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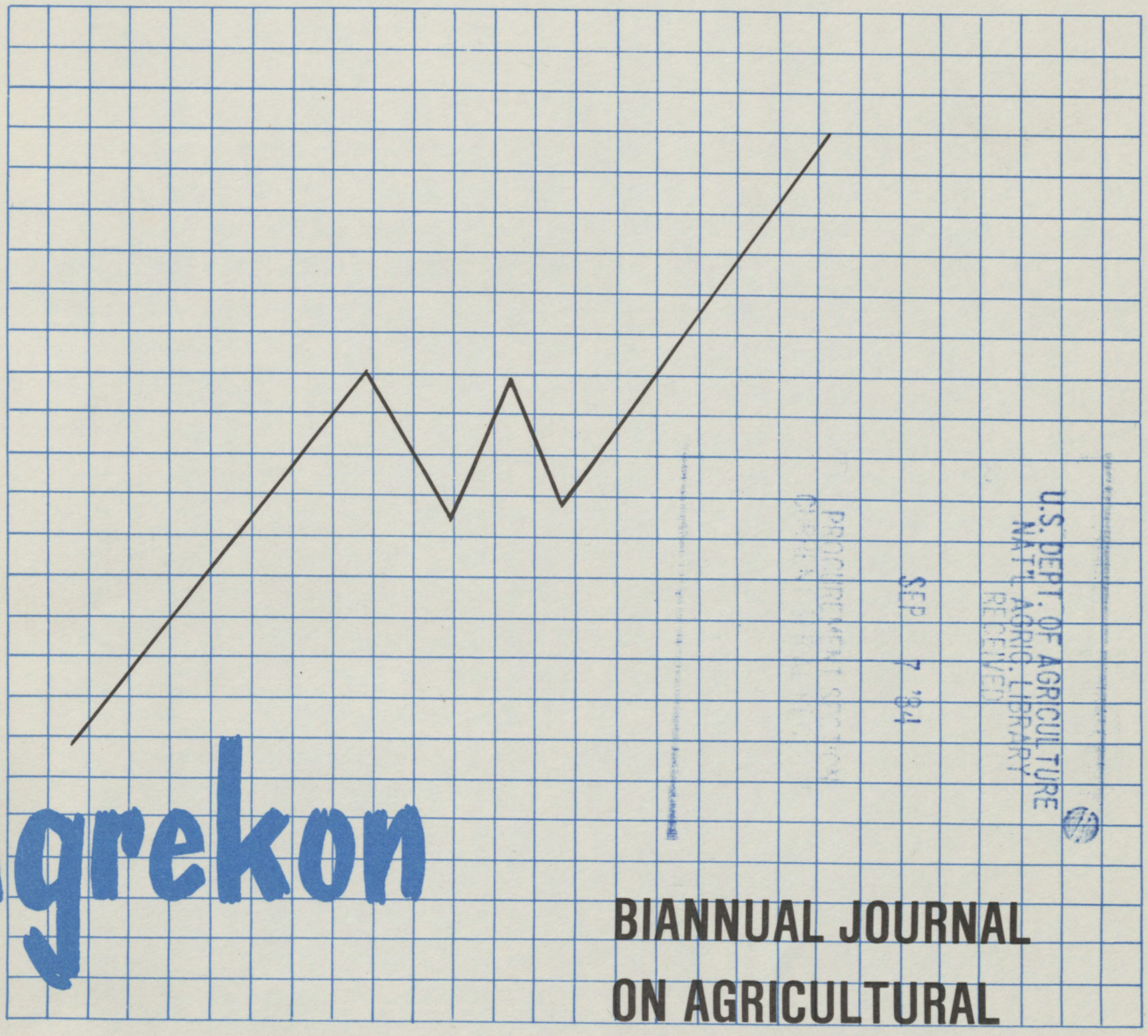

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THE EFFECTS OF TRANSPORT POLICIES ON THE SOUTH AFRICAN SUGAR INDUSTRY

