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Pricing of Queensland Sugar Cane: appraisal of the present formula and a suggestion for reform

Peter B. Dixon and David T. Johnson*

Production and milling of sugar cane in Queensland occur in a highly regulated environment. In particular the price of cane is determined by a formula which has been used virtually unchanged for about 70 years. Under this formula, the returns to millers are tied to the price of sugar, not the costs of milling. It is argued in the paper that this could lead to economically unjustified changes in milling arrangements and wasteful uses of milling resources. Other weaknesses of the present formula are also identified. An alternative formula, overcoming all identified problems, is suggested.

1. Introduction

Ninety-five per cent of Australia's sugar cane is grown and milled along the eastern coast of Queensland. Both the growing and milling of cane is subject to extensive regulation by the Queensland Government. These regulations are described in detail in Industries Assistance Commission (IAC) (1983, pp. 35-65). Under these regulations the Queensland Government acquires all raw sugar produced. Through various Boards, production quotas are set for all mills and farms. Each farm is assigned to a mill and must deliver all of its output to that mill. In these circumstances it is necessary to administratively set the price that mills must pay for cane. This is done through a cane payment formula set out in the Regulation of Sugar Cane Prices Acts (see Government of Queensland 1983).

The regulations surrounding the Queensland sugar industry have been subject to criticism in recent inquiries by the Bureau of Agricultural Economics (BAE),¹ the Industries Assistance Commission (IAC 1983) and a sugar industry working party (Savage *et al.* 1985). Nevertheless, as stated by the Director of the BAE, "The changes which have followed those inquiries have been relatively minor compared to those recommended".² Thus, there appears to be little likelihood that major changes to the existing regulatory framework will be made in the foreseeable future.

In this paper we are therefore not concerned with radical reform of the sugar industry. Our objective is to critically analyse the present sugar

cane payment formula in Queensland in the context of the present regulations regarding production of sugar cane and raw sugar. In section 2 we describe the formula and highlight its main problems. In section 3 we set out an alternative formula which overcomes the main weaknesses of the existing formula. Section 4 contains concluding remarks.

2. Present Formula for Determining the Price of Cane

The present cane pricing formula in each mill area takes into account the price of sugar and the sugar content of the cane delivered to the mill as follows:

$$(1) \quad P^C = \frac{90}{100} \times P^S \times \left(\frac{CCS - 4}{100} \right) + 0.328$$

where

P^C is the average price of green cane (\$ per tonne) paid to farmers over the season in the mill area,

P^S is the price of raw sugar (\$ per tonne of 94 nt sugar)³

and

CCS is the average commercial cane sugar content of sugar cane for the mill area (typically CCS is about 13.6 per cent).

The sugar price, P^S , appearing in equation (1) is mill specific, reflecting the shares of the mill's output which are allocated by the Queensland Government to the No. 1 and 2 pools. The No. 1 pool is made up of returns from domestic market

* Institute of Applied Economics and Social Research, Melbourne. The authors are indebted to Brian Parmenter, the editors and three anonymous referees for valuable suggestions.

1. BAE papers include Borrell and Wong (1986), Borrell and Lawrence (1984), Lawrence, Borrell and Tsolakis (1983), and BAE (1985).

2. See Foreword by R. Bain in Connell and Borrell (1987).

3. Net titre (nt) is a raw sugar quality measure. It refers to the pure white sugar content of the raw sugar. Quantities of raw sugar are often expressed as equivalent tonnes of raw sugar of 94 nt quality.

sales, long term contract sales and sales to certain preferred markets. The No. 2 pool is made up of spot sales on the world market. The cane prices received by individual farmers vary from P^c according to the CCS content of their cane and other quality characteristics mentioned in Government of Queensland (1983, S.58).⁴

The sugar revenue earned by a mill per tonne of cane processed is:

$$(2) \quad \text{Revenue} = P^s \times \frac{\text{CCS}}{100} \times \frac{\text{COW}}{100}$$

where COW, the coefficient of work, is the percentage ratio of the weight of 94 nt sugar produced to the weight of CCS in the cane from which the sugar was derived. It is a measure of the efficiency of the mill in extracting sugar from the cane. Typically, COW is about 102.

