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How Does Economic Development and Import Dependency Affect Agricultural Price Protection? A Pooled Cross-Country and Time-Series Analysis for the Wheat Sector

by

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How Does Economic Development and Import Dependency Affect Agricultural Price Protection? A Pooled Cross-Country and Time-Series Analysis for the Wheat Sector

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Abstract

This article analyzes determinants of agricultural price protection for one important food, wheat, in a pooled cross-country and time-series analysis. For the aggregate sample it is shown that wheat price protection increases with a rising level of economic development and with a growing import dependency in wheat. Beyond this general pattern, the paper shows that the variation in wheat price protection can be significantly better explained if qualitative variables are introduced additionally into the model. For example, in Japan, in the Northern countries and during the commodity price boom (1973-75), wheat price protection followed a specific pattern. Income elasticities and import-dependency elasticities of wheat price protection are computed for all countries in 1968-80, and additionally for various sub-regions and sub-periods.

Introduction

There is a growing interest in the measurement of the levels, the determinants and the costs of agricultural protection within cross-country analyses [Anderson/Hayami (1986), Honma/Hayami (1986), Kerr (1985), World Bank (1986), FAO (1987), OECD (1987)]. On the determinants of agricultural protection, econometric evidence from cross-country studies is available for total agricultural protection in selected country groups. Results are provided for Asia in Anderson/Hayami (1986) and for industrialized countries in Honma/Hayami (1986). Two other studies refer to a broader country sample including developed and developing countries [de Haen/Schäfer (1987), Balisacan/Roumasset (1987)]. Their results indicate a less satisfactory explanation of the cross-country variation in protection levels when both industrialized and less-developed countries are taken into account[1].

This study extends the discussion on the determinants of agricultural protection in two major respects:

1. The studies cited above are not related to individual agricultural products. A product-specific approach seems necessary, however, as protection varies considerably between agricultural products [World Bank (1986), OECD (1987a)]. An aggregate approach for total agriculture obscures these differences. This article tries to elaborate major determinants of agricultural price protection for one important agricultural product - wheat. Although several studies are available which measure wheat price protection in various countries [e.g., Bigman (1985, pp. 101 et seq.), Byerlee/Sain (1986)], none of them estimates econometrically the determinants of wheat price protection across countries.

2. The influence of economic development and import dependency on price protection is elaborated in more detail than in earlier studies. Quantitative approaches have ignored these determinants totally [Anderson/Hayami (1986), Honma/Hayami (1986)]

or partly [Balisacan/Roumasset (1986)] or have measured their influence in an aggregate number within a cross-country study for one specific year [de Haen/Schäfer (1987)]. In this paper, a pooled cross-country and time-series approach is used. This allows it to analyze the impacts of economic development and import dependency not only on levels of protection across countries but also over time. As the uniformity of the regression coefficients is additionally tested by slope-dummy variables, it is also possible to detect region-specific and period-specific differences in these impacts.

It will be shown that a fairly high share of the cross-country variation in wheat price protection can be explained. This holds true not only for a country sample of industrialized countries but also for the total sample, including both developed and developing countries. An important reason for this result is that a more extensive use is made of qualitative independent variables than in former studies.

The paper is organized as follows. Section 1 explains the theoretical model and the measurement of the variables entering the model. The hypotheses will be put forward that price protection increases with a rising level of economic development and with a decreasing level of self-sufficiency for wheat. These hypotheses are tested in Section 2 on the basis of a pooled cross-country and time-series approach for 38 wheat-importing countries in the period 1968-80. The results indicate that the estimated regression coefficients are not constant across countries or between sub-periods. Therefore, the empirical analysis is extended in Section 3 by introducing structural differences in the protection pattern between countries and sub-periods by various intercept-dummy and slope-dummy variables. Elasticities of wheat price protection with respect to per-capita income and wheat import dependency are derived for various countries, country groups and sub-periods. Finally, conclusions for further research are drawn and major results are summarized.

