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Costs and Benefits of Agricultural Price Stabilization in Brazil

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The welfare gains from reducing risk through agricultural price stabilization are unlikely to be large relative to the welfare gains from price reform that reduces market distortions for the six agricultural commodities considered in this study.

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This paper — a product of the Agricultural Policies Division, Agriculture and Rural Development Department — is part of a larger effort in PRE to analyze the efficiency and equity implications of agricultural policies. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Cicely Spooner, room N8-035, extension 30464 (40 pages, including tables).

In recent years, agricultural price stabilization policies have been recommended in Brazil as a way to reduce government intervention and open the sector for international trade without internalizing the instability of world prices.

The proposal discussed (and eventually implemented in 1987) was to establish a system of price bands around a moving average of past prices, with the government relying on stocks to defend the bands.

Braverman and his associates evaluated the "band proposal" for six commodities, using historical data and posing this question: what would have happened if price bands had been adopted in the past six to ten years (compared with free trade)? There were two major findings.

First, the implications of adopting a band-rule policy depend heavily on the specific characteristics of the commodities. The results suggest that:

- For edible beans, the band policy benefits producers. Risks associated with this crop are great and the efficiency cost of interventions is smaller than the benefits to farmers in reduced risk. The band rule will not stabilize producers' income, however, and will require an unreasonably high level of stocks.

- For corn, the risk benefits are low. The best alternative for the government may be free trade.

- For rice, free trade hurts producers because it destabilizes income and reduces its mean. But the efficiency cost of current policies (which protect producers) is large. The band rule reduces the cost of risk to producers significantly and its efficiency costs are relatively small.

- For wheat, the current situation is riskier than free trade and large deficits are incurred to support producer prices and to subsidize consumers. The inefficiencies caused by the band rule are larger than the value attributable to reducing risks.

- For cotton, free trade will increase risk. No calculations of the inefficiencies of current policies were made but other studies indicate that they are great.

- For soybeans, the band rule has virtually no effect on price instability, producer revenue, and producer surplus. The same conclusion on instability is seen for soy oil and soy meal.

Second, the welfare gains for risk reduction through agricultural price stabilization are unlikely to be large relative to the welfare gains from price reform that reduces market distortions for these six agricultural commodities.

More research is needed into the macroeconomic implications of price stabilization policies, particularly in countries with unstable but moderate rates of inflation, countries in which agricultural expenditures represent a large proportion of the budget.

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by
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Costs and Bene ts of Agricultural Price Stabilization in Brazil

1. Introduction

Agricultural Price Stabilization came to the forefront of the policy debate in Brazil in recent years. To a large extent stabilization policies were advocated as an instrument to reduce government intervention, opening up the sector for international trade, without internalizing the instability of world prices.

The first reform proposals (see Dias and Lopes (1983), Lopes and Dias (1984), Dias and Mendonça (1983) and Lopes (1987)) to incorporate these two objectives consist of a system of price bands around a three year moving average of international prices (FOB for exportables and CIF for importables) for all agricultural commodities. If prices remained within the upper and lower limits established, 'free trade' would take place. Otherwise the government intervenes through tariffs and subsidies.

This proposal, was first implemented in 1987. The main aspects of the policy were: a) the reference price was a five year moving average of wholesale prices in São Paulo (and not international prices), b) to defend the band the government would rely on stocks and c) the bands were established for only three commodities: edible beans, rice and corn (complete 'free trade' was adopted for soybeans and cotton).

In this paper we present a methodology to evaluate the 'band proposal' (which can be applied to other countries or other commodities) and results for edible beans, rice, cotton, corn, soybeans and wheat (even though there has never been a specific proposal for wheat, it was included). The approach relies on historical data and poses the following question: what would have happened if

price bands have been adopted in the past (say the last six to ten years)? To answer and maintain consistency with policy makers' objective of trade liberalization, we have first considered the implications (for price stabilization) of free trade in all six commodities.

Newbery and Stiglitz (1981) is a major contribution to this area and is the basis for our study. The methodology, however, is subject to important limitations. First, it only considers microeconomic aspects of price stabilization. It may well be that policy makers' concerns derive from the macroeconomic implications of price instability. With nominal wages sticky downwards, unexpected price increases may lead to demands for higher wages, but in the symmetric case of unexpected price declines, nominal wages are not reduced. This, in turn, leads to an increase in average real wages and, very likely, to higher inflation. These negative supply shocks can be mitigated by price stabilization. The net effect, though, can not be determined without detailed quantitative analysis since the band policy has a budgetary cost which may exert further pressure on inflation.

A second limitation has to do with credit rationing, bankruptcy and impacts on productivity. It may be, for example, that farmers facing severe credit constraint (as is the case for many small producers and tenants) will be forced to reduce, for some time, the use of modern inputs and/or consumption following a year of low prices and low income, with negative implications for factor productivity and well being. For farmers living close to the poverty line, a year of bad prices and low income may lead to starvation.

In spite of the limitations, the focus on a microeconomic representative agent model raises many important issues. In an economy in which few risk markets for agricultural commodities exist, as is the case in Brazil, price

stabilization may be an important form of insurance to the average producer. Benefits are measured by the value farms attach to that insurance[1].

The paper is organized as follows: in section 2 we present a brief summary of the methodology adopted for the study; in section 3 the main results for edible beans, corn, rice, cotton and wheat are presented. Section 4 contains the results for soybeans separately because the model is, in fact, a simplified multi-market. The last section has some concluding comments and suggestions for future research.