When the cane pricing formula was originated in 1917, it did not include the small adjustment term (0.328 in equation 1).⁵ At that time, typical values for CCS and COW were 12 and 90 respectively. This meant that revenue per tonne of cane milled was, in most years, divided between millers and farmers approximately in the ratio 1 to 2. This ratio was thought to give both millers and farmers equal rates of return on their assets after meeting the costs of labour and other variable inputs. Between 1925 and 1949, the cane pricing formula was gradually adjusted in favour of farmers. The present adjustment term stands at \$0.328 per tonne. However, because of the relative movements in COW and CCS, the share of sugar revenue going to the millers has increased. Over the last 70 years COW has risen, and in the last five years it has averaged 101.6. Although CCS varies from season to season, 13.6 has been an average value in recent years. With these values for CCS and COW, and with the price of sugar at \$220 (the No. 1 Pool support price recommended for 1985 by Savage *et al.* 1985), the revenue per tonne of cane processed is split between millers and farmers in the ratio 364 to 636 (*i.e.* approximately 1 to 1.75 *cf.* the original ratio of 1 to 2).

2.1 Efficiency incentives in the cane payments formula

Apart from providing equal rates of return to farmers and millers, an objective of the cane payment formula is to encourage efficient use of resources within the framework of quantity regulations. Millers are rewarded for improving their COW whilst farmers are rewarded for improving the CCS content of their cane. Millers

improve COW through investment and improvements in milling practices while farmers improve CCS by appropriate choices of cane varieties and other good farming practices.

By examining equations (1) and (2) it can be seen that, if P^s is held constant, then all of the extra revenue derived by the industry from an increase in COW accrues to the millers. As COW increases in the revenue formula there is no change in the price per tonne of cane.

Still holding P^s constant it can be seen that, in the case of increases in CCS, a very high percentage of the extra revenue accrues to farmers. Assume, for example, that CCS increases from 13.6 to 14.6 with P^s at \$220 and COW at 101.6. Then revenue per tonne of milled cane increases by \$2.24 but the price of cane to the farmer increases by \$1.98. This means that 88 per cent of the increase in industry revenue accrues to the farmer.⁶

With regard to CCS in the present formula, a problem highlighted in Borrell and Wong (1986, pp. 25-32) concerns the lack of incentives for millers to increase their throughput in the middle of the season. Sugar production could be increased if milling operations were more concentrated at the middle of the season when the CCS level of the cane is at its peak. This would require weekend milling during the weeks of high CCS levels. However, it would also mean a later start to the harvesting/milling season and an earlier finish. The shortening of the season would cause labour relations difficulties for mill owners. As presently constructed, the formula provides little incentive to the mill owners to overcome these difficulties. The benefits of concentrating the harvesting/milling season are generated via higher overall CCS levels. As noted above, under

4. In determining the prices received by individual farmers it is also recognized that the sugar content of cane varies through the milling season. Payments to individual farmers are adjusted so that farmers who are required to deliver cane to the mill at times when CCS is low are not disadvantaged relative to farmers whose deliveries are in the high CCS part of the season.

5. For a history of the developments in the cane payment formula see Desmarchelier (1979).

6. During the course of our research, it was suggested to us that farmers in some areas may have been reducing the CCS by over-use of nitrogen fertilizers. However, the present formula provides no incentives that could explain this behaviour. We suspect that over-use of nitrogen could be explained, in some cases, as an attempt by farmers to increase their cane production to meet their farm quotas.

the present formula with a constant P^s only about 12 per cent of the benefits of higher CCS levels go to the millers.

Borrell and Wong (1986) noted in their analysis of the weekend milling problem that the average sugar price (P^s) received by a mill should be treated as a variable. This is because extra output from the mill arising from an increase in CCS may be allocated by the Queensland Government to lower priced markets via the pool system. If P^s is lowered, then it can be shown under some circumstances that the present formula over-rewards farmers for increases in CCS and that the profits of the mill are reduced. In other words, the incentive to mill owners to shorten the milling season allowing an increase in overall CCS can be negative.