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1. INTRODUCTION

A large proportion of cane transport costs are not borne directly by cane growers or millers. Growers and millers are refunded for transport costs through the Cane Transport Scheme, which implies that they do not pay directly for the transportation of cane. Growers and millers do, however, pay indirectly for cane transportation since the subsidy for transport is financed from the proceeds of sugar sales. The chief criticism of the Cane Transport Scheme is that it distorts normal incentives. Firstly, the subsidisation of cane transport costs has removed the incentive for growers to change to a cheaper mode of transport. Secondly, millers have little economic incentive to locate mills at sites where cane transport costs are minimal, since millers are not directly liable for transport costs. Thirdly, there is little incentive for millers to exchange quotas to reduce cane transport costs. Fourthly, it is possible for some growers to exploit the scheme at the expense of others.

The fact is, however, that cane transport costs are indirectly borne by all millers and growers.

Because the Cane Transport Scheme has been responsible for inefficiency of this nature, growers and millers have to bear a greater cost than would have been the case in the absence of a subsidised scheme. This article shows the fallacy inherent in the subsidisation of a transport scheme.

2. HISTORICAL REVIEW OF THE CANE TRANSPORT SCHEME

Prior to the introduction of the Cane Transport Scheme, growers were responsible for transporting sugar cane to the mills. Subsidisation of these costs by millers, was widespread, however. This was a source of friction and discontent among growers because some growers were subsidised and others not. The Commission of Inquiry into the Sugar Industry of 1970 recommended that growers should bear full cane transport costs.

The Commission's recommendation was not accepted by either millers or growers, however. It was also during this period that rail tariffs were increased dramatically, and this affected a particularly vociferous section of the industry. The Cane Transport Scheme was introduced in the 1973/74 season to appease discontented growers.

The Cane Transport Scheme actually extended the subsidisation of cane transport costs to all growers on a common basis. Under the Scheme, growers are only responsible for the costs they bore during the 1969/70 season. These costs are adjusted according to increases or decreases in the sucrose price, but are not adjusted for any inflation in transport costs. The average transport cost paid by growers is included in the sucrose price. Millers are also only responsible for the cane transport costs paid by them in the 1969/70 season. These costs are averaged out using a complicated formula, in order to determine each miller's return. All increases in transport costs above the adjusted 1969/70 levels are paid directly by the industry to the people incurring the cost. As transport costs have increased owing to inflation and the energy crisis, so this amount has grown. During the 1981/82 season, 52% of the total costs of cane transport were not the direct responsibility of either growers or millers.

Sugar-cane is produced on spatially dispersed farms, delivered to seventeen mills where raw sugar is produced, then exported, refined or sold locally as brown sugar. Sugar is refined at seven refineries, six attached to mills, and sold locally. The price of sugar-cane delivered to the mill is the same for all farmers.

The price mills receive for a ton of raw sugar is the same for all mills. It is determined through the division of proceeds formula and is based on average costs of production. The local sugar price is controlled by the Government.

The price at any one point in South Africa is the Durban price plus sugar transport costs, from Durban to that point. All revenue accruing to sugar transport is pooled and each mill or refinery paid back its actual sugar transport costs (Burnett, 1982). Sugar is exported at free world prices, which tend to be volatile. All exports take place through the Export Division of the Sugar Association. Proceeds from local and export sales are divided among growing and milling sectors, using the division of proceeds formula.

The subsidisation of a large proportion of sugar-cane transport costs has tended to remove economics of location in sugar-cane farming, and the location of the mills in relation to producing

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regions. The policy of pooling sugar transport costs and paying actual transport costs has also removed economics of location of mills and refineries in relation to markets.

3. MODELS

To determine what effects the Cane Transport Scheme has had on the industry an inter-regional transportation model of the industry was formulated. The transportation model finds the allocation pattern of sucrose supplies to mills that will minimise sugar-cane transport costs. A number of permutations of this model were used in analysing cane transport costs.