2. Methodology

To estimate the value of price stabilization Newbery and Stiglitz, op. cit., relied on the fact that risk has a cost for both producers and consumers. If we let y_0 and y_1 be income (both random variables) before and after prices stabilization respectively, the value of stabilization for a producer is B, given by:

$$EU(y_0) = EU(y_1-B)$$

where U is the utility function and E is the expectation operator. This equation can, in principle, be solved numerically to yield the value of B. Taking Taylor series approximations Newbery and Stiglitz (1981) (see also Kanbur (1984)) show that:

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[1] Braverman et al [1990] considers also multi-market effects of price stabilization. Braverman, Hammer and associates made use of multi-market models in deterministic settings to study the impacts of price policies. Their results indicate that interactions among markets is significant and that, in many cases, ignoring this effects may even lead to wrong qualitative results. However, for the study of price stabilization the results were far less interesting. In view of this they are not reported here.

$$\frac{B}{Ey_0} = -\frac{\Delta Ey}{Ey_0} - 0.5 \times R \times \Delta\sigma^2 \qquad (1)$$

where Δ indicates the difference between the values on the pos and pre stabilization scenarios, Ey_0 and Ey_1 are mean incomes in the two scenarios, σ_i ($i = 0,1$) are the coefficients of variation of income before and after stabilization has taken place and R is the coefficient of relative risk-aversion of Arrow-Pratt.

Equation (1) has two components: the first term (called transfer benefit, B_T) indicates the gain or loss to producers due to the change in average income. This gain or loss will occur irrespective of the agent's behavior with respect to risk. The second term is the efficiency gain (B_e) and it is the 'pure gain' due to stabilization. It depends, rather intuitively, on the extent of risk reduction ($\Delta\sigma^2$) and on the magnitude of the coefficient of relative risk aversion. For an agent which is risk-neutral ($R = 0$) this term will be zero. The higher the degree of relative risk aversion, the higher the weight of B_e in the determination of the final value of the benefit.

In general there is no guarantee that price stabilization will stabilize income (see Newbery and Stiglitz, op. cit.). The transfer benefit may also be negative. This will be the case, for example, if supply is the unique source of instability, the stabilized price is set so that demand will take up average supply and demand elasticity is less than one, as it is for many agricultural commodities (Kanbur, op. cit.).

To measure the benefit to consumers Newbery and Stiglitz rely ont the same principle (i.e., the cost of risk). They show that for consumers the benefit of price stabilization, B^C, can be approximated by:

$$\frac{B^C}{X} = (1/2)(1 - \epsilon)\sigma_p^2 + \{(1/2)\epsilon\sigma_p^2 - R^C\rho(p,I)\sigma_I\sigma_p\} \quad (1')$$

where X is average consumer expenditure, ϵ is the elasticity of demand, σ_p and σ_I are coefficients of variation of price and consumer income, $\rho(I,p)$ is the coefficient of correlation between price and consumer income, R^C is the consumer's relative risk aversion to income variability, given prices.

The first term on the right side of (1') is simply the consumer transfer benefit. The first term in the curly bracket, is referred to as the 'arbitrage benefit', which could accrue even if consumers were income risk neutral. In fact, these are the pure social gains that we might expect private storage activity to capture. The assumption behind intervention must be that because of market imperfections these gains remain unexploited. The last term in expression (1') is the risk benefit.

It was not possible to use Newbery and Stiglitz method directly in the case of Brazil. First because the wedge between producer and consumer prices introduced by government interventions does not allow the application of the above formulae: which price should be used to calculate the coefficient of variation? Second, the band proposal is really one of allowing free trade within certain limits, and whether or not the limits are hit depend on the potential free trade outcome. In order to evaluate the policy, therefore, we have to characterize the free trade outcomes. Third, the appropriate domestic market specification that corresponds to the Newbery and Stiglitz international market analysis is that of a non-traded good. For traded goods in a small open economy the approach and the formulae have to be modified.

The principal aspects of the model to evaluate the costs and benefits of price stabilization in Brazil are the following (for more details, see Braverman et. al., 1990):

i) linear supply and demand equations;

ii) the slopes of demand and supply are assumed constant over time. They were estimated from average prices and quantities for each commodity and the respective elasticities[2];

iii) uncertainty only affects the intercepts of demand and supply. Intercepts were estimated from the historical data and the (constant) slopes.

The analysis is in three steps: first we look at the historical situation and characterize variability of the relevant series (producer prices, producer revenues, producer income[3], production, consumer prices, consumption and consumer surplus); then we assume that all interventions are removed and show the consequences of this free trade policy and, finally, we study the implications of the 'band proposal' for the same set of variables.

Because of transportation costs and middle-men margins all prices are referred to São Paulo. A description of the procedures utilized to make these conversions as well as a complete account of all the data base can be found in Braverman et. al.(1990). The relevant demand and supply elasticities are listed in the Appendix.

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[2] If a is, say, the price elasticity of supply the slope is given by $a.(Eq/Ep)$, where Eq and Ep are average quantity produced and average price received by the farmer respectively.

[3] Producer income is assumed to be equal to producer surplus.

3. Selected Results: Single Market Analysis

The products considered in the analysis were divided into two categories: traded and non-traded. Cotton and wheat are traded, rice, corn and edible beans are non traded. This classification should be taken with care. For both rice and corn there exists an active international market and Brazil engages in trading in these markets (as an importer of rice, and as both exporter and importer of corn[4]). However, this was a consequence of policy decisions to control and/or stabilize prices and does not necessarily reflect trade advantages or disadvantages. For edible beans the non-traded good assumption is the natural one to make: the international market is restrict and Brazil very seldom imports according to its needs.

3.1 Edible Beans

This a critical crop from the point of view of policy. It is an important food staple and production is growing at a small pace in recent years. Moreover, in contrast with recent trends in other food crops (rice and wheat, for example) yields are stagnant or decreasing.

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[4] During the 1980s, Brazil was a net importer of corn. However, during the period covered by our data, there were years in which the country was a net exporter.

Table 1 presents a summary of the analysis for edible beans.[5] The first column of the table displays average values for the period 1971/1986 for key economic variables. The average real price received by farmers was Cz$ 10.30[6] per kg and the price paid by consumers was Cz$ 10.50 per kg. The coefficient of variation of consumer price is higher than that for producer price, possibly reflecting the instability of the policy during the period. In order to sustain the price differential the government has maintained average stocks of the order of 25 thousand metric tons.