1 Hypotheses and Data

The basic theoretical model rests on two hypotheses:

1. Wheat price protection rises with an increasing level of economic development as indicated by GDP per capita. The reason is that a rich country is more likely to be in a position to ignore the economic advantages which the international division of labor provides and to protect the agricultural sector from international competition. It is expected that this argument holds not only true for agriculture as a whole, but also for the wheat sector.
2. Nearly all countries stress the self-sufficiency goal for foodcrops. It is expected here that the wheat sector will be protected more the lower the degree of self-sufficiency in wheat or the higher the degree of import dependency in wheat. One reason for this hypothesis is that the self-sufficiency goal might become more important for policy makers when import dependency is particularly high. A second reason is that a given level of price protection is cheaper to realize for the government, ceteris paribus, when the self-sufficiency ratio is low than when it is high.

Formally, this implies that the following basic model is formulated:

$$(1) \quad PR = f(GDPC, IMPDEP)$$

with $\frac{\partial PR}{\partial GDPC} > 0$ and $\frac{\partial PR}{\partial IMPDEP} > 0$.

PR indicates wheat price protection, GDPC is GDP per capita and IMPDEP is import dependency in wheat. PR is measured with nominal protection coefficients for wheat, i.e. as the ratio between domestic wheat prices and border prices for wheat. The data on nominal protection coefficients are corrected for transport costs and are taken from Bigman (1985). GDP per capita is used as an indicator for economic development. It is widely acknowledged in the literature [Gilbert/Kravis (1954), Kravis/Heston/Summers (1978)] that official exchange rates are inappropriate as a basis

for international income comparisons. Hence, real GDP data based on purchasing-power parities are used from the International Comparison Project [Summers/Heston (1984)]. Import dependency is defined as the percentage share of wheat imports in wheat consumption. Wheat consumption is defined as the sum of wheat production and wheat imports. An unlagged import-dependency variable would create simultaneity problems in the basic model. This is because wheat imports and wheat production can be expected to change with varying wheat price protection levels. Therefore, import dependency is specified as a one-year lagged variable. It can then be regarded as a truly exogenous variable in the model. Data for wheat imports and wheat production are taken from the FAO Trade and Production Yearbooks. All the unlagged variables are available for the period 1968-80 and the lagged variable for 1967-79. The country sample includes 38 wheat-importing countries[2], both developed and developing.

In a first step, the basic model will be estimated on the basis of the pooled cross-country and time-series data set for all countries as well as for all industrialized and all developing countries. Separate estimates will be carried out for the subperiods 1968-72 and 1976-80, i.e. periods excluding the phase of a commodity price boom in the world market (1973-75).

2 Empirical Evidence on the Influence of Income and Import Dependency on Wheat Price Protection

Table 1 indicates how the level of economic development and import dependency in wheat affected wheat price protection[3]. The major results are as follows:

1. In the period 1968-80, both hypotheses of the theoretical model are clearly confirmed. Wheat price protection increases with a rising level of economic development and with a growing import dependency in wheat. This holds true for the whole sample of 38 wheat-importing countries as well as for the industrialized and the developing countries within this sample.

Table 1: The Influence of Income and Import Dependency in Wheat on Wheat Price Protection, 38 Countries, 1968-80[a]

Country Sample/ Period	Determinants of Wheat Price Protection			Test Statistics		
	Intercept	GDP per Capita (PPP-corrected)	Import Dependency (Lagged)	$\bar{R}^2$	F	DF
All countries:						
1968-80:	62.891***	0.01460***	0.545***	0.22	67.63	458
	(10.13)	(9.90)	(8.08)			
		((0.31))	((0.20))			
1968-72:	97.207***	0.01056***	0.394***	0.20	23.93	184
	(14.48)	(5.53)	(4.91)			
		((0.17))	((0.13))			
1976-80:	25.195	0.02388***	0.829***	0.36	46.30	157
	(1.93)	(8.77)	(6.35)			
		((0.52))	((0.30))			
Industrialized countries:						
1968-80:	-4.939	0.026180***	0.935***	0.35	39.23	138
	(-0.19)	(5.12)	(7.03)			
		((0.84))	((0.19))			
1968-72:	3.964	0.03154***	0.640***	0.58	37.74	52
	(0.18)	(6.32)	(5.32)			
		((0.85))	((0.13))			
1976-80:	-51.428	0.03427**	1.404***	0.43	20.33	50
	(-0.87)	(3.20)	(5.38)			
		((1.05))	((0.24))			
Developing countries:						
1968-80:	86.907***	0.00663**	0.316***	0.07	12.51	317
	(13.51)	(2.60)	(4.30)			
		((0.10))	((0.15))			
1968-72:	128.80***	-0.01062**	0.304***	0.11	9.44	129
	(17.02)	(-2.75)	(3.45)			
		((-0.11))	((0.12))			
1976-80:	56.92***	0.02264***	0.360**	0.26	19.39	104
	(4.62)	(5.80)	(2.75)			
		((0.39))	((0.17))			