A transhipment model was also used in analysing the sugar industry. The solution to the transhipment model provides shadow prices on all the demand regions in the model. These shadow prices are actually market price differentials. If the price of one demand region is known then prices at the other regions can be calculated. Because the least cost solution of the model is the pattern that is likely to evolve in a free market, the free market can be simulated using shadow price analyses. This was done using a transhipment model and a plant size location model.

A transhipment model minimises both sugar-cane transport costs. The plant size location model, which employs a non-linear programming technique, separable programming, simultaneously minimises sugar cane transport and milling costs.*

4. EFFECTS OF THE CANE TRANSPORT SCHEME - MODEL RESULTS

Using different permutations of the inter-regional transportation model, it was possible to determine the detrimental effects of the Cane Transport Scheme. This was done by solving for the economically optimum situation and comparing it with the actual.

4.1 Least cost modes of transport

The extension of transport subsidies to all growers has in many instances removed any incentive for growers to change to a cheaper mode of transport. For instance the amount of cane transported by each mode during the 1971/72 season is very similar to the amounts transported by each mode in the 1980/81 season. Ignoring tramline transport, it was estimated that if all growers used their most economical mode of transport, up to R3 million could be saved in transport costs every season. If tramlines were discarded and replaced with either tractor-trailer or hilo transporters, an estimated R6 million would be saved every season. Therefore, if all growers used their most economical mode of transport to the mill, total cane transport costs could drop by as musch as R9 million per season.

Table 1 shows the amount of cane transported by each mode during the 1979/80 season, compared with the amount transported by each mode if the most economical mode were used. It is apparent that tramline transport would be discarded completely if least cost modes were used. The amount of cane transported by road would increase at the expense of tramlines. Most of the increased road transport is by hilo. The creation of mill sites has been the cause of inefficiency in cane transport. Mill sites have been created where old mills were closed down. A mill site was created at Bedlane in the Nkwaleni Valley because Huletts indicated that they intended building a new mill there.

TABLE 1 - Percentage of total crop transported by each mode

Mode	1979/80 season %	Least cost mode %
Railways	10,0	9,5
Tramline	10,9	-
Hilo	59,6	79,0
Lorry	9,0	2,0
Tractor-trailer	10,2	9,5
Total road transport	78,8	90,5

Source: Lamusse J.P., 1979/80, p.118

Growers are responsible for the transportation of cane to the mill site. Thereafter, the millers take over the transport function. The cane is therefore transhipped from the growers vehicle into the millers vehicle.

In some cases this has lead to double transhipping. For example, at the Esperanza mill site, growers from the Dumisa and Highflats area tranship cane into their own hilo transporters. The cane is then taken to the Esperanza mill site, where it is again transhipped into other hilo transporters owned by the millers. These hilos then transport the cane to the Sezela mill, only 13 km away. Double transhipping at the Esperanza mill site wastes approximately R16 000 per season. Because the Cane Transport Scheme has entrenched the use of certain transport modes, millers are obliged to provide facilities to offload these modes at the mill. Generally, this has lead to an underutilisation of offloading equipment. For example, the Railways offloading system at the Malelane mill has a capital cost equal to approximately half the total cane yard cost, but it only handles 15% of Malelane's total cane supply. The Cane Transport Scheme has thwarted millers attempts at streamlining their offloading systems. Kedian has found that mills with one, or predominantly one, offloading system are more efficient than mills that have many offloading systems (Kedian 1979), pp. 408 -s 416).

* The separable programme used is described by Chadwick and Nieuwoudt (1982) and is based on the model described by Baritelle and Holland (1975)

4.2 Rationalisation of sucrose quotas

The quota system attaches each grower to a particular mill, which that grower has to supply. The grower can only change his crush mill with the consent of the millers concerned. Because neither growers nor millers are directly responsible for a large proportion of cane transport costs, growers do not necessarily supply their nearest mill. In some cases, cane actually by-passes a mill before arriving at its crush mill. Cross-haulage of cane also occurs.