Instability of supply and demand and of government policies are responsible for the variability of prices, revenues and incomes. Risk averse producers will pay to have that instability reduced. To measure this, the risk premium (that is, the cruzado value of the insurance producers would pay to get rid of instability) is 2.84 percent of the average value of producers revenue and 1.80 percent of producers income. These calculations, based on the assumption that the coefficient of relative risk aversion is equal to one[7], are shown in Table 2, which also displays the risk premium for other values of the coefficient of relative risk aversion.

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[5] Sensitivity analysis was performed with respect to key parameters adopted in the analysis of all six crops included in the study (like elasticities, width of the band rule, etc.). The results are not reported here (see Braverman et. al.), but the qualitative nature of the conclusions did not change in response to these tests.

[6] All cruzado values in the paper refer to 1986. Currency units were not changed back to cruzeiros.

[7] No attempt to estimate the coefficient of relative risk aversion was made. The value of one was estimated by Binswanger (1980) from a sample of agricultural producers in India. In view of the crucial role that this coefficient plays, all tables containing risk analysis will display results for various values of R.

Table 1

BEANS SINGLE MARKET SUMMARY (1971-1986, Detrended)

Series / Units		Historical Data	Free Trade	Band Rule
Producer Revenue	Mean	20675.58	21416.64	16182.06
Million Cz$	C.V.	0.2	0.38	0.22
Producer Surplus	Mean	16115.48	16573.04	13264.53
Million Cz$	C.V.	0.19	0.33	0.26
Consumer Surplus	Mean	20158.58	21071.87	25502.51
Million Cz$	C.V.	0.28	0.34	0.36
Producer Price	Mean	10027.87	10173.56	8292.30
Cz$/ton	C.V.	0.30	0.35	0.12
Consumer Price	Mean	10503.59	10173.56	8292.30
Cz$/ton	C.V.	0.37	0.35	0.12
Production	Mean	2119.84	2131.95	1975.66
1000 Tons	C.V.	0.16	0.17	0.24
Consumption	Mean	2095.27	2131.95	2341.01
1000 Tons	C.V.	0.14	0.17	0.18

Table 2

BEANS PRODUCE SURPLUS (Million Cz$, Detrended)

Risk Coefficient :	Historical Data	Free Trade	Band Rule
1.00			
Risk Premium :	289.38	832.03	532.96
% of series mean :	1.80%	5.02%	4.02%
1.33			
Risk Premium :	388.80	1103.81	728.26
% of series mean :	2.41%	6.66%	5.49%
1.67			
Risk Premium :	489.74	1376.05	931.23
% of series mean :	3.04%	8.30%	7.02%
2.00			
Risk Premium :	592.20	1650.38	1140.66
% of series mean :	3.67%	9.96%	8.60%

The 'free trade' (or competitive equilibrium) solution of the model is displayed in the second column of Table 1 (and the corresponding risk analysis is in the second column of Table 2). Notice that producer price is more unstable, but consumer price is not (in other words, government interventions destabilized consumer price over the period of analysis). Similarly, producer revenue and producer income (as estimated by the producer surplus) display higher coefficients of variation. As indicated in Table 2 the risk premium is substantially higher: 6.70 percent of average revenue and 5.02 percent of average income, respectively. A comparison of values of the income streams (expression 1) indicates that stabilization of producer has a value of 3.64 percent of free trade income; this is partly compensated by a negative transfer equivalent to 2.75 percent of free trade income (i.e., income is 2.75 percent lower in the actual situation than in the competitive solution). From the producers' point of view, actual policies were favorable compared to the free trade outcome, even though the gain is small in quantitative terms.

The efficiency costs of current policies can be roughly estimated by the change in <u>average</u> producer and consumer surpluses plus the change in the government deficit (which is zero under free trade) calculated from <u>average</u> prices and quantities. The change in surpluses (free trade values minus current situation values) is approximately 1,370 millions Cz$; the government runs an estimated surplus from beans operations of 950 millions Cz$.[8] The deadweight loss due to government intervention is 420 million Cz$. The monetary value of

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[8] The estimated impact of the policies on the budget is given by: $(p^c - p^p)C + (p^f - p^p)(Y - C) - p^p(Y - C)r$, where: p^c and p^p are, respectively, producer and consumer price; C is the level of consumption, Y is the level of production, p^f is the free trade price and r (=15 percent per year) is the storage cost of the government. Observe that government stocks are valued at the free trade price since they are relatively small compared to production and consumption.

reduced risk to producers, for a coefficient of relative risk aversion of one, is (832 - 289 =) 543 million Cz$ which is even larger than the inefficiency losses associated with current interventions.

The value of price stabilization for edible beans is high compared with some of the other crops included in the study. This does not come as a surprise. The coefficient of variation of production is one of the highest among the crops included in the study and so is the coefficient of variation of producer prices. In addition, risk markets do not exist to allow producers to defend themselves against the bad states of nature[9].

The 'band proposal' considered in the analysis resembles the policy first adopted in 1987. The reference price is a 60 month moving average of the past prices. The upper and lower limits are 17 percent above and below the reference price (in actual fact, the lower limit was the minimum price).

Producer and consumer prices under this policy will be more stable than both free trade and the historically observed prices. Average prices are lower than in the other two scenarios. In spite of the stabilization of prices, this policy will not stabilize producer surplus compared with the actual situation, but it will when compared to the free trade outcome. However, for producers the additional stabilization will not be enough to compensate for the decline in the average prices.

One additional difficulty with the band proposal for edible beans is that, on average, consumption will be higher than production. The government will be required to sell, on average, every year, 360 thousands metric tons of beans

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[9] Formal risk markets do not exist for most agricultural commodities in Brazil. In the case of edible beans this is even worst because informal risk sharing arrangements, like, for example, advance purchases made by industry with guaranteed prices, are not common.