***,**,* Statistically different from zero at the 0.1%, 1%, 5% level of significance.

[a] Wheat price protection is measured with the nominal protection coefficient (in %), GDP-per-capita data are taken from the International Comparison Project (Summers/Heston 1984) and measured in $ per capita. Import dependency is defined as the percentage share of wheat imports in the sum of wheat production and imports. The import-dependency variable is introduced with a one-year lag. Values in one parenthesis are t-values. Values in two parentheses are elasticities, evaluated at mean values. $\bar{R}^2$ is the corrected coefficient of determination, F is the F-value and DF indicates the degrees of freedom.

Source: Own computations on the basis of data from Bigman (1985); FAO, FAO Production Yearbook. Rome, various years; FAO, FAO Trade Yearbook. Rome, various years; Summers/Heston (1984).

2. For the total sample of 38 countries, an increase in the PPP-corrected GDP per capita by 100$ raised the nominal coefficients of wheat price protection by 1.46 percentage points. An increase in the import dependency in wheat by one percentage point led to a rise in the nominal coefficient of wheat price protection by 0.55 percentage points. The regression coefficients are clearly higher in the second sub-period, 1976-80, than in the first sub-period, 1968-72. This means that the influence of economic development and import dependency in wheat on wheat price protection became stronger over time.

3. The regression coefficients for the industrialized countries have the same sign and are also significantly different from zero, but are higher than those for the total sample. For example, an increase in the PPP-corrected GDP per capita by 100$ raised wheat price protection by 2.6 percentage points. Analogously, a rise in the import dependency in wheat by one percentage point caused a 0.935 percentage-point increase in wheat price protection. It is striking that the influence of the import status became stronger over time.

4. Developing countries with a higher real GDP per capita tended to have also a higher nominal protection for wheat than others with a lower GDP per capita. However, this statement is only valid for the whole period 1968-80 and for the second sub-period (1976-80). In the first subperiod, 1968-72, poorer developing countries still supported their wheat producers more strongly than richer developing countries. In any case, the income effect on wheat price protection is clearly smaller than for industrialized countries. There is a positive relationship between import dependency in wheat and wheat price protection in developing countries just as in industrialized countries. The impact arising from the import status, however, is again smaller in developing countries.

5. Interesting additional information on the influence of economic development and import dependency in wheat is available through the calculation of wheat price protection elasticities. A wheat price protection elasticity measures the percentage change in price protection caused by a one percent change in an exogenous variable. Such elasticities, evaluated at the mean values of the variables, are provided in Table 1 in two parentheses under the regression coefficients. Both the income elasticity and the import-dependency elasticity of wheat price protection are positive but relatively low. With one exception - the income elasticity in 1976-80 for industrialized countries - the point estimates indicate an inelastic reaction of protection levels. For 1968-80 and the total sample of 38 wheat-importing countries, the income elasticity of wheat price protection is 0.31 and the import-dependency elasticity is 0.20. The import dependency elasticities are of the same order in industrialized and developing countries. However, the income elasticity of wheat price protection is clearly higher in industrialized than in developing countries: 0.84 as opposed to 0.10 in the period 1968-80.

The overall performance of the basic model is satisfactory with respect to the t- and F-statistics. The basic hypotheses are confirmed and in one case rejected at high levels of statistical significance. However, the model yields unsatisfactory $\bar{R}^2$ values, especially for developing countries and all countries. This suggests that the model suffers from an omitted-variables problem. Therefore, the basic model will be extended in order to take structural differences between countries and periods into account.

