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THE EFFECTS OF US FARM POLICY ON AUSTRALIAN COTTON REVENUES

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An econometric model of the world cotton market has been developed to analyse the effects of US farm policy. Various US farm policy scenarios were simulated to observe the effect on world price and sales revenue to Australian producers. It is concluded that the protectionist policies in place in 1985-86 in the United States had the net effect of supporting the world price at a level higher than it would have been otherwise, thus benefiting Australian growers.

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The agricultural policies of the United States as embodied in the US Food Security Act have greatly affected the world market for cotton. US farm programs during the 1950s and 1960s included a loan rate which served as a guaranteed minimum price for the US grower. As the United States was a large producer and exporter in the world cotton market over this period, the loan rate provided a price floor for both the US and the world markets. Because of the level at which the loan rate was set, it encouraged non-US production and exports (US Department of Agriculture 1984). The effects of US farm policy on the world cotton market have diminished more recently as the importance of the United States as a world producer and exporter has declined and other countries have increased in significance. Although American producers still benefit from the income and price support that is provided, it is unclear to what extent these programs affect the world market and whether they still benefit growers in other nations.

The purpose of this paper is to examine the effects of the current US farm program on Australian cotton industry revenues by making use of an econometric model of the world cotton market. The structure of the world cotton market is described and a brief history of the US farm programs is presented. The model of the world market is then outlined, and regression results and relevant elasticities are reported. The results of some simulations with different US policy options are then presented. Finally, the implications of these results are discussed.

World Market Structure

The world cotton market is dominated by the United States, the People's Republic of China and the USSR. These countries are the three largest cotton producers (Figure 1) accounting for over 50 per cent of total production in 1986-87. India and Pakistan are the next largest producing nations while the remaining production comes from numerous smaller countries. In 1986-87, Australia ranked tenth among world producers with 1.3 per cent of total

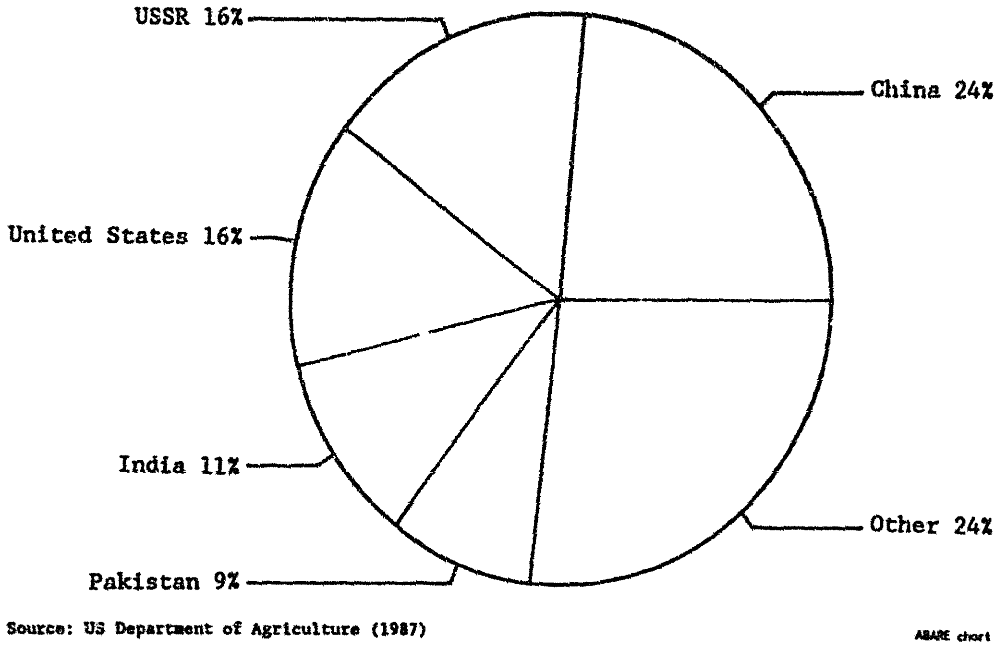

FIGURE 1 - World Producers of Cotton.