(this occurs because the upper limit of the band is hit more often the lower limit). Compared to historical stock levels and with imports over the period, this is extremely high. It is very unlikely that the government will be able to sustain the policy over an extended period of time.

3.2 Corn

Production of corn in Brazil is widespread. Most of the states produce it, even though with very different technologies. Only a small proportion of production is directly utilized for human consumption; the bulk of consumption is animal feed. Table 3 shows average values of the relevant variables for corn for the period 1977-1986. Price instability is not as large as for edible beans. Consumer price shows more instability than producer price and this is reflected in the larger coefficient of variation of consumer surplus in relation to producer surplus.

The simulation of free trade is presented in the second column of Table 3. Producer price is now more volatile; consumer price is also more volatile but the increased variability is far less than observed for producer price. Both producer revenue and income are more unstable under free trade.

Table 4 presents the risk analysis. For producer's income the risk premium is 1.59 percent of mean income. A comparison of revenue and income streams under free trade and the actual situation indicates a welfare value of stabilization of only 0.36 percent of average income under free trade. Since the free trade average value of producer income is higher than the observed, the net result of the policy is a welfare loss equivalent to 1.52 percent of free trade income.

Table 3

CORN SINGLE MARKET SUMMARY (1977-1986, Detrended)

Series / Units	: Historical Data		Free Trade	Band Rule
Producer Revenue	: Mean	33931.09	35103.37	35198.21
Million Cz$	: C.V.	0.15	0.18	0.13
Producer Surplus	: Mean	28128.02	29003.02	29139.99
Million Cz$	: C.V.	0.17	0.19	0.16
Consumer Surplus	: Mean	37509.06	31632.03	31572.71
Million Cz$	: C.V.	0.24	0.25	0.27
Producer Price	: Mean	1953.48	1998.10	2003.33
Cz$/per ton	: C.V.	0.12	0.14	0.08
Consumer Price	: Mean	1679.52	1998.10	2003.33
Cz$/per ton	: C.V.	0.13	0.14	0.08
Production	: Mean	17484.98	17618.74	17634.42
1000 Tons	: C.V.	0.13	0.13	0.13
Consumption	: Mean	19220.75	17618.74	17592.44
1000 Tons	: C.V.	0.12	0.13	0.14

Table 4

CORN PRODUCER SURPLUS (Million Cr$, Detrended)

Risk Coefficient	Historical Data	Free Trade	Band Rule
1.00			
Risk Premium	373.17	461.98	331.55
% of series mean	1.33%	1.59%	1.14%
1.33			
Risk Premium	494.62	602.85	435.26
% of series mean	1.76%	2.08%	1.49%
1.67			
Risk Premium	614.68	737.28	535.76
% of series mean	2.19%	2.54%	1.84%
2.00			
Risk Premium	733.43	865.38	633.21
% of series mean	2.61%	2.98%	2.17%

The 'band proposal' consists of upper and lower limits of 12 percent of the reference price, which is calculated as a 60 month moving average of (past) wholesale prices in São Paulo. With respect to the actual situation the results indicate that both consumer and producer prices are higher and more stable. Average producer revenue and producer income are higher with the price band, but consumer surplus is lower. Producer revenue is more stable (the coefficient of variation is reduced by roughly 13 percent) and the variability of producer income is only marginally affected. Nonetheless, the value of the welfare gains are very small: 0.28 and 0.17 percent respectively for revenue and income.

One of the most attractive features of this policy is its impact on the government deficit. The actual situation is one in which average consumer prices are lower than average producer prices and consumption is higher than production. It is difficult to estimate the implied deficit because average prices include the margins in the final market[10] (in this case wholesale margins). However, if one assumes that producer prices are equal to world prices the estimated deficit based on average consumption and prices would be 6,123 millions of cruzados[11]. With the price band, production is only 41,000 tons higher than consumption; with consumer, producer and free trade prices virtually the same the costs for the government are negligible.

Compared to the free trade situation, a reduction of 43 percent in the coefficient of variation of prices is observed. Even though the coefficients

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[10] Data were not available to correct for that. Changes in average values, because of this, have to be taken cautiously.

[11] This may be somewhat overestimated because of the assumption that producer prices are equal to world prices. Braverman et. al. (1990) indicates that for reasonable values of the coefficient of nominal protection the error is relatively small.

of variations of producers revenue and income are reduced, the final welfare value of the additional stability is only 0.53 percent of free trade income.

3.3 Rice

Production of rice has moved from the states of the Northeast (principally Maranhao) to the Southeast and to the Central West of Brazil. The South produces mainly in irrigated land, however, about 70 percent of rice production takes place in rainfed areas in the states of the central western part of Brazil.

The Brazilian government has been involved in almost all stages of rice marketing. Concerns with price fluctuations in the major urban centers have been the driving force of the intervention. As Table 5 indicates, the coefficient of variation of the detrended series of producer prices is 15 percent, 10 percent for production and 7 percent for consumption. The coefficient of variation for producer surplus and producer revenue is around 15 percent. The risk cost to producers was 456 million Cz$ (based on producer surplus), i.e. 1.07 percent of mean income over the period (Table 6).