3 Empirical Evidence on the Influence of Income, Import Dependency and Structural Differences Between Countries and Periods on Wheat Price Protection

The following stylized facts on the differential agricultural price protection across countries are often stressed in the literature[4]:

1. Industrialized countries protect agricultural producers more strongly than developing countries.
2. Japan protects its agriculture more strongly than most other countries.
3. Northern countries like Norway, Finland or Switzerland protect their agricultural sectors more than most other countries.
4. The EC protects agriculture more than most other countries.
5. East Asian newly industrializing countries increased agricultural protection significantly with economic growth and now protect their sectors more than most other countries.

Moreover, it is well-known that world market prices for agriculture were boosted during the period of the commodity price boom, 1973-75, and followed an upward trend during the period under consideration. This leads to two additional hypotheses:

1. The particularly high denominator of the nominal protection coefficient in the years 1973-75 is responsible for an agricultural price protection being lower in the period of the commodity price boom 1973-75 than during the other years. This can be expected as most countries have decoupled producer prices from international prices and do not fix the nominal protection coefficient.

2. The trend factor in world agricultural prices is responsible for agricultural price protection being higher in the post-commodity boom period than in the pre-commodity boom period.

Some of these stylized facts have been confirmed for individual years in the empirical literature [FAO (1987), OECD (1987)]. It is tested here whether the stylized facts are valid after having introduced income and import dependency as major economic determinants of wheat price protection. Dummy variables are used in order to characterize structural differences in wheat price protection between regions and sub-periods. Usually, only intercept dummies are used[5]. However, this is an a-priori restriction that is not accepted here. Theoretically, it is possible that the influence of income and import dependency on wheat price protection differs among regions and among sub-periods. Therefore, structural differences are tested here by introducing intercept-dummy as well as slope-dummy variables[6]. Empirical results are summarized in Table 2.

First, equation 1 confirms the structural differences in wheat price protection between industrialized and developing countries as indicated in Table 1. The coefficients of the intercept dummy and the slope dummies for industrialized countries are significantly different from zero. An increase in the PPP-corrected GDP per capita by the same amount in industrialized and developing countries leads to a significantly stronger increase in the nominal protection coefficient of industrialized countries. Analogously, an increase in import dependency by one percentage point in both developing and industrialized countries causes a significantly stronger increase in wheat price protection in industrialized countries[7].

Many additional findings can be derived, however, if the groups "industrialized countries" and "developing countries" are further disaggregated and if various sub-periods of 1968-80 are distinguished. The variables D2 to D7 are introduced in a first step as intercept dummies. D2 characterizes Japan, D3 the Northern non-EC countries Norway, Finland and Switzerland, D4 the period of the commodity price boom (1973-75), D5 the Asian newly industrializing countries Korea, Singapore and Malaysia. D6 stands for the period 1976-80 and D7 for EC countries. It can be seen that these structural dummy variables lead to a significant improvement of

Table 2: The Influence of Income, Import Dependency and Structural Differences Between Countries and Periods on Wheat Price Protection, 38 Countries, 1968-80[a]

Determinants of Wheat Price Protection	Regression Equations 1	2	3	4
Intercept	86.907*** (11.91)	99.980*** (17.85)	113.762*** (15.72))	115.365*** (28.71)
Income	0.00663* (2.29)	0.00597** (2.97)	0.00109 (0.43)	
Import Dependency	0.316*** (3.79)	0.286*** (4.68)	0.254** (2.80)	0.275*** (4.93)
D1	-91.846*** (-4.16)			
D1 x Income	0.01955*** (3.85)			
D1 x Import Dependency	0.620*** (4.54)			
D2		155.073*** (10.75)	-337.836*** (-4.08)	
D2 x Income			0.103*** (6.04)	0.141*** (6.25)
D2 x Import Dependency			-[b]	-5.688*** (-4.74)
D3		62.426*** (5.90)	-13.474 (-0.26)	
D3 x Income			0.01602 (1.62)	0.01306*** (9.47)
D3 x Import Dependency			-0.03484 (-0.20)	
D4		-56.11*** (-10.57)	-42.360*** (-3.67)	-57.077*** (-11.74)
D4 x Income			-0.00530* (-1.75)	
D4 x Import Dependency			-0.04149 (-0.32)	
D5		31.534*** (3.83)	-7.136 (-0.37)	
D5 x Income			0.01973* (2.13)	0.01742*** (4.84)
D5 x Import Dependency			-[b]	
D6		-7.025 (-1.42)	-44.841*** (-4.02)	-37.560*** (-5.09)
D6 x Income			0.00842** (2.97)	0.00890*** (4.38)
D6 x Import Dependency			0.159 (1.30)	
D7		6.643 (0.76)	24.240 (0.81)	
D7 x Income			-0.00090 (-0.15)	0.00271* (2.10)
D7 x Import Dependency			-0.185 (-1.10)	
Test Statistics:				
$\bar{R}^2$	0.28	0.51	0.58	0.59
F	36.39	61.72	36.99	74.03
DF	455	452	442	451