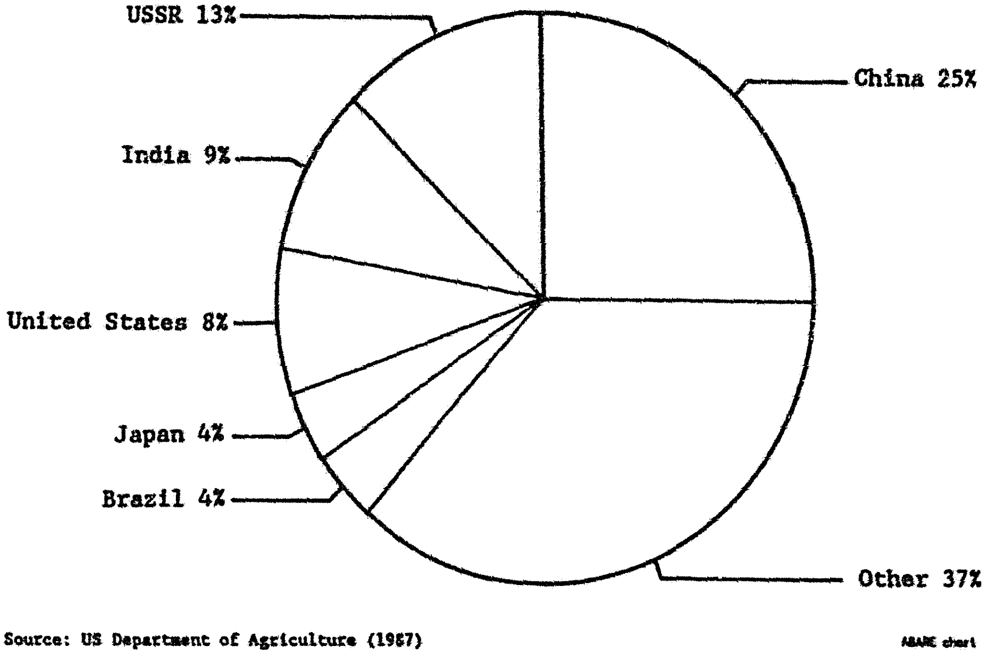

FIGURE 2 - World Consumers of Cotton.

world production. The main consumers of cotton are China, the USSR, the United States and India (Figure 2). Japan and Brazil are the largest consumers of the remaining countries but they each account for only 4 per cent of the mill use of cotton.

World trade in cotton was 36 per cent of total production in 1986-87. The price of cotton in international trade is often markedly different from the domestic prices. In many producing and consuming countries the domestic price may be influenced by tariffs or quotas, or administratively set by government. The accepted 'world price' for cotton is the Liverpool 'A' index which is compiled by the England based firm Cotton Outlook Inc., and is the average of the five lowest of eleven quotes for a particular quality of cotton, middling 1 3/32 inch, as quoted by exporting countries cif northern Europe.

The main exporters of cotton in 1986-87 were the United States, Pakistan, the USSR and China with 28, 13, 12 and 10 per cent respectively of world exports. Australia ranks as the fifth largest exporter with 4 per cent of world trade. Pacific Basin nations, particularly Japan, dominate the import market. Italy and the Federal Republic of Germany are also large importers of cotton.

The influence of the United States on world cotton market developments stems from its large share of production, consumption and trade which averaged 15, 8, and nearly 30 per cent respectively over the last five seasons. The loan rate acted as a price floor for both the US and world markets in the 1950s and 1960s. The potential for US farm policy to still influence the market was clearly exhibited in 1986 when announcement of provisions of the 1986-87 US farm program caused the world price to fall from around US117c/kg to US82c/kg despite the supply and demand conditions remaining basically unchanged. The price fall reflected an expectation on the part of market participants that a large proportion of US cotton stocks, which had been held off the market under the previous program, would be quickly released.

US Farm Programs

Farm policies in the United States are influenced by domestic and world market conditions for the relevant commodity as well as broader political and economic considerations. Although the provisions for each commodity are largely independent, they are influenced by the US government's overall agricultural policy (Stults 1985) and hence may appear to be at odds with prevailing market conditions. The crux of the US farm programs for cotton has been the availability of non-recourse loans to producers as a method of guaranteeing a minimum price. Under this system, growers can place their cotton as collateral with the Commodity Credit Corporation from whom they receive a loan payment based on the level of the loan rate. Individuals can regain possession of their cotton within the next eighteen months by repaying the loan, or forfeit their cotton to the Commodity Credit Corporation and retain the loan payment. Such non-recourse loans were first made available to producers in 1933-34 and have continued to be made available until the present day.

During the Korean war years of 1951 to 1953, there were no production restrictions in force and production and stocks increased, prompting a return to the system of acreage allotments and marketing quotas. Growers were allocated an acreage allotment on the basis of their historical record of plantings and those who abided by their acreage allotment were eligible for the loan price support. The acreage allotment is multiplied by a predetermined yield to calculate the individual grower's marketing quota, the amount that they could sell without incurring a penalty tax. This prevented non-participants from sharing in the financial benefits of the program.