Similarly, under the present formula with a variable P^s , mills may be over-rewarded for increases in COW. Imagine for example that a mill is able to increase COW by two per cent and this has the effect of reducing P^s by one per cent. Then, as well as receiving one per cent more revenue the mill gains the advantage of a reduction in P^c . Consequently the compensation to the mill for any increase in costs associated with the increase in COW is more than the total increase in the value of sugar produced.

2.2 Proportionality between the price of cane and the price of sugar

With the present formula, the price of cane moves proportionally with the price of sugar except for the minor adjustment term. That is, for given values of CCS and COW, and a given quantity of cane, an x per cent change in the price of sugar changes the gross revenue of both millers and farmers by about x per cent.

A change in the price of sugar has no effect on the millers' costs of processing a tonne of cane (labour, capital and material costs other than cane). Consequently, under the present formula, the rate of return on the millers' capital is heavily dependent on the price of sugar.

Assume that millers can make a normal rate of return on their capital with the price of sugar at, say, \$300 per tonne. By "normal" we mean a rate of return equal to that earned by commercial enterprises facing similar risks in other parts of the economy. During periods in which the price of sugar is less than \$300, under the present formula millers would not be able to cover the opportunity costs of their capital⁷. On the other hand, while the price of sugar is above \$300, millers would make

abnormal profits. That is, they would earn rates of return on their capital above the levels earned by commercial enterprises facing similar risks in other parts of the economy.

We see two dangers in this situation: one arises during extended periods of low sugar prices while the other occurs during extended periods of high sugar prices.

2.2.1 Low sugar prices

First consider the low price case. If millers are unable to make normal profits for an extended period of time then eventually the proprietary millers, responsible to shareholders, must withdraw from the industry. Under the present formula this could occur even in circumstances where the price of sugar was sufficiently high to justify the continued growing and milling of cane.

A key point underlying our argument is that farmers own a fixed factor of production, their land. For most of the cane land of Queensland, the next best use (beef cattle, for example) would generate returns to the farmers which would be only a small fraction of the returns earned from cane growing, even at the low prices of sugar which have prevailed in recent years. This means that the prices of sugar could remain at its present low level or go much lower, yet farmers would still make more money from growing sugar cane than from adopting any alternative use for their land.

In the long run, assuming no government assistance, farmers can earn from cane growing only the value of the raw sugar produced less the costs of milling the cane. An important part of the costs of milling is the return to capital. This cannot be avoided. If the proprietary millers are driven from the industry because they are unable to earn a normal rate of return on their capital, then alternative milling arrangements must be made. For example, cooperative mills run by the farmers may be set up. (Currently about 40 per cent of milling in Queensland is undertaken by cooperatives.) However, without government assistance, cooperatives must cover the opportunity costs of their capital if they are to meet interest obligations on their debts and provide normal rates of return to those farmers

7. We have in mind opportunity cost in an *ex ante* sense. In an *ex post* sense the opportunity cost of using an existing mill may be extremely low, merely scrap value. However, if commercial milling is to remain viable in the long run, then millers must be able to foresee rates of return sufficient to justify the replacement of worn-out and/or obsolete equipment.

who invest in them.

In calculating farmers' earnings we should deduct any subsidization that farmers may provide to cooperative mills. If farmers accepted less than normal rates of return on their investment in cooperatives they would be effectively subsidizing the cooperative milling operation. Their true income from cane growing would be lower than is implied by the cane payment formula.

A situation in which farmers' true earnings from cane can exceed the value of raw sugar less the full costs of milling (including the capital costs) can only be sustained via assistance from the taxpayers. In the past this has sometimes been available in the form of loans from government authorities under favourable terms. We see no economic justification for long term government assistance to milling operations whether carried out by proprietary millers or cooperatives. Certainly we see no justification for assistance to milling carried out under one set of organizational arrangements and not the other.

If sugar prices remain low and governments cannot be persuaded to assist the industry (either milling or farming) then farmers will suffer a capital loss. The value of cane land will fall. Nevertheless, as emphasized earlier, production of cane will remain the farmers' best option. Consequently milling operations will be required. A danger of the present formula is that it may lead to either the cessation of milling operations or the replacement of proprietary millers by other milling arrangements although these other arrangements may be less efficient. This would impose unnecessary costs on either the farmers or the general taxpayer.