***,**,* Statistically different from zero at the 0.1%, 1%, 10% level of significance.

[a] Wheat price protection, income and import dependency in wheat are defined and measured as in Table 1. $\bar{R}^2$, F and DF are also defined as in Table 1. Values in parentheses are t-values. D1 is a dummy variable indicating the country status: 1 - industrialized countries, 0 - less developed countries. The country list of the Development Assistance Committee of the OECD is used. D2 is the Japan dummy with 1 for Japan and 0 otherwise. D3 is the dummy variable for Northern non-EC countries with 1 for Norway, Finland and Switzerland and 0 otherwise. D4 is the dummy variable for the period of the commodity price boom with 1 for the years 1973, 1974 and 1975 and 0 in all other years. D5 is the dummy variable for Asian NICs with 1 for Korea, Singapore and Malaysia and 0 otherwise. D6 is a dummy variable for 1976-80 with 1 in this period and 0 in all other years. D7 is the EC dummy with 1 for France, FR Germany, Italy and the Netherlands in 1968-80, Ireland and the United Kingdom in 1974-80 and 0 for all other countries in the whole period under consideration. Of course, the income and import dependency variables refer to the respective region or period when they are combined with the variables D2 to D7. - [b] This variable had to be excluded as it was nearly perfectly correlated with another exogenous variable.

Source: See Table 1.

the econometric results. In equation (2) of Table 2, where the dummy variables were taken into account, the $\bar{R}^2$ value more than doubles compared with the first equation in Table 1, where dummies were excluded. More than 50% of the variation in wheat price protection across countries and over time can be explained by income, import dependency in wheat and the intercept dummies D2 to D7 ($\bar{R}^2 = 0.51$). The following structural differences between periods and regions can be derived from the results of equation 2:

1. Apart from the general increase in wheat price protection with income and import dependency in wheat, there are remarkable differences in the levels of protection between regions and sub-periods.

2. Japan's protection level is significantly higher than in the other countries: by 155 percentage points.

3. Wheat price protection is significantly higher in the Northern countries Norway, Finland and Switzerland than in the other countries: by 62 percentage points.

4. During the period of the commodity price boom, 1973-75, wheat price protection was significantly lower than in the other years: by 56 percentage points.

5. In the Asian newly-industrializing countries Korea, Singapore and Malaysia, wheat price protection was significantly above that in the other countries: by 32 percentage points.

6. Wheat price protection was somewhat lower in the period 1976-80 than in the other years. It was somewhat higher in the EC than in the other countries. Both intercept dummies, however, were not statistically different from zero at the 10% level.

In equation (3) of Table 2, D2 to D7 are introduced additionally as slope-dummy variables. This is done in order to test whether the pattern, which governs the influence of income and import dependency on price protection, varies between regions and sub-periods. The comparison with equation (2) shows that the $\bar{R}^2$ value rises by more than 10% due to the introduction of the slope dummies: from 0.51 to 0.58. The regression coefficients of various slope dummies are significantly different from zero. This is especially the case when dummies were multiplied by the income variable. A problem with equation (3) is that it obviously suffers from multicollinearity problems. There is a fairly high coefficient of determination, given cross-sectional standards, but more than 10 regression coefficients are not statistically different from zero. Therefore, a stepwise regression procedure is utilized in equation (4). Only those independent variables from equation (3) are considered which contribute most to the explanation of the variation in wheat protection levels. The regression coefficients of all included variables are statistically different from zero at least at the 90% level. The following findings are striking:

1. Equation (4) explains about 60% of the variation in protection levels across countries and over time. This is a relatively high share given a sample that includes both developed and developing countries. Four variables alone explain 52% of the variation in protection levels: the dummy variable characterizing the commodity price boom (D4), and the slope dummy variables for Japan, the Northern non-EC countries and the Asian NICs, combined with the respective income variables (D2 x INCOME, D3 x INCOME, D5 x INCOME).