The sugar industry would increase its efficiency and save money if a rationalisation of quotas among mills were to take place. If quotas were exchanged among mills in such a way that the processing levels of the mills were unaffected, an estimated R1 244 000 could be saved each season. If growers were able to supply any mill subject to the maximum capacity of that mill, then total cane transport costs would be decreased by R1 866 000 per season. Milling costs would also be affected however, because the processing levels at some mills would increase at the expense of mills with a locational disadvantage. If growers were able to supply their nearest mill, R3 148 000 could be saved in transport costs every season. This allocation pattern of sugar-cane supplies would involve the expansion of some mills and the contraction of others.

4.3 Production in areas distant from mills

Distant areas with high transport costs may not be economically viable for cane production. In order to determine the viability of an area, the profit margin (return on capital and management allowance in the sucrose price) and the average cost of cane transport for the industry must be known. The profit margin in the 1981/82 sucrose price was R34,00 per ton of sucrose (Cane Growers' Association, 1982). The average cane transport cost used in the analysis is R25,70 per ton of sucrose. This would be the average cost per ton of sucrose if each grower used his most economical mode of transport. In the medium term, growers would change to their most economical mode and marginal growers would go out of cane production, assuming that either growers or millers pay cane transport costs. The maximum cane transport cost that an average grower would be able to bear before making a loss is R59,70 (R34,00 + R25, 70) per ton of sucrose. Areas that are marginal in terms of distance from the mill are shown in Table 2. If growing costs in these areas are not below average, cane production will not be viable. It is likely that a number of growers in these areas would sell their quotas and go out of sugarcane production.

If these areas went out of production, the industry would lose 59 715 tons of sucrose, and total transport costs would drop by R4 million. This would further reduce the cost of cane transport to R24,21 per ton of sucrose and other areas would then become marginal.

TABEL 2 - Marginal areas owing to high transport costs

Area	Actual transport cost R	Difference between actual and maximum transport cost R
Highflats	73,45	13,75
Umzimkulu Flats	65,78	6,08
Muden	59,78	0,08
Melmoth	69,15	9,45

The introduction of the Cane Transport Scheme has resulted in a pattern of cane production which is not optimal in relation to mills. If either growers or millers take over cane transport costs, there is likely to be a concentration of cane production around mills. At present cane transport costs are not an important factor in the location of cane production.

Another possibility is that mills will be erected to process cane in these distant areas. For example, a co-operative mill could be built at Melmoth, or the Huletts Group might be forced to build a mill at Bedlane. The cost of transporting cane from Melmoth to Bedlane is only R38,96 per ton of sucrose, well within the maximum cost of R59,70 per ton of sucrose. Melmoth would then be economically viable as a cane-producing area. This illustrates the importance of mill locations in relation to cane-producing areas.

4.4 Mill sizes and locations

Apart from distorting the production of cane in relation to the raw sugar mills, the Cane Transport Scheme has also resulted in some mills being located far away from their main supply areas. An example is the Illovo mill, which is situated on the South Coast but receives most of its cane supplies from the Southern Midlands over 50 km away. Because neither millers nor growers are paying the bulk of these high transport costs, there is no incentive for millers to resite the mill. If the Illovo mill were moved to Eston in the Southern Midlands, however, the saving in cane transport costs would be R3 694 000 every season. The Mt. Edgecombe mill on the North Coast also receives a fairly large proportion of its supplies from the Southern Midlands. The above saving in transport costs assumes that cane in the Southern Midlands presently being crushed at Mt. Edgecombe would also be sent to the mill at Eston. Other anomalies in mill location are the proximity of the Union Co-op and Noodsberg Mills, and the location of the Sezela mill virtually on the beach.