During the years 1956 to 1958, a program called the 'soil bank' operated to reduce the area planted to allotted crops and to provide for the long term retirement of land for conservation uses (US Department of Agriculture 1984). Until 1965 high loan rates were offered in conjunction with acreage allotments to constrain production (Firch 1985). The 1965 Food Security Act, which covered the 1966 to 1970 crops, set the loan rate at 90 per cent of estimated world price levels. To offset this lower price support, growers received additional payments if they reduced their area planted by at least 12.5 per cent of their acreage allotment. This was the first case of a paid acreage reduction for participants in the program. While the provisions of the 1965 Act were effective in reducing the large stocks that had built up by 1964, by 1970 the the substantial cost of the program to the US treasury and the size of payments going to large producers had become important issues (US Department of Agriculture 1984).

The 1970 Act abolished marketing quotas. This effectively removed the constraints on non-participants, making the program entirely voluntary. The loan rate continued to be 90 per cent of the world price prevailing over the previous two years and direct government payments were limited to $55 000 per producer. The 1973 Act was similar to the 1970 Act except for the introduction of the target price concept to separate income and price support. Prices were still supported through the loan rate system but if US market prices fell below the US target price then additional direct income support payments were made.

The system of loan rates and target prices has continued to the present day, varying only in the way the loan rates and target prices have been set. The 1981 Act included provisions for an acreage reduction program. In order to qualify for income and price support growers had to reduce their acreage by a specified amount of their allotment. Despite these provisions the recession in the early 1980s resulted in increased stocks and falling prices and incomes. In response, the payment in kind program was implemented in 1983. Under this program growers could leave idle up to 50 per cent of their acreage allotment for a combination of a cash payment and payment in kind, that is, they were paid in cotton from government stocks. Growers could even leave their entire acreage idle for a payment in kind of 80 per cent of farm yield. This one-off program was effective in reducing the US stockpile and since 1983 the farm programs have been limited to the setting of target prices and loan rates with varying acreage reduction requirements.

The Model

A model was required that incorporated the principal elements of the world cotton market and the relevant policy instruments, and that would provide a framework for the simulation experiment. A partial equilibrium system was chosen, based on three cotton acreage supply equations, for the United States, Australia and the rest of the world, three mill demand equations for the United States, Western Europe and the rest of the world, a world stocks equation and a market clearing identity.

There are two types of cotton traded on the world market: upland and extra long staple (ELS) cotton. Upland cotton has a staple length of less than 1 3/8 inch while ELS cotton has a staple length of 1 3/8 inch or greater. Monke and Petzel (1984) found that these two cotton types have distinct markets, reflecting limited substitution in processing. They also showed that in the upland cotton category price movements between staple lengths were not independent, because spinners were able to switch between staple lengths and still produce yarn of the same count. Spinners are able to trade off the lower price of the shorter staple raw cotton against the higher processing costs involved due to more frequent breakage of the yarn. Thus, upland cotton has relatively stable grade price differentials (Monke and Petzel 1984) and, for the purposes of this analysis, can be treated as homogeneous. The 'A' index is a representative price for upland cotton.

The centrally planned economies of China and the USSR are treated as exogenous in the model, reflecting preliminary econometric findings that their production and mill use are unresponsive to the world price. This result is supported by Adams and Behrman (1976) who conjecture that production and mill consumption decisions in the centrally planned economies reflect government plans and goals.

Price expectations in the area equations were hypothesised to be of the naive or no change type reflecting prices prevailing prior to planting. Various lags on world market prices were specified and estimated. However, a simple lagged price term proved to be the best option on the basis of goodness of fit. The possibility of using futures prices was considered and rejected on the basis of results of an assessment of forecasting accuracy and market efficiency of the futures market carried out in 1986 (L. Boman, University of New England, personal communication, 1986). These results indicated that futures prices were inaccurate forecasts of future spot price when compared to current price.

Annual observations from 1954-55 to 1986-87 were used and these were based on the cotton crop year of August to July wherever possible. After testing linear, log linear and double-log forms of the model, a linear in levels functional form was found to have the most desirable statistical properties. The equations were estimated using ordinary least squares after estimation using Zellner's Seemingly Unrelated Regressions was tried without improving the statistical results.

Figures in parentheses are t-statistics, R^2 is the coefficient of determination, F is the F test of the null hypothesis that the equation does not explain the variation in the dependent variable, and h is Durbin's h statistic. The Durbin's h statistic was adopted because of the presence of a lagged dependent variable in most equations. The statistic is normally distributed and an absolute value greater than 1.96 indicates 95 per cent confidence in first order autocorrelation.