2. In each identified country group wheat price protection depends to a different extent on income. Generally, wheat price protection increases significantly with income in Japan, in the Northern non-EC countries, in the Asian newly-industrialized countries and in the EC. An increase in the PPP-corrected GDP by 100$ leads to the strongest rise in the nominal protection coefficient in Japan (by 14.1 percentage

points), followed by the Asian NICs (1.7 percentage points), the Northern non-EC countries (1.3 percentage points) and the EC countries (0.3 percentage points). If we compare these coefficients with the aggregate coefficient for all countries in Table 1, it can be seen that wheat price protection rose faster with income in Japan, in the Asian NICs and the Northern non-EC countries.

3. The slope dummies, which were combined with the import-dependency variable, proved to be significant in only one case: in Japan, a lower import dependency was followed by a higher protection level in wheat. This is contrary to the positive overall influence of import dependency on wheat price protection. In the other regions and in the sub-periods characterized by D3 to D7, no statistically significant deviation from the general pattern occurred.

Two more general and indicative conclusions can be drawn from the equations (3) and (4):

1. Wheat price protection is dependent on income not only across a broad country sample but also for individual countries and small country groups over time. The intensity of this relationship varies across countries and country groups.

2. The level of wheat price protection depends on the import dependency in wheat more from a cross-country point of view than over time for individual countries and small country groups. Across all countries, a clearly positive influence of import dependency on price protection could be established. For individual countries and small country groups, however, the regression coefficients of the respective slope dummies were negative, only being statistically significant for Japan. This indicates that the positive influence arising from import dependency on wheat price protection is weaker or does not exist at all at the country level. It seems that cross-country

differences in import dependency, and not changes in self-sufficiency over time, drive the overall positive coefficient.

The pattern of wheat price protection which has been highlighted is basically confirmed by separate results for the industrialized and the developing countries. Selected econometric estimates are presented in Table 3. Equations (1) and (3) take all relevant intercept and slope dummies into account, equations (2) and (4) only those which contribute the most to the explanation of the cross-country variation in protection. In equations (2) and (4), only those variables are included whose parameters are at least at the 95% level significantly different from zero. The following additional results can be derived from Table 3:

1. The explanation of the variation in wheat price protection across countries and over time is much more satisfactory for industrialized than for developing countries. More than 80% of the variation in protection levels among industrialized countries can be explained by equation (2). This share is extraordinarily high for cross-sectional analyses. Three variables alone explain some 70% of the variation in wheat price protection:
   - the intercept dummy for the period of the commodity price boom (D4), and
   - the slope dummies for Japan and the Northern non-EC countries, combined with the respective income variables (D2 x INCOME, D3 x INCOME).

   Again, it is striking that various slope dummies reveal significant differences in the regression coefficients between regions and between sub-periods. Wheat price protection within industrialized countries depends to a different extent on income and import dependency across countries and over time. For developing countries, only 39% of the variation in protection levels can be explained by equation (4). The relative-

Table 3: The Influence of Income, Import Dependency and Structural Differences Between Countries and Periods on Wheat Price Protection in Industrialized and Developing Countries, 1968-80[a]