The closing down of the Empangeni and Felixton mills and the creation of a new "supermill" at Felixton will have a detrimental effect on cane transport costs. It will, in fact, increase total transport costs by R1 255 000 per season. If, instead of a single huge mill at Felixton,

two medium-sized mills were built, one at Felixton and the other at Bedlane, total transport costs would drop by R1 865 000 per season. The difference in transport costs between the two decisions is therefore R3 120 174 every season. This illustrates the effect mill locations and sizes have on cane transport costs.

It was hypothesised that the trend towards the concentration of milling facilities at a few locations was also the result of the Cane Transport Scheme. This is because millers do not have to take cane transport costs into account but only aim at the minimisation of milling costs. Because economies of scale apply in sugar milling, millers would favour large mills and the expansion of their existing mills. It was hypothesised that both milling and transport costs would be minimised if there were more smaller mills than at present. This hypothesis was tested, using a computer model that simultaneously minimised both milling and transport costs. It was found, in fact, that economies of scale in milling costs outweighed increases in transport costs. The trend towards large mills therefore appears to be economically sound. This, however, only holds true up to a point. There is a danger that if the Cane Transport Scheme continues, the trend towards large mills will continue beyond the upper limit set by transport costs. It is therefore important for the long-term development of the industry that cane transport costs should be the direct responsibility of either growers or millers.

4.5 Efficiency of Cane Transport Scheme

By entrenching the existing transport systems, removing the economies of location, and removing incentives to economise, the Cane Transport Scheme has caused cane transport costs to be higher than necessary. In fact, if each grower used his most economical mode of transport, mill sites were abolished, quotas were rationalised among mills, marginal areas went out of production, and the Illovo mill was moved to Eston, then an amount of R18 113 000 could be saved every season.

This is a cost saving of 24,7% per season. Any lowering of the industry's cost structure would make it more competitive on the world market. This would benefit both millers and growers. There would also probably be a saving to the consumer because the price of sugar is based on the average costs of production.

5. INTER-REGIONAL PRICES

Shadow prices of the model provide an impression of regional prices in a free trade situation. By simulating a free market it is possible to determine the effects that policies (which distort the free market) have had. The model does not simulate a perfect free market, however, because supply and demand are assumed to be perfectly inelastic. The base price used in the shadow price analysis is the average free world price for the 1981/82 season, R359,92 per ton of raw sugar (Butles 1982). If South Africa lifted all restrictions on the importation of sugar and the sugar industry operated in a free market then local prices would be dependent on world prices.

5.1 Shadow price analyses - transhipment model

Sugar prices were determined for the markets used in the model and then compared with prices calculated using the present price formula. It was found that in a free market inland markets, particularly in the Eastern Transvaal, would have lower sugar prices. This is because the inland markets are supplied directly by Malelane, Pongola and Umfolozi in the model rather than via Durban. The cost difference in prices amounted to R4,5 million per annum for refined and brown sugar.

On the basis of the average free world price, the Durban price per ton of raw sugar is R332,10. Adding a packing and marketing margin of R47,00, the Durban brown sugar price becomes R379,10 per ton. Adding a refining margin of R36,00 the Durban refined sugar price is R415,10 per ton. The refinery prices per ton of refined sugar are included in Table 3.

TABLE 3 - Refinery prices per ton of refined sugar

Refinery	Price R
Malelane	426,91
Pongola	419,53
Umfolozi	414,20
Emtumeni	405,63
Gledhow	409,54
Noodsberg	414,05
Huletts	415,10

It is apparent from Table 3 that Malelane and Pongola receive the highest prices. This is because they are relatively closer to the large, high-priced Witwatersrand market. Noodsberg and Umfolozi are also relatively closer to inland markets. Huletts Refinery in Durban supplies the coastal Cape markets.

The per ton of raw sugar prices and per ton of sugar sucrose prices prevailing at the mills are given in Table 4.

The per ton of sucrose prices are the raw sugar prices less a milling margin, converted to a sucrose basis using each mill's extraction efficiency. The milling margin is an average milling cost of R94,52 per ton of raw sugar. Once again Malelane and Pongola have high prices indicating their relative locational advantages. Noodsberg also has a high sucrose price because the advantage of having a refinery is passed on to the mill. Mt. Edgecombe, Tongaat and Illovo also have high sucrose prices owing to their proximity to Durban. Small mills, such as Entumeni and Glendale, with compact supply areas have lower sucrose prices.