United States area

The lagged 'A' index deflated by the US gross national product (GNP) deflator is used for the cotton price expectations variable in the area equation. A lagged dependent variable reflects partial adjustment and the lagged US farm price for soybeans, deflated by the GNP deflator, reflects alternative production possibilities. Soybeans were chosen because they are an alternative to cotton across all cotton growing areas and because the soybeans price has been less distorted by farm programs since the price received by farmers has only rarely been close to the national average support level.

The US farm program can be considered as having two effects. First, the loan rate and the target price provide price and income support; second, provisions in the program constrain production. The program has been modelled with four variables. The first is the acreage reduction requirement that producers must comply with to become eligible for program benefits. It is usually set after consideration of the size of US government stocks (US Department of Agriculture 1984). If the acreage reduction requirement is x per cent then the variable assumes the value of x/100. The second variable is the guaranteed price that growers receive if they abide by program provisions, deflated by the GNP deflator. For years prior to the 1973 Food Security Act, this was usually the loan rate. In subsequent years, this became the target price which was introduced to support incomes. Both the target prices and the pre-1973 loan rates were set having regard to farm income levels (US Department of Agriculture 1984). The different motivation behind the acreage reduction and the guaranteed price arrangements means that it is unlikely that these two variables will be correlated. The third variable is a dummy variable equal to one for the soil bank years of 1956 to 1958 and zero elsewhere. Finally, another zero-one variable is included for the payment in kind program which operated during the 1983-84 season.

$$\underset{}{AUS} = \underset{(4.9)}{3171} + \underset{(4.0)}{22}\, PW_{-1}/DEF_{-1} + \underset{(2.5)}{0.26}\, AUS_{-1} - \underset{(-3.6)}{265}\, PUSFSOY_{-1}/DEF_{-1}$$

$$- \underset{(-3.6)}{4284}\, ARR - \underset{(-3.6)}{1108}\, SOILBANK - \underset{(-4.2)}{1990}\, PIK + \underset{(1.2)}{7.0}\, PUSGOV/DEF$$

$R^2 = 0.88 \quad F(7/25) = 26 \quad h = 1.31$

where:

AUS is the area of cotton harvested in the United States, in thousands of hectares;

PW is the 'A' index, in USc/lb;

DEF is the US GNP deflator, with 1985-86 = 100;

PUSFSOY is the US farm price received for soybeans in US$/bushel;

ARR is the acreage reduction requirement for participation in the US farm program;

SOILBANK is a dummy variable for the soil bank years 1956 to 1958;

PIK is a dummy variable for the payment-in-kind program of 1983-84; and

PUSGOV is the guaranteed price to growers under the farm program, in USc/lb.

All coefficients are of the correct sign and, with the exception of PUSGOV, significant at the 5 per cent level. The low t-statistic for the coefficient on PUSGOV could be the result of correlation with PW. The coefficient on ARR implies that a 30 per cent acreage reduction requirement, as was enforced in 1985-86, would decrease US area by 1.29 million ha or 20 per cent of total acreage allotments in 1985-86. This reflects the fact that some growers did not participate in the farm program and the fact that some participants would not have planted their full allotment even if the acreage reduction requirement was not in force. The positive coefficient on PUSGOV occurs because the guaranteed price reduces growers price risk and hence is likely to encourage extra plantings. However, in years when an acreage reduction requirement is in effect, the guaranteed price may represent the incentive to participate in the acreage reduction. It seems that this is more than offset by the extra plantings from less efficient producers that the guaranteed price encourages.

Australian area

The Australian equation for area planted uses the lagged 'A' index, converted to Australian currency and deflated by the Australian consumer price index, a lagged dependent variable to account for partial adjustment, and a lagged wheat price as explanatory variables. The wheat price variable is the average export price of Australian wheat, fob Sydney, in the financial year prior to planting. The price was converted from Australian Wheat Board US dollar quotes to Australian dollars and then deflated by the consumer price index. A time trend variable is used to approximate the growth in investment in infrastructure in the Australian industry. Over the sample period, land was developed that was suitable for cotton cultivation and growers have gradually made better use of advanced technology in cotton production.

$$AAU = \underset{(-2.3)}{-98.8} + \underset{(2.1)}{0.31}\, PW_{-1}/ER_{-1}/AUCPI_{-1} + \underset{(8.8)}{0.76}\, AAU_{-1}$$

$$- \underset{(-2.8)}{5.1}\, AUWHFY_{-1}/ER_{-1}/AUCPI_{-1} + \underset{(3.1)}{1.57}\, TREND$$

$$R^2 = 0.95 \quad F(4/28) = 141 \quad h = 1.52$$

where:

AAU is the area of cotton harvested in Australia, in thousands of hectares;

ER is the US$/$A exchange rate;

AUCPI is the Australian consumer price index for the financial year, with 1980-81 = 100;

AUWHFY is the average Australian export price for wheat for the financial year, in US$/bushel; and

TREND is the time trend.