The problems described in this subsection are illustrated by events in the NSW sugar industry over the last 10 years. As in Queensland, cane prices in NSW are proportional to sugar prices. In 1978 the commercial miller (CSR Ltd) withdrew from the NSW industry rather than undertake the significant investment necessary to upgrade its mills. Presumably CSR forecast that sugar prices would not be high enough to enable it to cover the opportunity cost of new investment. By 1985 the Co-operative which took over the NSW mills was in financial difficulties (see New South Wales Sugar Industry Study Group 1985). It required help from the NSW Government to service the loans which it had incurred in upgrading the mills. It had also imposed an additional milling levy on cane farmers. All of this attests to our point: in the long run, without subsidization of milling or

canegrowing, the earnings of farmers cannot exceed the value of raw sugar produced less the full costs of milling. The practice of tying the price of cane to the price of sugar may merely cause changes in milling arrangements with no overall economic benefits. Unless the changes induce increased milling efficiency, then any advantage to the industry (millers and growers) will be at the expense of other members of the Australian community.

2.2.2 High sugar prices

In a period of sustained high prices for sugar, the present formula allows the emergence of abnormal profits in milling. In an unregulated sugar industry, abnormal profits in milling would disappear. Competition for scarce cane between existing millers or from new millers, or the threat of such competition from potential millers,⁸ would force up the price of cane.

In a regulated industry, with little scope for competition between millers or entry of new millers, it is also likely that the abnormal profits in milling would be eliminated, but the process would be different. The millers would face more vociferous demands from unions for better conditions, and government assistance to the whole industry (e.g. the home price support scheme) would be threatened. Other possible outcomes include overcapitalization of mills, over-staffing, reduction in technical efficiency and a general loss of incentive to control labour and management costs.

Most importantly, the emergence of abnormal profits for millers arising from high sugar prices would strengthen the arguments of farmers for a more favourable price of cane relative to the price of sugar. Without such an adjustment, farmers would be able to point out that rates of return from milling had risen relative to rates of return in cane growing. Although, with proportional increases in the prices of sugar and cane, gross revenues to farmers would increase, rates of return on their capital would not. Increased demand for cane land would raise its price so that rates of return in farming (calculated on current market values of land) would remain at normal levels. No such mechanism for restraining rates of return operates in milling where increases in the price of sugar do not affect replacement costs of milling capital.

8. As implied by Baumol *et al.* (1982) in their work on contestable markets, unregulated entry is the key to achieving a competitive outcome. It would not be necessary to have many different milling companies.

Consistent with our own analysis, Borrell and Lawrence (1984) argued that "the milling sector [is] in a position to earn above-normal profits via the revenue-sharing formula". They suggested that there are considerable economies of scale in milling. As output has grown over the last 70 years, these economies should have led to a declining share of industry revenue going to the millers. Instead, as mentioned earlier, this share has increased slightly. Borrell and Lawrence (1984, p. 2) implied that part of the potential above-normal profits available in milling have been dissipated by failure to rationalize and achieve available cost savings. In summary, recognition by regulated millers that they cannot channel abnormal profits to their shareholders over an extended period of time may have induced economically inefficient expenditures.

3. Alternative Approach to Determining Cane Prices

In this section we propose an alternative method for determining the price of cane. Our main objective is to devise a formula which avoids the dangers of proportionality discussed in sections 2.2.1 and 2.2.2. In its simplest form, our proposed formula shares with the existing formula the problems mentioned in section 2.1 concerning inappropriate division between farmers and millers of the rewards for improvements in CCS and COW. After introducing our formula we then indicate how it could be modified to overcome these latter problems.