TABLE 4 - Mill prices of raw sugar and sucrose

Mill	Per ton of raw sugar R	Per ton sucrose R
Malelane	343,68	213,48
Pongola	336,53	208,16
Umfolozi	326,23	194,62
Entumeni	320,35	188,35
Empangeni	320,96	191,59
Felixton	321,18	192,88
Amatikulu	322,58	196,79
Darnall	323,85	199,24
Mt. Edgecombe	327,50	203,26
Glendale	322,27	187,46
Gledhow	325,62	198,20
Noodsberg	331,05	207,72
Union Co-op.	321,57	195,95
Tongaat	326,00	201,92
Illovo	329,54	204,86
Sezela	325,92	199,60
Umzimkulu	322,86	198,18

5.2 Shadow price analysis - plant size location of mill

This analysis is similar to the previous analyses except that both transport and milling costs are minimised in the model and instead of a constant milling margin being used, actual milling costs are used. In the model, milling costs outweigh transport costs, so that in a free market some mills close down and others expand. This becomes clear if Tables 4 and 5 are compared. If milling costs are considered the Glendale mill is closed down and it is likely that this trend would continue in the long term.

The refinery prices in this analysis are the same as those given in Table 3. The mill prices are given in Table 5. Glendale, processing 38 000 tons of sucrose per season, is the smallest mill in the industry. It is closed down and its cane supplies diverted elsewhere. Entumeni, with a processing level of 50 500 tons of sucrose per season, is also small. It therefore has high milling costs and cannot pay more than R165,40 per ton of sucrose delvered to the mill. The Union Co-op. is also a small mill with a low sucrose price.

Larger mills with lower milling costs owing to economies of scale can afford to pay higher prices. Conversely they need more sucrose supplies and therefore they need to offer higher sucrose prices. The larger mills could expand by forcing the smaller mills to close down. They could do this by offering higher than eqkuilibrium prices to all farmers. If the price was high enough, farmers who had previously supplied the small mill would switch over to the large mill. In making this decision the large mill would weigh up the increase in sucrose price necessary to attract the additional sucrose supplies against the saving through economies of scale. In this way there is likely to be a rationalisation of sugar milling in a free market.

TABLE 5 - Raw sugar and sucrose mill prices (actual milling costs)

Mill	Per ton of raw sugar R	Per ton of sucrose R
Malelane	343,68	215,23
Pongola	336,53	199,71
Umfolozi	326,23	192,84
Entumeni	320,62	165,40
Empangeni	320,97	187,71
Felixton	321,18	184,49
Amatikulu	323,98	208,37
Darnall	323,85	203,80
Mount Edgecombe	327,50	201,87
Gledhow	325,62	203,10
Noodsberg	329,72	213,38
Union Co-op.	322,04	173,74
Tongaat	326,00	213,12
Illovo	329,54	198,57
Sezela	324,38	206,67
Umzimkulu	322,84	193,05

6. A FREE SUGAR MARKET

If the production and sale of sugar in South Africa were left to the forces of the free market, it is postulated that the following situation would develop. The local price would be dependent on free world prices. Anyone would be free to import sugar into the country. The maximum price at any one place would be the prevailing free world price plus transport costs to the market. This would be the maximum price that South African sugar producers could afford to charge consumers without being undercut by importers. South African sugar producers would compete among themselves and against importers and manufacturers of alternate sweeterners on local and overseas markets. This is theoretically likely to reduce the local price of sugar. However, because the world price of sugar is so volatile South African consumers could experience large fluctuations in sugar prices.

Each refinery and mill would sell sugar wherever they got the best price. The mill/refinery price would be the price of sugar at the point of sale less transport costs. Each mill would receive a different mill/refinery price for sugar, depending on how effectively it competed on local and overseas markets and on its location.