All coefficients are of the correct sign and are significant at the 5 per cent level.

<u>Rest of the world area</u>

The final area equation is for the rest of the world except for China and the USSR. The explanatory variables are the lagged 'A' index deflated by the US GNP deflator, a lagged dependent variable for partial adjustment and a lagged wheat price. The Australian wheat export price was used since it is representative of the world price because, as pointed out by Perkins, Sniekers and Geldard (1984), it is highly correlated with United States wheat export prices which are indicative of the world price. The wheat price is a calendar year series lagged by two periods so that it represents the price prevailing over the calendar year prior to when planting decisions have to be made in the northern hemisphere.

$$\underset{}{AROW} = \underset{(1.7)}{4409} + \underset{(2.2)}{11.1}\ PW_{-1}/DEF_{-1} + \underset{(6.5)}{0.75}\ AROW_{-1} - \underset{(-2.8)}{134}\ AUWYCY_{-2}/DEF_{-2}$$

$$R^2 = 0.64 \quad F(3/29) = 16.8 \quad h = 0.29$$

where:

AROW is the area of cotton harvested in the rest of the world, in thousands of hectares; and

AUWHCY is the average Australian wheat export price over the calendar year, in US$/bushel.

The coefficients have correct signs and are statistically significant at the 5 per cent level.

World production of cotton is derived from the area equations using yield identities for Australia, the United States and the rest of the world, with China and the USSR being treated as exogenous. The areas as determined by the model are multiplied by yields. Cotton farmers can influence yield by varying inputs. However, because of complications of modelling weather, general seasonal conditions and other agronomic factors and following some statistical testing that showed that yields were likely to be independent of expected price, yields were treated as exogenous.

Mill demand has been disaggregated into four groups; China and the USSR, which are treated as exogenous, the United States, Western Europe and the rest of the world. These country groups have been chosen because the United States and Western Europe are large users of cotton and are expected to be very responsive to price given the free market nature of their economies. The rest of the world group is dominated by India, other Asian countries and Oceania.

The common features of the demand equations are outlined here. Mill demand is hypothesised to be a function of the lagged price of cotton relative to rayon, an alternative to cotton throughout the sample period. The lagged price, rather than the current price, is used because mills accept orders for their goods up to twelve months in advance and hence need to secure raw cotton supplies by buying forward to ensure that they can meet their contracts. The alternative hypothesis that mills used current period prices was tested and rejected. The approach is supported by the results of Stennis, Pinar and Allen (1983). A lagged dependent variable is also included in each equation since mills are not expected to be able to adjust production levels instantaneously.

United States mill demand

$$DUSA = \underset{(4.0)}{9074} - \underset{(-4.2)}{2420}\, PW_{-1}/RAYP_{-1} - \underset{(-3.0)}{52}\, TREND + \underset{(5.3)}{0.65}\, DUSA_{-1}$$

$R^2 = 0.89$ $F(3/29) = 79$ $h = -1.15$

where:

DUSA is the mill demand for cotton in the United States, in thousands of 480 lb bales; and

RAYP is price for 1.5 and 3.0 denier rayon, in USc/lb.

Initially, a trend and an income variable were included along with the price and lagged dependent variables in the equation. The index of real GDP for industrialised countries was chosen because industrialised countries represent a large market for textiles. Real income has shown a rising trend over the sample period and this is likely to have caused some increase in demand. However, this variable's estimated coefficient was not statistically significant and hence the variable was dropped. An inference from this is that demand for cotton by US mills is highly income inelastic. The trend approximated the effects of the shrinking of the US industry due to competition from cheaper foreign producers, mostly Asian. The trend variable's coefficient can be interpreted as supporting the argument that significant restructuring of the US apparel industry has occurred over the sample period as textile investment has been relocated to countries where the cost of labour is low, such as Taiwan, Hong Kong and Korea. The level of investment in the US textile industry will be tested in future work to see if it can replace the trend variable. The statistical results are significant and consistent with theory.

Western European mill demand

$$DWEUR = \underset{(3.5)}{7063} - \underset{(-4.0)}{1509}\, PW_{-1}/RAYP_{-1} - \underset{(-2.8)}{34}\, TREND + \underset{(3.6)}{0.52}\, DWEUR_{-1}$$

$R^2 = 0.88$ $F(3/29) = 74$ $h = -0.89$

where:

DWEUR is the consumption of cotton in Western Europe, in thousands of 480 lb bales.

The coefficient for the income variable was not significant and hence the variable was dropped. Again structural change in the cotton textile industry has resulted in a trend toward imports rather than locally produced products. The signs on the coefficients are consistent with theory and statistically significant at the five per cent confidence level.