Under free trade, the coefficient of variation of prices is far greater than the observed one. The same is true for revenue and income of producers. The risk premium associated with the latter now increases to 7.23 of average revenue, as can be seen in Table 6. Comparing the historical data with the simulated free trade series, the monetary value of the increased risk cost is (1625.02-642.34=) 982.68 million Cz$ per annum. The corresponding figure for producer income is (1110.64 - 456.12 =) 654.5. Producers lose out on the risk front; the transfer benefit of going to free trade is also negative (this has

Table 5

RICE SINGLE MARKET SUMMARY (1971-1986, Detrended)

Series / Units	: Historical Data		Free Trade	Band Rule
Producer Revenue	: Mean	52338.32	22477.03	20821.60
Million Cz$	: C.V.	0.16	0.37	0.10
Producer Surplus	: Mean	42584.64	19370.94	18530.43
Million Cz$	: C.V.	0.15	0.33	0.11
Consumer Surplus	: Mean	74387.20	94489.79	95846.20
Million Cz$	: C.V.	0.13	0.15	0.12
Producer Price	: Mean	7392.17	3912.02	3614.18
Cz$/per ton	: C.V.	0.15	0.39	0.09
Consumer Price	: Mean	7469.90	3912.02	3614.18
Cz$/per ton	: C.V.	0.14	0.39	0.09
Production	: Mean	7140.53	5929.94	5826.33
1000 Tons	: C.V.	0.10	0.08	0.14
Consumption	: Mean	5255.87	5929.94	5986.37
1000 Tons	: C.V.	0.07	0.08	0.06

Table 6

RICE PRODUCER SURPLUS (Million Cr$, Detrended)

Risk Coefficient	Historical Data	Free Trade	Band Rule
1.00			
Risk Premium	456.12	1110.64	119.63
% of series mean	1.07%	5.73%	0.65%
1.33			
Risk Premium	602.46	1498.31	160.13
% of series mean	1.41%	7.73%	0.86%
1.67			
Risk Premium	745.70	1890.50	200.92
% of series mean	1.75%	9.76%	1.08%
2.00			
Risk Premium	885.73	2284.14	241.99
% of series mean	2.08%	11.79%	1.31%

to be interpreted with care because of margins, but this fact has been confirmed by other studies, Brandão and Carvalho [forthcoming]). The major gain from free trade is, of course, that the inefficiency costs of price distortions are avoided. In the case of rice, the allocative gain of the movement to free trade, computed, as usual, from the changes in consumer and producer surpluses and changes in government accounts, is of the order of 10,367 millions of cruzados.

The band proposal consists of upper and lower limits of 12 percent above and below the reference price (computed as a 60 month average of past prices) for price variation without any intervention from the government. Producer and consumer prices will be more stable compared with the two other scenarios. The average price with the band is not that different from the free trade outcome -- the real difference is in the variability. The band rule will also stabilize producer revenue and producer income. With a risk aversion coefficient of 1 the risk gain from the free trade base is equal to (1625.02-102.02=) 1522.99 million Cz$ in terms of revenue (for producer surplus the corresponding figure is 991.09 million Cz$). The efficiency loss on average in going from free trade to band rule is 227 million Cz$.

Comparing the actual situation with the band rule the risk gain is 540.31 million Cz$ for producer income and 336.49 million for producer surplus. This compares with an average efficiency gain of around 11,624 million Cz$.

3.4 Cotton

Cotton is produced mainly in the Center-South of Brazil. Ceara is the only important producer in the Northeast. It is exported, but the volume is

declining over time. It is, of course, an important input to the textile industry, which has great influence on the formulation of cotton policies.

Instability of domestic supply and demand, of the world price and of government policy induces the instability observed in prices received by farmers and prices paid by consumers as well on producer revenue and income and on consumer surplus. Table 7 summarizes the main results of the analysis. Instability of producer prices during 1979-1986 is not very large. The coefficient of variation of producer price is lower than that for consumer price. This indicates that for cotton too current policies have been more successful in the stabilization of producer prices.

Table 8 shows the risk analysis for producers income. The estimated value of the risk premium, for a coefficient of relative risk aversion of one, is 2.26 percent of average producer income.

In the free trade scenario, there is more instability of consumer and producer prices. The risk premium on income is 5.86 percent of average income. Comparing the revenue and income streams in the two policy regimes it is seen that the risk benefit implicit in the stabilization provided by current policies is 3.04 percent of mean revenue under free trade and it 2.81 percent for producer income.

The band proposal for cotton considered upper and lower limits of 25 percent above and below a 36 month moving average (adopted because data availability)[12]. Under this policy regime, the average price received by

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[12] When the band proposal was first implemented, complete free trade was adopted for this commodity. However, because earlier proposals included cotton in the band policy, we estimated the effects of one plausible version of the policy.

Table 7

COTTON SINGLE MARKET SUMMARY (1979-1986, Detrended)

Series / Units	:	Historical Data	Free Trade	Band Rule
Producer Revenue	: Mean	12135.73	10298.06	10822.57
Million Cz$	: C.V.	0.11	0.27	0.20
Producer Surplus	: Mean	6285.85	5257.39	5570.61
Million Cz$	: C.V.	0.20	0.34	0.25
Consumer Surplus	: Mean	2467.79	4140.54	3681.67
Million Cz$	: C.V.	0.14	0.30	0.26
Producer Price	: Mean	18231.77	16683.13	17181.10
Cz$/per ton	: C.V.	0.11	0.18	0.15
Consumer Price	: Mean	18894.61	16683.13	17181.10
Cz$/per ton	: C.V.	0.13	0.18	0.15
Production	: Mean	676.13	621.14	638.83
1000 Tons	: C.V.	0.13	0.18	0.15
Consumption	: Mean	616.87	789.91	750.95
1000 Tons	: C.V.	0.07	0.16	0.14

Table 8

COTTON PRODUCER SURPLUS (Million Cr$, Detrended)

Risk Coefficient	Historical Data	Free Trade	Band Rule
1.00			
Risk Premium	142.31	308.10	179.00
% of series mean	2.26%	5.86%	3.21%
1.33			
Risk Premium	192.94	412.86	239.15
% of series mean	3.07%	7.85%	4.29%
1.67			
Risk Premium	245.26	517.67	299.22
% of series mean	3.90%	9.85%	5.37%
2.00			
Risk Premium	299.26	621.83	359.01
% of series mean	4.76%	11.83%	6.44%

producers is higher than the free trade price. The instability associated with producer prices is higher when compared with the observed situation.