Each mill would offer farmers a different price for sucrose. The price would depend on the efficiency of the mill, milling costs, the size of the mill, how widespread its supply areas were, the competition among mills for sucrose supplies and the returns farmers could receive from alternative crops. Any farmer would be free to grow sugar cane and sell it to any mill. The competition for sucrose supplies between mills would keep on-farm prices in equilibrium.

Competition in a free market would result in a high level of efficiency and optimum use of resources. Milling, refining and transport costs would be minimised by all enterprises to enable them to compete effectively on the open market. Inefficient and uneconomic enterprises would be

forced out of production. This would result in a rationalisation in milling, refining and marketing. Inefficient farmers who are kept in cane production by the present quota scheme and could compete in a free market would be forced out of production. Cane production would also be rationilised with cane being produced in optimum areas. Competition between local sugar producers, importers and artificial sweeteners would ensure that consumers would be offered sugar at reasonable prices. It would not be possible for local sugar producers to charge monopoly prices.

The volatility of world prices and their effect on the local sugar industry could be buffered if the mills hedged on the futures market, and drew up contracts with overseas refineries and local sugar-using industries at set prices.

7. CONCLUSION

The controls present in the sugar industry, especially the subsidies on transport costs, have caused anomalies in the economics of location. The Cane Transport Scheme, by removing competition and entrenching existing systems, has resulted in the industry having a higher cost structure than is necessary. Because the incentive to growers (or millers) to minimise transport costs has been removed many growers do not use their most economical mode of transport. This costs the industry approximately R3 million per season. In South Africa, tramline transport is the most expensive mode of transport. By entrenching tramline systems the Cane Transport Scheme has resulted in transport costs being R6 million higher than would be the case if other modes were used.

The mill site system is tied in with the Cane Transport Scheme and it has resulted in some of the grosser anomalies that occur. Furthermore, many growers do not supply the nearest mill. A least cost rationalisation of cane transport to mills could save R1 244 000 per season without affecting mill through-puts. Further rationalisation would affect mill processing levels but if all growers were able to supply their nearest mills a total of R3 148 000 could be saved every season.

The existence of the Cane Transport Scheme has caused the expansion of cane production into areas beyond the economic transport distance. If growers had to pay transport costs, then cane production in these areas would probably become economically unviable. The worst affected areas are Melmoth, Muden, Highflats and the Umzimkulu Flats, but other distant areas could also be affected. All in all R14 419 000 could be saved every season, with a further saving of R3 694 000, if the Illovo mill were resisted at Eston. Because all millers and growers indirectly pay for these inflated costs, the industry as a whole is adversely affected. This shows the fallacy inherent in the subsidisation of a transport scheme.

The subsidisation of sugar transport costs has also created an economically undesirable situation. Mills and refineries close to their markets do not benefit from their location, and in effect are subsidising mills and refineries which are further from their markets. The method of calculating inland sugar prices has resulted in some areas having higher prices than would have prevailed in a free market. The policy of channelling all sugar through Durban (except for Malelane and Pongola) also increases sugar transport costs unnecessarily. Mills and refineries would save money if they supplied their markets direct.

Removing economics of location in the siting of mills and refineries could result in a higher cost structure through an uneconomic pattern of mill/refinery location. In a free sugar market growers would receive an on-farm price for sugar cane equal to the mill price less cane transport costs. The prices at mills would differ, depending on efficiency of the mill, milling costs, size of the mill, size and nature of its supply area, competition from other mills, and competition from alternative crops. Growers would be free to deliver cane to any mill and the above factors would keep mill and on-farm prices in equilibrium.

Free trade in sugar would keep the retail prices of sugar on South African markets in equilibrium through the competition between sugar producers, importers and artificial sweeteners. The intense competition that would result in a free market would force all enterprises connected with the production of sugar to minimise costs. Inefficient enterprises would be driven out of production.

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