Rest of the world mill demand

$$DROW = \underset{(4.6)}{5645} - \underset{(-2.9)}{2273}\, PW_{-1}/RAYP_{-1} + \underset{(3.6)}{138}\, GDP_{-1} + \underset{(3.2)}{0.46}\, DROW_{-1}$$

$$R^2 = 0.99 \quad F(3/29) = 1163 \quad h = 0.31$$

where:

DROW is consumption of cotton in the rest of the world, in thousands of 480 lb bales; and

GDP is the index of gross domestic product for industrialised countries, with 1980 = 100.

In this equation the coefficient on the income variable was significant. This reflected two differences in market structure from that of the United States and Western Europe. First, the rest of the world group does not import cotton textiles and hence increased demands for cotton textiles resulting from income growth will be met by mills within these countries resulting in increased raw cotton consumption. Second, the rest of the world group is generally poorer and hence cotton can be expected to have a higher income elasticity of demand. A trend variable was included in the initial specification; however, collinearity with income combined with its small independent contribution to the sum of squares led to the trend variable being dropped from the equation.

World closing stocks

The model is completed by the inclusion of a stocks equation. World closing stocks, which include both public and private stocks, is specified as a function of three variables. First, a lagged dependent variable is included because it is likely that the low elasticities of demand place limits on the speed with which stocks can be released to the market in any period without significantly depressing price. Thus a partial adjustment is expected to occur. Second, the change in the price of cotton relative to the price of rayon over the past year was included to capture the price incentives to sell off or hold stocks. Third, the deviation of yield in the current year from the average of the previous three years who added to the equation reflecting the fact that mills plan production around long run trends and hence the elasticity of demand is relatively low. Thus unexpected shortfalls or surpluses in supply attract large premiums or discounts in price. The incentives for stockpiling will be reflected by changes in current period yield which will not be reflected in current prices because the latter do not enter the mill demand equations.

$$WCS = 1935 + 0.82\ WCS_{-1} - 5087\ (PW/RAYP - PW_{-1}/RAYP_{-1}) + 37938\ YDEV$$
$$\quad (1.2) \quad (13.6) \qquad\qquad (-2.1) \qquad\qquad\qquad\qquad\qquad\qquad (9.8)$$

$R^2 = 0.91 \quad F(3/29) = 92 \quad h = 1.43$

where:

WCS is world closing stocks of cotton, in thousands of 480 lb bales; and

YDEV is deviation of the average world yield from the average of the previous three years.

Coefficients are of the expected sign and are significant.

The model is closed out by an identity balancing opening stocks and supply with closing stocks and mill demand.

Elasticity Estimates

The price elasticity estimates from the above equations calculated at the means are presented in Table 1. The area planted in the United States and Australia is responsive to price in the short run though less responsive than the Adams and Behrman (1976) elaticity of 1.35 for developed economies. Australia is also very responsive in the long run. The supply elasticity estimates for the rest of the world are relatively low, possibly reflecting the substantial government price support for growers that is provided in many developing countries because cotton is a valuable foreign exchange earner. This is consistent with the Adams and Behrman (1976) elasticity of supply for developing countries of 0.07. The responsiveness of Australian growers to price changes is consistent with the absence of any government price support and availability of production alternatives.

The demand elasticities are also presented in Table 1. As expected, mill demand is more responsive to price in the United States and Western Europe than in the rest of the world. However, mill demand for cotton in all country groups is inelastic. This can be attributed to the demand for raw cotton being derived from the demand for textiles as a whole and the fact that the cost of raw cotton only makes up a small amount of the total cost

TABLE 1

Price Elasticity Estimates

Region	Short run	Long run
Area		
United States	0.48	0.64
Australia	0.59	2.46
Rest of the world	0.06	0.25
Mill demand		
United States	-0.34	-0.97
Western Europe	-0.26	-0.54
Rest of the world	-0.10	-0.19

TABLE 2

Cross-Price Elasticity Estimates

Region	Short run	Long run
<u>Area</u>		
United States	-0.45	-0.61
Australia	-0.56	-2.35
Rest of the world	-0.05	-0.19

of the finished garment. That is, if cotton prices change, there will be little effect on the price of the garment and thus the demand for raw cotton would not be expected to change much. Also, mills cannot change instantaneously and without cost from cotton to alternative fibres. Even in the long run, the scope for adjustment appears limited, especially in the rest of the world.