If the policy is viewed as an alternative to free trade, the situation is slightly different: both prices and producers' income are more stable. The change in mean income is +5.96 percent and the efficiency gain due to more stable income is 4.34 percent.

The band policy will benefit producers compared to the free trade situation, and, of course, the government will collect some revenue from the tariff it imposes (roughly estimated as 54 millions of cruzados)[13] . In the observed situation, the government runs an even larger surplus (roughly estimated as 240 millions of cruzados) because the tax on consumers more than compensates the subsidy to cotton producers (both the subsidy to consumers and the tax on producers estimated from a comparison between domestic and world prices).

Distortions of the exchange rate were not taken into account. This does not affect the results of the risk analysis because the coefficient of variation of the official exchange rate and that of an equilibrium exchange rate estimated by Brandão and Carvalho, op. cit. are quite similar. Nonetheless, it should be noted, when it comes to average impacts, the use of the equilibrium exchange rate can make a big difference (see Brandão and Carvalho, op. cit.).

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[13] We remind the reader that average values are to be interpreted carefully since they are very sensitive to the way margins were calculated. In particular, even though our results indicate that Brazil, under both the free trade regime and the band rule regime, will become a net importer of cotton, we do not think that the methodology and the procedures utilized in this study permit that inference. The calculations referring to averages are mostly illustrative, specially in the case of cotton for which there exists evidence of high taxation of producers (Brandao and Carvalho [forthcoming]; note also that the period analyzed in that study is not the same as in this one).

3.5 Wheat

Government intervention in the wheat market is strong. The government sets producer and consumer prices for wheat sold to mills, flour and bread prices. Marketing of wheat grain is entirely in the hands of the government, which purchases from domestic producers, imports and sells grain to millers. Brazil has been a traditional importer of wheat and this situation would have prevailed even under free trade[14]. In the actual situation, since consumer prices are held below world prices, the tendency is for imports to be larger and this tendency is not outweighed by producer prices being above their world price levels. The gap between producer and consumer prices and the world price means a significant fiscal deficit.

Domestic prices different from world prices generate well known inefficiencies. Liberalization, on the other hand, would mean that domestic prices will be subject to the vagaries of international markets, a state of affairs that it was the intention (at least partially) of the initial interventions to mitigate. If intervention prices are more stable than world prices, there is a clear trade-off between the stabilization gains from the intervention and the deadweight losses thereof. The band rule proposal can be seen as a solution to the problem that lies between the two extremes of complete liberalization and complete stabilization.

Table 9 summarizes the picture for the period 1977-1985. It can be seen that on average the producer price was kept 22.5 above the world price and the

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[14] The 1980s witnessed a substantial increase in wheat yields in Brazil. Self-sufficient in the future is possible.

consumer price was kept 49.0 percent below the world price. However, what is

Table 9

WHEAT SINGLE MARKET SUMMARY (1977-1985, Detrended)

Series / Units	: Historical Data	Free Trade	Band Rule
Value of Imports	: Mean 11175.71	5475.36	4741.89
Million Cz$	: C.V. 0.19	0.41	0.35
Fiscal Deficit	: Mean 9728.07	0.00	-108.79
Million Cz$	: C.V. 0.35	0.00	-2.12
Producer Revenue	: Mean 7090.65	5265.29	5645.11
Million Cz$	: C.V. 0.39	0.37	0.31
Producer Surplus	: Mean 5243.30	4041.33	4278.42
Million Cz$	: C.V. 0.46	0.43	0.39
Consumer Surplus	: Mean 11828.34	5195.78	4725.67
Million Cz$	: C.V. 0.21	0.37	0.33
Producer Price	: Mean 3111.22	2540.53	2693.74
Cz$/per ton	: C.V. 0.14	0.11	0.07
Consumer Price	: Mean 1295.14	2540.53	2693.74
Cz$/per ton	: C.V. 0.22	0.11	0.07
Production	: Mean 2239.61	2026.06	2083.39
1000 Tons	: C.V. 0.27	0.30	0.29
Consumption	: Mean 6593.46	4259.17	3972.00
1000 Tons	: C.V. 0.11	0.18	0.14

striking is that the free trade price has been less volatile than either the producer price or the consumer price domestically. The risk cost associated with producer surplus, as shown in Table 10, has a monetary value of 487 million Cz$ or 9.32 percent of average surplus. To sustain the policy it was necessary to incur in a large deficits and a large import bill.

With free trade, of course, there is no fiscal deficit and the import bill is smaller. The allocative gain has a monetary value of 1,875 million Cz$ average per year and there would be no reduction in the variability of producers' revenue or income. Note, however, that consumption is more unstable with free trade.

The gain in stability of income for producers is only 113.77 million Cz$, which is small relative to the mean loss suffered by producers.

Even though there have not been any formal band proposal for wheat, we simulated the results of imposing upper and lower limits of 12 percent above and below a reference price (calculated as a 60 month moving average of past prices). The policy actually reduces the coefficient of variation of consumers and producer prices compared with the historical situation and with free trade. The average consumer price increases when compared to free trade, but it is less than the average price in the current situation. Producer price is higher than free trade price but lower than the observed historically. Consumer surplus, producer surplus and producer revenue are stabilized. The monetary value of the risk benefit to producers is 52.00 million Cz$ which has to be compared to the efficiency cost of 125 million Cz$ of the policy.