3.1 The alternative formula

Our approach is based on the equation:

$$\begin{aligned}
 (3) \quad \text{abnormal profit for standard mill} &= \left[\frac{\text{tonnes of cane}}{100} \right] \times \frac{\text{CCS}}{100} \\
 &\quad \times \left[\frac{\text{standard COW}}{100} \right] \times P^s \\
 &\quad - \left[\frac{\text{fixed operating costs for standard mill}}{\text{tonnes of cane}} \right] \\
 &\quad - \left[\frac{\text{tonnes of cane}}{\text{tonnes of cane}} \right] \times \left[\frac{\text{variable operating costs for standard mill per tonne of cane}}{\text{tonnes of cane}} \right] \\
 &\quad - \left[\frac{\text{tonnes of cane}}{\text{tonnes of cane}} \right] \times P^c \\
 &\quad - \left[\frac{\text{full replacement cost of standard mill}}{\text{tonnes of cane}} \right] \times R,
 \end{aligned}$$

where R is the opportunity cost of millers' capital, including allowances for risk and interest.

We suggest that P^c be varied so that the left hand side of this equation has an average value of zero through time.⁹ Under this approach, millers can earn normal rates of return irrespective of long run movements in the price of sugar. In the equation, costs and revenues on the right hand side are for a standard mill. This allows super efficient millers (those whose costs are less than standard) to be rewarded by rates of return above those earned by other millers while the converse applies to inefficient millers. It also ensures that farmers attached to inefficient mills are not penalized.

Implementation of our formula would be comparatively easy if the milling technology appropriate for each region was the same. However land availability, climatic conditions and regulations governing regional outputs mean that the appropriate capacity for mills will vary between regions. The standard mill for regions producing small amounts of cane would have less capacity than the standard mill for regions producing large amounts of cane. Because there are economies of scale in milling, implementation of our suggestion would introduce further regional variations in cane prices beyond those arising in the present formula from regional variations in CCS and P^s . Cane prices in areas producing small volumes would be lowered relative to cane prices in areas producing large volumes. Other factors which would have to be considered in determining standard milling costs in different regions include regional quality characteristics of cane, haulage costs for cane and sugar and variations in number of milling days lost caused by climatic conditions.

Under our approach, as with the present method of determining cane prices, millers would obtain 100 per cent of the benefits of increases in COW in the situation in which P^s is unaffected. Notice that it is a standard COW (say 101.6) which appears on the right-hand side of our equation, not the actual COW. Still assuming that P^s is unaffected, we see that if the actual COW equals the standard COW, then under our approach farmers receive 100 per cent of the benefits of increases in CCS. If actual COW is greater than standard COW then, in common with the present formula, our formula allows millers a share of the extra revenue associated with

9. P^c could be varied so that the left hand is zero in every year or so that it has an average value of zero over a number of years. This is discussed in section 3.2.

increases in CCS. However this share is likely to be very small. For example, if actual COW were two per cent above standard then, with P^s constant, two per cent of the extra revenue associated with increases in CCS would go to the miller.

As pointed out in section 2.1, when increases in sugar output from a mill cause a reduction in P^s , the present cane payment formula may over-reward farmers for increases in CCS and over-reward millers for increases in COW. Our proposed formula does not suffer from the weakness with respect to increases in CCS. Assume for example that CCS rises by 10 per cent reducing P^s by 4 per cent. Then, for a given quantity of cane, sugar revenue for the mill rises by 6 per cent. In our approach this extra revenue would be absorbed by the farmers through an increase in P^c without reducing the profits to the miller. The left hand side of equation (3) would remain at zero.

However, the problem in the present cane payment formula of over-rewarding millers for increases in COW also occurs in the simple version of our formula. If increases in COW lead to reductions in P^s then under our formula the millers will benefit from reductions in P^c . (Notice again that it is the standard COW which appears on the right hand side of equation (3) not the actual COW.) In these circumstances the miller may invest more in equipment for increasing COW than could be justified by the increase in the joint returns to millers and farmers. One approach to overcoming this problem would be to replace P^s in equation (3) with P^s (standard). This would be the price which would have applied if the mill had achieved standard COW. By using P^s (standard) on the right hand side of equation (3) we ensure that increases in COW do not affect P^c .