The cross-price elasticities presented in Table 2 appear to follow a similar pattern to the own-price elasticities. The United States and Australia are more responsive to the prices of the alternative crops to cotton, especially Australia in the long run, while the rest of the world appears relatively unresponsive. The United States and Australia have greater production flexibility due to their technology and their range of production alternatives. Also, ready access to markets enables them to switch easily between alternative crops on the basis of relative profitability.

Analysis of US Government Policy

To analyse the effects of US government policy on Australian producers, a further equation was added to the model:

AUSTREV = SAU.PW/ER/AUCPI

where SAU is total Australian production of cotton.

AUSTREV is thus an estimate of the sales revenue received by Australian growers. This is, however, an approximation since not all Australian cotton is sold on the world market. About 20 kt (92 000 bales) is sold on the domestic market. This is sold at a price based on import parity because of an arrangement between processors and mills. Since the import parity price is determined by the world price, the revenue equation should be an excellent proxy for total industry revenues. A second reason why AUSTREV is only an approximation is because not all Australian cotton is of the quality that the 'A' index represents. However, as Monke and Petzel (1984) have shown, the set of premiums and discounts for various grades of cotton are stable. Hence the percentage variation in sales revenue, as indicated by changes in AUSTREV, can be expected to accurately reflect the effects of the policy changes on Australian producer revenue.

The exogenous variables in the model were assigned their 1985-86 values and the model was simulated to ensure that the model was dynamically stable.

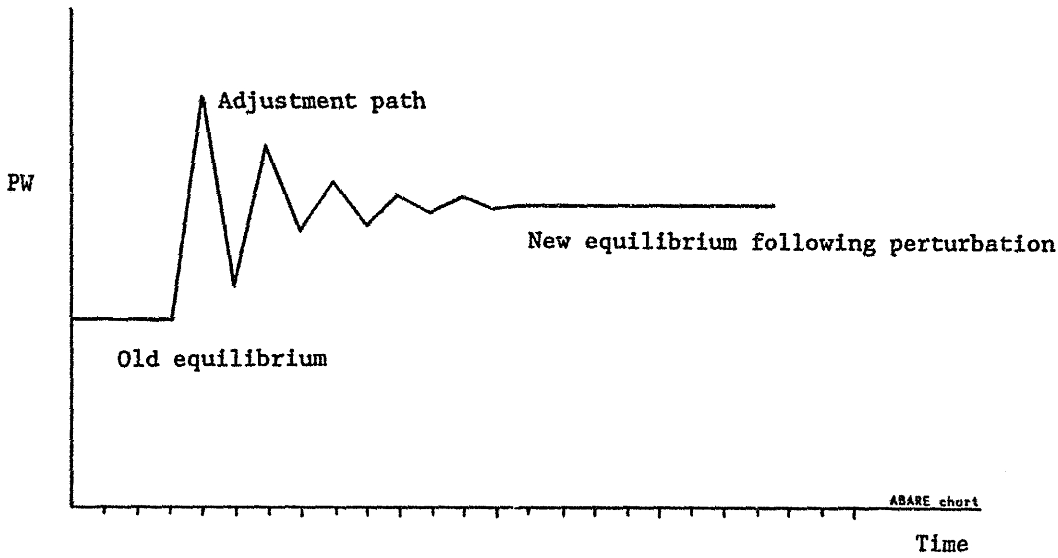

FIGURE 3 - Typical Adjustment Path of Simulations.

The policy variables in the US area equation were then adjusted and the model allowed to follow its time path toward a new equilibrium. The resulting percentage change in the value of AUSTREV was used to measure the impact on Australian producers of changes in US government policy. While the model took time to find its new equilibrium, new adjustment paths seemed to follow a set pattern in all the simulations. Initially the market overreacted. It then compensated in each period moving to the new equilibrium level in the manner shown in Figure 3.

The results of the simulations must be qualified. US supply would be expected to increase over time because of the reduction of risk due to the farm programs. If the farm program was permanently discounted then supply might be expected to contract somewhat over time. A further qualification is that exogenous variables, which were held constant throughout the simulation, may also change in the long run. For example, the model may underestimate the effect of a sustained price rise on production because Chinese and Soviet production plans, currently treated as exogenous, may be influenced in the long run. Thus the simulated effects of US policy changes on world price and Australian growers should be seen as short term phenomena and not indicative of the longer run effects.

Five scenarios were analysed, and the results are given in Table 3. For the first simulation, in which the acreage reduction requirement was reduced by half, price fell by 46.5 per cent in the first period from its previous equilibrium value of US70c/lb. Halving the acreage reduction requirement allows US growers to increase their area planted and the extra production forces price down. This first period response is only short term, however, as all producers respond to lower prices by reducing their areas planted and mills respond by increasing their demand. The results indicate a reduction in price of 10.7 per cent in the long run. Australian sales revenue falls by the same percentage as price in the first period because the area planted to cotton was decided on the basis of price in the previous period. Over the long term, production is adjusted to the new price and total revenue for Australian producers decreases by 15.5 per cent.