Table 10

WHEAT PRODUCER SURPLUS (Million Cr$, Detrended)

Risk Coefficient	Historical Data	Free Trade	Band Rule
1.00			
Risk Premium	488.60	374.83	322.83
% of series mean	9.32%	9.27%	7.55%
1.33			
Risk Premium	638.03	494.37	430.05
% of series mean	12.17%	12.23%	10.05%
1.67			
Risk Premium	779.49	608.95	535.63
% of series mean	14.87%	15.07%	12.52%
2.00			
Risk Premium	912.56	717.65	638.79
% of series mean	17.40%	17.76%	14.93%

4. The Soybean Complex

The soybean complex consists of three interrelated commodities: soybeans, soy oil and soy meal. Their relation stems from the fact that soy oil and soy meal are joint products and that, partly due to policy measures in Brazil, industrial crushing demand is the most important component of soybeans demand (the other component being exports). The model of this complex is, naturally, a multi-market model, albeit a simple one. The structure used in this paper is adapted from that utilized by Braverman, Hammer and Brandão (1987) and earlier by Williams and Thompson (1982). It is assumed that by setting export quotas to the three products of the complex the government seeks to maintain capacity utilization in the crushing industry. Even though this has not being the unique instrument of intervention its utilization was overwhelming and, for the purposes of the model, it captures the essence of government intervention.

The equations of the soy complex are the following:

$$S^{s,t} = \alpha^{s,t} + \beta^{s} p^{s,t} \qquad (2)$$

$$D^{s,t} = C^{s,t} + X^{s,t} \qquad (3)$$

$$S^{s,t} = S^{s,t} \qquad (4)$$

$$W^{so}{}_{x} C^{s,t} = D^{so,t} + X^{so,t} \qquad (5)$$

$$W^{sm}{}_{x} C^{s,t} = D^{sm,t} + X^{sm,t} \qquad (6)$$

$$D^{so,t} = a^{so,t} - b^{so,t}{}_{x} P^{so,t} \qquad (7)$$

$$D^{sm,t} = a^{sm,t} - b^{sm,t}{}_{x} P^{sm,t} \qquad (8)$$

$$p^{s,t} = W^{so}{}_{x} P^{so,t} + W^{sm}{}_{x} P^{sm,t} + d^{t} \qquad (9)$$

$$C^{s,t} = a^{s,t} - b^{s}{}_{x} d^{t} \qquad (10)$$

Equations (2), (3) and (4) specify the supply function for soybeans, the demand for soybeans as a sum of crushing demand ($C^{s,t}$) and export demand ($X^{s,t}$)

and the equilibrium condition of supply equals demand, respectively. Equation (5) introduces W^{SO}, the proportion whereby crushed soybeans are converted to soy oil. The left hand side of (5) is thus the supply of soy oil. The right hand side is domestic plus export demand for this commodity. Similarly, (6) specifies equality of the supply of soy meal and domestic and foreign demand for it. Equations (7) and (8) are domestic demand functions for soy oil and soy meal. Equation (9) defines the crushing margin, d^t -- the difference between revenue from sales of the product of one unit of soybeans and its cost. The profitability of crushing will determine the demand for soybeans; equation (10) captures this in terms of a linear demand curve relationship between $C^{s,t}$ and d^t.

Notice that all slopes in equations (2)-(10) do not have the index t, while the intercepts do. This is in keeping with the assumption that shocks displace supply and demand purely through vertical shifts.

With the model set up as above, we can proceed to the analysis of instability. The methodology is the same as before: first we examine the historical situation, then free trade is simulated and finally a band rule proposal is examined. The original proposal contemplated a band of 25 percent above and below the long run prices (here defined, because the price series is short, as a 36 month average of past prices). This is utilized in the simulations below[15] together with the data required by the model.

Tables 11, 12 and 13 summarize the results for soybeans, soy oil and soy meal respectively. Notice that over this period average free trade prices for

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[15] Up to this date, no band rule has been applied to soybeans. Since the implementation of the band rule for edible beans, rice and corn, the soybean complex was mostly under free trade.

Table 11

SOYBEANS MULTI MARKET SUMMARY (1980-1985, Detrended)

Series / Units	: Historical Data		Free Trade	Band Rule
Value of Exports	: Mean	12.13	-57.51	-59.26
Million Cz$	: C.V.	1.19	-0.72	-0.71
Fiscal Deficit	: Mean	0.15	0.00	-0.15
Million Cz$	: C.V.	2.25	-	-2.22
Producer Revenue	: Mean	361.66	360.78	361.79
Million Cz$	: C.V.	0.15	0.18	0.18
Producer Surplus	: Mean	178.76	178.96	179.48
Million Cz$	: C.V.	0.16	0.22	0.22
Consumer Surplus	: Mean	416.12	597.90	603.28
Million Cz$	: C.V.	0.09	0.05	0.06
Producer Price	: Mean	25.65	25.63	25.67
Cz$/per ton	: C.V.	0.14	0.13	0.13
Consumer Price	: Mean	25.65	25.63	25.67
Cz$/per ton	: C.V.	0.14	0.13	0.13
Production	: Mean	14055.29	14042.07	14066.44
1000 Tons	: C.V.	0.09	0.12	0.12
Consumption	: Mean	13586.67	16295.93	16363.18
1000 Tons	: C.V.	0.05	0.03	0.03

Table 12

SOYBEANS PRODUCER REVENUE (Million Cz$, Detrended)

Risk Coefficient	:	Historical Data	Free Trade	Band Rule
1.00				
Risk Premium	:	4.76	6.93	6.41
% of series mean	:	1.32%	1.92%	1.77%
1.33				
Risk Premium	:	6.47	9.48	8.76
% of series mean	:	1.79%	2.63%	2.42%
1.67				
Risk Premium	:	8.24	12.15	11.21
% of series mean	:	2.28%	3.37%	3.10%
2.00				
Risk Premium	:	10.06	14.94	13.75
% of series mean	:	2.78%	4.14%	3.80%

Table 13

SOY OIL MULTI MARKET SUMMARY (1980-1985, Detrended)