Another problem which was discussed in section 2.1 concerns lack of incentives in the present formula for millers to shorten the harvesting/milling season thereby raising CCS. This problem also applies to our proposed formula in equation (3). In both formulae, incentives to millers and farmers to shorten the harvesting/milling season could be provided by replacing CCS with CCS* defined by:

$$(4) \quad CCS^* = a \times CCS(SS) + (1-a) \times CCS.$$

In this equation

CCS(SS) is the average level of CCS which would have occurred if the season's cane had been harvested/milled according to a standard schedule;

CCS is, as before, the actual average CCS level and a is a number between 0 and 1.

In calculating average CCS we use a formula of the form:

$$(5) \quad CCS = \sum_m w_m CCS_m$$

where CCS_m is the CCS level applying in month m and w_m is the proportion of the season's cane milled in month m . CCS (SS) would be calculated as:

$$(6) \quad CCS(SS) = \sum_m w_m^* CCS_m$$

where w_m^* is the proportion of the season's cane which would be milled in month m under a standard or historically normal harvesting/milling schedule. If the season were shortened relative to the standard season then w_m would be higher than w_m^* for months near the middle of the harvesting/milling season and lower for months at either end. CCS would be higher than CCS(SS).

With CCS* replacing CCS in either equations (3) or (1) we see that the benefits from increases in CCS arising from a shortened harvesting/milling season are shared between the farmers and the millers. Assume for example that a is set at 0.5 and that CCS is raised by 10 per cent through shortening the harvesting/milling season. Then with no changes in the CCS_m 's we find that CCS* increases by 5 per cent. Assuming that P^s falls by 2 per cent then, with a constant quantity of cane, total sugar revenue increases by 8 per cent. In equation (3), 3 percentage points or three-eighths of the extra revenue would go to the farmers through an increase in P^c whilst five-eighths would remain for the miller. Under equation (1), assuming initial values for P^s , CCS, CCS(SS) and COW of \$220, 13.6, 13.6 and 101.6, 60 per cent of the extra revenue would go to the farmers and 40 per cent to the millers.

In both equations (3) and (1), with CCS* replacing CCS, the division of extra revenue between farmers and millers arising from shortening of the harvesting/milling season depends on the value set for a . This value should be chosen to reflect the relative costs to the two parties of shortening the season.

Finally, the use of CCS* in equations (3) and (1) is compatible with farmers receiving the full benefits from increases in CCS related to improved farming practices. Such improvement would raise the CCS_m 's, increasing both CCS and CCS(SS).

3.2 Sharing risks between farmers and millers

Under the present cane payments formula, the risks arising from year to year fluctuations in sugar prices are shared between farmers and millers. The two groups enjoy good and bad times together. In our formula, if P^c were varied so that the left hand side of equation (3) were zero in every year then all the risks would be borne by the farmers. Returns to millers would be insensitive to the price of sugar. Fluctuations in the price of cane would be even greater than in the present situation.

It may be considered desirable to continue the system of sharing these risks. This might be justified, for example, if it could be shown that canefarmers had inadequate access to capital markets. In this situation, they may have difficulty surviving periods of very low income even when their farms have sound long term prospects.

In the context of our approach it would be possible to reduce the year-to-year fluctuations in the price of cane by requiring that the left hand side of equation (3) has an average value of zero over a number of years rather than a value of zero in each year. For example, P^c could be set according to the formula:

$$(7) \quad P^c = \frac{CCS}{100} \times \frac{\text{standard COW}}{100} \times P^s - \frac{X}{Q} + \frac{CCS}{100} \times \frac{\text{standard COW}}{100} \times (F(P^s) - P^s),$$

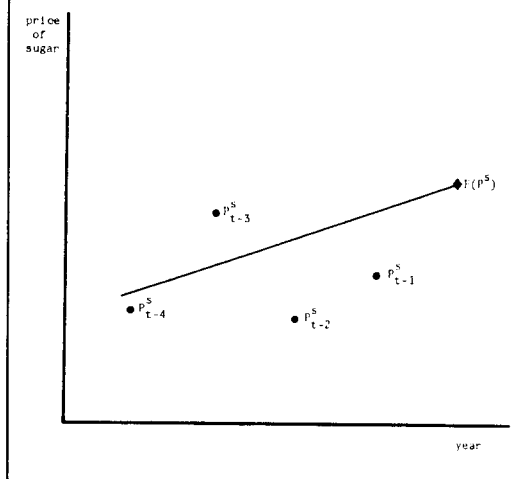
where X/Q is milling costs per tonne of cane; i.e.

