue. The restricted consumption of fresh milk and the production of relatively expensive surplus fresh milk results in a net social cost to society.

Quotas can reduce the cost associated with over-production yet they do not remedy the distortions associated with reduced consumption.

The policy of price discrimination and rigid price control is seen as the cause of the market distortions. Prices should be allowed to fluctuate in sympathy with demand and supply. Restrictions on marketing in controlled areas should therefore be lifted. The private sector is capable of adjusting to price uncertainty through forward contracting.

Manchester (1983, p. 287) feels some degree of control in the milk industry is needed, while maintaining room for competitive forces. The National Marketing Council, 1983, suggests the fixing of minimum producer prices for industrial milk. If this minimum price is set low enough to allow price fluctuation the present distortions can be reduced. As fresh milk is highly perishable and cannot be stored for long, the case for controlling it is stronger than that for industrial milk. If similar arrangements were introduced for fresh milk minimum prices would have to be set sufficiently low to prevent price discrimination.

A measure of stability in the industry is desirable. However, the rigid price control in the milk industry stifles competition, flexibility and efficiency.

Empirical research by the authors (1984) has shown that the demand for milk has become more price sensitive (elastic) over time because of the increasing availability of substitutes and the growing number of Blacks in society. This implies that price will become a more important feature in the selling of milk. The price discrimination scheme may not benefit producers in the long term as price support encourages the possibly irreversible consumption of substitutes. Producers should look to new institutional arrangements in order to cope with the threat of substitutes.

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APPENDIX

Critical parameters used in solving the milk model are presented in Appendix Tables 1 and 2.

APPENDIX TABLE 1a - Price and quantitity parameters used in solving the fresh milk model (Prices in cents per litre, quantities in millions of litres)

Year	Q_1	Q_{111}	$Q_{111}/Q_1 \times 100$	P_1	Pb
1979/80	436,2	68,7	15,5	21,5	19,5
1980/81	539,1	72,7	13,4	25,1	22,9
1981/82	606,4	46,1	7,6	29,6	27,2
1982/83	601,1	106,2	17,6	34,6	30,6

Source: (Dairy Board Annual Reports: Milk sales fund and pool accounts) (Q_1 includes full price sales to non-controlled areas)

APPENDIX TABLE 1b - Total value of fresh milk output and levies on fresh milk (million Rand)

Year	Total value (fresh milk) (1)	Levies (2)	(1)/(2)x100
1979/80	105,65	7,17	7,2
1980/81	150,74	9,99	7,1
1981/82	196,06	13,27	7,3
1982/83	238,96	22,05	10,1

Source: (Dairy Board Annual Reports: Milk sales fund and pool accounts)

APPENDIX TABLE 2 - Price quantity equilibrium in the fresh milk model (Prices in cents per litre and quantities in millions of litres)

		Ed = -0,47			Ed = -0,65		
		Es = 0,3	Es = 0,5	Es = 0,7	Es = 0,3	Es = 0,5	Es = 0,7
1979/80	PEF	16,9	17,5	17,8	17,5	17,9	18,2
	QE	483,8	477,8	474,0	488,6	483,4	480,0
1980/81	PEF	20,3	20,9	21,3	21,0	21,4	21,6
	QE	591,2	585,0	581,1	596,4	591,2	587,7
1981/82	PEF	26,0	26,3	26,4	26,5	26,6	26,7
	QE	643,9	641,2	639,5	647,5	645,7	644,6
1982/83	PEF	26,1	27,1	27,8	27,3	27,9	28,4
	QE	676,2	667,2	661,5	684,0	676,4	671,3