Series / Units	: Historical Data	Free Trade	Band Rule
Value of Exports	: Mean 68.24	71.05	71.81
Million Cz$	: C.V. 0.23	0.25	0.27
Fiscal Deficit	: Mean 50.92	0.00	-2.12
Million Cz$	: C.V. 0.27	-	-3.95
Consumer Surplus	: Mean 488.32	557.05	559.74
Million Cz$	: C.V. 0.35	0.31	0.30
Producer Price	: Mean 97.01	55.64	54.27
Cz$/per ton	: C.V. 0.11	0.18	0.13
Consumer Price	: Mean 97.01	55.64	54.27
Cz$/per ton	: C.V. 0.11	0.18	0.13
Production	: Mean 2862.83	3063.63	3076.28
1000 Tons	: C.V. 0.09	0.03	0.03
Consumption	: Mean 1643.32	1762.10	1766.05
1000 Tons	: C.V. 0.17	0.15	0.15

soybeans are slightly below domestic prices, which indicates that producers have been protected[16]. The net effect of free trade is to reduce slightly soybeans production and increase consumption. This comes about because domestic demand depends on the crushing margin which, as the results indicate, increase (even though soy oil and soy meal prices are reduced by free trade, soybeans price is also reduced, so that the net effect was an increase in the crushing margin) in response to free trade[17]. The coefficient of variation of soybean prices is slightly reduced with free trade. Both, producer revenue and producer surplus become more unstable under free trade; the cost of the additional risk, as can be seen in Table 14, is 2.22 million Cz$ per year. This has to be set against more stable consumption and consumer surplus and against a lower deficit. The efficiency cost in the soybeans market alone is 182 million Cz$. Free trade increases the instability of soy oil prices and reduces the instability of soy meal prices. Consumer surplus of both goods increase as a result of free trade.

Turning now to the band rule, we notice that it has virtually no effect on price instability, producer revenue, producer surplus, etc.. A detailed analysis shows that the band will be hit only once over the six year period 1980-1985. This would be in 1982, where the lower limit would be hit -- this also explains why the mean price with a band rule is higher than the mean price with free trade. The same conclusion on instability is seen for soy oil and soy meal, there are virtually no stability effects of such a wide band rule.

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[16] This only takes into account the so-called direct effects of soybean policies. It ignores, for example, the overvaluation of the currency which has been an important implicit tax on export commodities in Brazil (Brandao and Carvalho, op.cit.).

[17] As mentioned earlier, we would like to deemphasize the implications for trade flows, even though the results above seem plausible.

Table 14

SOY MEAL MULTI MARKET SUMMARY (1980-1985, Detrended)

Series / Units		Historical Data	Free Trade	Band Rule
Value of Exports	Mean	188.35	190.76	191.95
Million Cz$	C.V.	0.15	0.15	0.15
Fiscal Deficit	Mean	54.95	0.00	0.00
Million Cz$	C.V.	0.48	0.00	0.00
Consumer Surplus	Mean	27.23	42.48	42.48
Million Cz$	C.V.	0.67	0.33	0.33
Producer Price	Mean	26.37	20.62	20.62
Cz$/per ton	C.V.	0.16	0.13	0.13
Consumer Price	Mean	26.37	20.62	20.62
Cz$/per ton	C.V.	0.16	0.13	0.13
Production	Mean	11725.43	12547.86	12599.65
1000 Tons	C.V.	0.09	0.03	0.03
Consumption	Mean	2518.00	3272.38	3272.38
1000 Tons	C.V.	0.36	0.18	0.18

5. Summary and Conclusions

There are two general propositions that come from the analysis presented in this paper. First is that the implications of adopting a band rule policy are highly dependent on specific characteristics of the commodities. The results presented before indicate that:

a) for edible beans the policies adopted by the government benefited producers. Risks associated with this crop are large, and the efficiency cost of the interventions were smaller than the benefits to farmers of reduced risk. Furthermore, the band rule will not stabilize producers income and will require an unreasonably high (compared to historical) level of stocks;

b) for corn, the risk benefits to producers tend to be low. The band policy will reduce government deficit, and so it is an improvement when compared with the actual situation. However, when compared to free trade, the band proposal does not affect very much variability of key variables, indicating that perhaps the best alternative for the government is to adopt free trade;

c) for rice free trade will hurt producers both because it will destabilize income and reduce its mean. Nonetheless, the efficiency cost of current policies (which protect producers) is large. The band rule reduces significantly the cost of risk to producers and its efficiency costs are relatively small;

d) for wheat the current situation is riskier than free trade and large deficits are incurred to support producer prices and to subsidize consumers. The inefficiencies caused by the band rule proposal are larger than the value attributable to the reduction of risk;

e) for soybeans, the risk cost of free trade is smaller than the efficiency gain in the beans market. The 25 percent band rule has no effect upon instability compared to the free trade situation;

f) the results for cotton indicate that free trade will increase risk. Even though no calculations of the inefficiencies associated with current policies have been made (because of the strong implications for trade flows), other studies (Brandao and Carvalho, op. cit.) indicate that they are large.

The second general conclusion that comes out of this study is that the risk reduction welfare gains from price stabilization are unlikely to be large, in general, relative to the welfare gains from price reform, and that, in a number of cases, the transfer (dis) benefit outweighs the risk benefi .o producers.

Even though multi-market models (apart from the simplified soybean complex model) have not been discussed here, we concluded, based on the results of our study (Braverman, et. al., 1990), that they do not have quantitatively significant effects on the single market results, so far as stabilization is concerned. However, as is to be expected from the earlier work of Braverman, Hammer and Associates, multi-market interactions do affect average outcomes significantly.

To conclude the paper, we would like to emphasize the need for additional research into the macroeconomic implications of price stabilization policies. From the point of view of policy makers, those are rather important issues, specially in countries facing unstable but moderate rates of inflation and in which agricultural expenditures constitute a large proportion of the government budget.

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APPENDIX

ELASTICITIES

	Supply	Demand
Edible Beans	0.36	0.50
Corn	0.36	0.50
Rice	0.37	0.28
Cotton	1.10	2.80
Wheat	0.55	0.47
Soybeans	1.18	0.24
Soy oil	-	0.20
Soy meal	-	1.50

Source: Elasticities obtained from various studies. For details see Braverman et al, 1990.

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