$$X = \begin{bmatrix} \text{fixed} \\ \text{operating} \\ \text{cost for} \\ \text{standard mill} \end{bmatrix} + \begin{bmatrix} \text{variable} \\ \text{operating costs} \\ \text{for standard mill} \\ \text{per tonne of cane} \end{bmatrix} Q + \begin{bmatrix} \text{full} \\ \text{replacement} \\ \text{cost of} \\ \text{standard mill} \end{bmatrix} R,$$

where Q is the quantity of cane; and $F(P^s)$ is a function of the present and past values of P^s . The form of $F(P^s)$ is chosen so that the third term on the right hand side of equation (7) has an average value of zero through time.

At one extreme $F(P^s)$ could be set equal to P^s . Then we would be back to the situation where P^c is varied so that the left hand side of equation (3) is zero in every year and all the risks of year-to-year fluctuations in sugar prices are borne by the farmer. Alternatively, we might set $F(P^s)$ equal to an extrapolated value of sugar prices. This is illustrated in Figure 1 where $F(P^s)$ is the value on

Figure 1: Determination of extrapolated price of sugar, $F(P^s)$, for year t



the trend line of best fit through the sugar prices of the current year and the previous four. If this extrapolation method were based on a very long time series of sugar prices, say 20 years, then $F(P^s)$ would be affected very little by the current price of sugar, P_t^s . Accordingly the price of cane would be affected very little. In this case almost all the risks of year-to-year fluctuations in sugar prices would be borne by the millers.

In the determination of R to be used in calculating standard milling costs it would be necessary to take account of the division of risks between millers and farmers arising from year-to-year fluctuations in the price of sugar. If $F(P^s)$ were calculated from a long time series of sugar prices, then a higher value of R would be appropriate than if $F(P^s)$ were calculated from a short time series. Nevertheless, under our formula farmers would bear the risks of a sustained reduction in sugar prices. Even where a long time series was used, the smoothed price of sugar, $F(P^s)$, on the right hand side of equation (7) would eventually fall, reducing the price of cane and the price of cane land. However as argued in section 2.2.1, in the absence of government assistance no formula can protect the value of cane land in the presence of a sustained fall in the price of sugar.

3.3 Difficulties in implementation

A possible objection to the use of equation (7) is that it appears to impose a heavy informational load. It calls for quite detailed data on milling costs. However such data are currently collected by miller and grower organizations and estimates

of the costs of constructing average (notional) sugar mills of various capacities have been made. Under the present system growers and millers have felt obliged to collect these data either in support of or in opposition to suggested variations in the cane payments formula. Much of this information is currently confidential but its existence cannot be doubted.¹⁰

Perhaps the most difficult aspect of our proposal would be to achieve agreement on the appropriate value for the opportunity cost of the millers' capital, R . This consists of an interest component and a risk component. The interest component could be determined each year by reference to rates on long term bonds. One possibility for the risk component (R minus the interest rate) would be to adopt the value which has applied on average over the last twenty years. This would be appropriate if it were intended that the division of risks between millers and farmers arising from year-to-year fluctuations in the price of sugar should continue as in the past. In this case the length of the time series used in calculating $F(P^*)$ would be chosen so that equation (7), implemented with past data, generates the same level of fluctuation in the price of cane as has applied over the last twenty years. If less fluctuation were desired, then a higher value for the risk component would be appropriate. Similarly if it were intended that the price of cane should vary more than in the past, a lower value for the risk component would be chosen.

Implementation of our approach could present some transitional difficulties. In the initial year, it would probably be necessary to set R so that the value for P^* was the same under either the new formula or the old. It could then be agreed that R should be moved, perhaps over several years, to its appropriate value. In this way, any major disruption to cane prices caused by the change in the formula could be avoided.