TABLE 3

Summary of Results from Simulations

Perturbation	Initial change in world price and Australian growers' revenue	Long run change in world price	Long run change in Australian growers' revenue
	%	%	%
1. Decrease area reduction requirement by 50 per cent	-46.5	-10.7	-15.5
2. Increase area reduction requirement by 33 per cent	30.7	7.1	10.8
3. Decrease guaranteed price to US growers by 10 per cent	4.7	1.1	1.6
4. Decrease guaranteed price to US growers by 100 per cent	46.8	10.8	16.7
5. Remove all provisions of the farm program	-46.1	-10.6	-15.4

In the second simulation the acreage reduction requirement is increased by 33 per cent, causing the world price and Australian sales revenue to increase by 30.7 per cent in the first period. The world price rises by 7.1 per cent in the long run, while Australian sales revenue increases by 10.8 per cent after the area planted has adjusted to the new equilibrium price.

The third simulation could be considered an alternative scenario to the second because reducing the guaranteed price to US producers is an alternative to changing the acreage reduction requirement. When the price and income support guaranteed to US growers is reduced by 10 per cent, the world price and Australian sales revenue increase by 4.7 per cent in the first period. World price in the long run increases by 1.1 per cent while Australian sales revenue rises by 1.6 per cent. These results reflect the relatively low supply elasticity for the United States and, consequently, small production adjustment on their part.

While the removal of all price and income support under the US farm program is unlikely, the effects this would have on producers in the rest of the world is of interest. When the farm program guaranteed price support is reduced to zero the world prices and Australian sales revenues initially fall by 46.8 per cent. After world producers and consumers adjust to the new market conditions, the price is estimated to be 10.8 per cent higher and Australian producers benefit by sales revenue increases of approximately 16.7 per cent.

In the final simulation both the income and price support were removed and the acreage reduction requirement abolished. This represents complete removal of cotton from the agricultural support progam in the United States. Under this scenario, world prices fall initially by an estimated 46.1 per cent. This is the effect of the increase in US production. The actual change in US production is the net result of the incentives to increase production after the acreage reduction requirement is removed and incentives to decrease production after the price and income supports are removed. In the long run, price falls by 10.6 per cent and Australian sales revenue decreases by 15.4 per cent. It follows from this result that the US farm program provisions in 1985-86 have resulted in higher world cotton prices than would have occurred without the program. This is because the acreage restrictions which applied reduced area more than the provision of a guaranteed price increased it.

Conclusions

Australian cotton producers are more responsive to changes in world price than producers in other countries, including the United States. This reflects the openness of Australian trade policies and consequent exposure of Australian producers to world market pressures. Cotton plantings in the rest of the world appear to be relatively unresponsive to price changes. This may be due to the policies of some governments in insulating their producers from price fluctuations or it may be due simply to the lack of production alternatives.

As expected, mill demand for cotton is more elastic in the developed market economies of the United States and Western Europe than in the rest of the world. However, due to the small effect of the price of cotton in the determination of the price of textiles, the demand for raw cotton was found to be inelastic. While the long run elasticity of demand for cotton in the United States was close to unity, it was very much lower in the other regions studied.

The short term changes in sales revenue for Australian producers which could result from a range of possible changes in US farm policy were estimated. The results indicate that the acreage reduction requirement of the US farm program supports the world price because of the constraint that it places on US production. If this requirement is increased, the world price increases and Australian and other non-US producers benefit. If the acreage reduction requirement is reduced, the opposite happens. As expected, if price and income support provided to US producers is reduced, US production falls and the world price increases.

The effect which the removal of the 1985-86 provisions of the farm program would have on Australian producers was estimated via a simulation where both US acreage reduction requirements and price and income supports were removed. In this case, the world price would fall as production in the United States increased by more than production declined in other countries. This would cause the world price, and thus Australian sales revenue, to decline.

The conclusion of greatest interest is that the net effect of the US farm program for cotton in 1985-86 was to support the world market. Thus non-US producers shared in the benefits of the US farm program. It appears to be true that the price and income supports do encourage production in the United States. However, constraint of production through the acreage reduction program more than offsets the effects on production of the price and income supports. Thus, US farm policies can benefit non-US producers if US income and price supports are accompanied by measures which effectively control production. Under future farm programs, however, it is possible that the production constraints would be eased to the extent that the net effect of the US farm program would be to increase US production. Such a policy scenario, which would represent an increase in US market share, would be to the detriment of non-US producers such as Australia.

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