Once the new formula was in operation, the information requirements for the annual calculations of P^* could be reduced by relying on movements in agreed price indexes for updating the various costs on the right hand side of equation (7).¹¹ It would not be necessary to conduct major enquiries into milling costs each year. However, care would be required in the selection of the price indexes. On the one hand, the prices included in the indexes should be representative of the prices of inputs used in milling. On the other hand, the price indexes should not be composed simply of the prices actually paid by millers. If actual prices paid were used, then the need for major annual

enquiries into milling costs would not be avoided. In addition, the use of actual prices in updating the right hand side of equation (7) would weaken miller incentives to resist cost increases. For example, it may be better to use movements in average wage rates in Queensland for updating the wage components on the right hand side of equation (7), rather than movements in wage rates applicable to workers in the milling industry. Excessive wage demands by unions in the milling industry would then meet an appropriate level of employer resistance.

Another complication which would need to be considered in implementing our formula is the treatment of technological progress. Over time, the mills should be expected to achieve improvements in technical efficiency. This could be accomplished by including an efficiency adjustment in the annual updates of the right hand side of equation (7). For example, if an annual efficiency improvement of 1 per cent were considered reasonable for the milling industry, then all cost items in equation (7) for the standard mill could be updated by the percentage increase in the appropriate price index less one.

Periodically, say every five years, it would be necessary to conduct a full enquiry into milling costs for the purpose of rebasing the formula. At these times, the appropriateness of the price indexes and the efficiency adjustments could be checked. New indexes and a new value for the efficiency adjustment term could be adopted if required.

4. Concluding Remarks

In this paper we have critically analysed the present formula for pricing cane. We have concluded that an important problem with the formula is its proportionality: to a good approximation it allows the price of cane to move by the same percentage as the price of sugar.

Proportionality will cause long-term viability problems for millers if sugar prices remain low for an extended period. It poses the danger that efficient proprietary millers will be driven out of

10. Such information is alluded to in Savage *et al.* (1985, especially p. 17 and Appendix 5) and Borrell and Wong (1986, pp. 16-18 and Appendix F).

11. It would be necessary to specify indexes to represent annual movements in (i) fixed operating costs (e.g. indexes of management salaries, clerical salaries and building maintenance costs), (ii) variable operating costs (e.g. indexes of fuel costs) and (iii) full replacement costs (e.g. indexes of prices of relevant items of capital equipment).

the industry to be replaced by alternative milling arrangements. This could be justified only if it were shown that these alternative arrangements would lower the costs of milling without using additional government assistance. Proportionality will also generate problems in periods of high sugar prices. In these periods, millers will be able to make abnormal profits. In a regulated environment, the emergence of abnormal profits can lead to wasteful uses of resources.

In section 3, we proposed a formula for the pricing of cane which overcomes the dangers introduced by proportionality. Relative to the present formula, our proposed formula seems to require more data. It uses information on mill costs which is not required in the present formula. Nevertheless, we doubt that this is a significant disadvantage. Negotiations surrounding the present system of setting cane prices frequently include the presentation of data on both farm and mill costs. Collection of these data are, therefore, a cost of the present system. In fact, data collection costs might even be reduced under our proposal because no information on farm costs would be required.

Apart from the proportionality problem, the present cane formula suffers from various other defects. It can lead to overcompensation of millers for increases in COW and overcompensation of farmers for increases in CCS. In addition it fails to provide an incentive for millers to raise average CCS levels by shortening the harvesting/milling season. In section 3.1 we suggested solutions to each of these problems in the context of our proposed formula.

While urging substantial deregulation of the sugar industry the IAC (1983, p. 64) recommended that:

growers would continue to be directed as to which mill they must deliver up-to-peak cane. Millers would continue to be obliged to crush such cane. In these circumstances there would be little scope for unhindered negotiation to set the price and other terms and conditions, on which up-to-peak cane is delivered to mills. In view of this, the Commission does not propose any changes to the existing system of cane payment for up-to-peak sugar.

Like the IAC we accept that there will be a continuing need for a cane payment formula. However, we have suggested a new formula. If implemented, we think this would improve the operational efficiency of the industry.

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