Determinants of Wheat Price Protection	Regression Results for Industrialized Countries		Developing Countries	
	Equation (1)	Equation (2)	Equation (3)	Equation (4)
Intercept	67.735* (2.43)	107.881*** (13.42)	137.357*** (13.37)	121.629*** (21.96)
Income	0.00729 (1.02)		-0.01600 (-1.86)	
Import Dependency	0.527* (1.80)		0.171 (1.47)	0.208** (3.03)
D2	-376.496*** (-4.40)			
D2 x Income	0.113*** (6.22)	0.137*** (6.20)		
D2 x Import Dependency	-[b]	-5.070*** (-4.37)		
D3	-22.858 (-0.44)			
D3 x Income	0.02244* (2.18)	0.01885*** (9.77)		
D3 x Import Dependency	-0.242 (-0.79)			
D4	-19.095 (-0.45)	-79.731*** (-9.47)	-74.024*** (-5.23)	-50.009*** (-8.96)
D4 x Income	-0.01096 (-1.24)		0.01168* (1.90)	
D4 x Import Dependency	-0.416* (-2.02)		0.121 (0.77)	
D5			19.248 (0.88)	
D5 x Income			0.01021 (1.08)	0.01817*** (4.65)
D5 x Import Dependency			-[b]	
D6	-55.872 (-1.44)	-97.993*** (-3.42)	-65.397*** (-4.97)	-56.449*** (-6.53)
D6 x Income	0.00546 (0.69)	0.01308* (2.52)	0.02952*** (5.49)	0.02289*** (6.65)
D6 x Import Dependency	0.115 (0.54)	0.389** (2.86)	0.01383 (0.09)	
D7	46.74*** (3.55)	45.537*** (4.87)		
D7 x Income	-[b]			
D7 x Import Dependency	-0.277 (0.86)			
D8			-19.997* (-1.55)	-11.855* (-2.28)
D8 x Income			0.00651 (0.96)	
D8 x Import Dependency			-0.01975 (-0.13)	
Test Statistics:				
$\bar{R}^2$	0.79	0.79	0.36	0.36
F	37.12	68.54	14.60	30.61
DF	125	132	306	313

***,**,* Statistically different from zero at the 0.1%, 1%, 10% level of significance.

[a] Wheat price protection, income and import dependency in wheat are defined as in Table 1. $\bar{R}^2$, F and DF are also defined as in Table 1. Values in parentheses are t-values. On the definitions of D2 to D7, see Table 2. D8 distinguishes "typical" from "untypical" developing countries. Untypical developing countries (D8=1) are oil-exporting high income and upper-middle income developing countries according to the World Bank Classification. Typical developing countries (D8=0) are those ranking below upper-middle income developing countries. - [b] This variable had to be excluded as it was nearly perfectly correlated with another exogenous variable.

Source: See Table 1.

ly weaker results for developing countries are consistent with earlier findings of other authors. Even in the sample of developing countries, however, several statistically significant coefficients show that income, import dependency and structural differences between countries and periods are important for the explanation of differing wheat price protection levels.

2. Two interesting additional findings refer to differences between 1976-80 and the earlier years. Equation (2) shows that wheat price protection in industrialized countries was affected by import dependency significantly more strongly in 1976-80 than in the rest of the period. One possible explanation for this is that self-sufficiency arguments might have become stronger over time as a determinant of wheat price protection in industrialized countries. Equation (4) reveals that wheat price protection in developing countries became significantly more dependent on income compared with the earlier years. Protection rose particularly strongly in the periods 1976-80 with an increase in PPP-corrected GDP per capita.

3. It has already been shown in Table 1 that wheat price protection in developing countries increased in the period 1968-80 with a rising income. Equation (4) allows some conclusions why this is so. A first explanation is that increases in income in the sub-period 1976-80 caused a higher wheat price protection. A second explanation is indicated by the fact that the regression coefficient of the variable (D5 X INCOME) is positive and significantly different from zero. This shows that the influence of income has been clearly higher in Asian newly-industrializing countries than in other developing countries. It can be concluded that the overall positive income elasticity of wheat price protection in developing countries is mainly due to two reasons:
   - that income became more important over time as a determinant of wheat price protection;
   - that income played an important role for protection in Asian newly-industrializing countries.

The quantitative results on the impacts of income and import dependency in wheat on price protection are conveniently summarized as elasticity coefficients in Table 4. For all countries in the period 1968-80 and for various disaggregations with respect to countries and time[8], it is shown how a 1% change in the PPP-corrected GDP per capita (import dependency in wheat) affects the nominal protection coefficient for wheat in percentage terms. The following main results can be summarized:

1. In nearly all cases, the elasticities of wheat price protection are positive as expected. Exceptions are the developing countries in 1968-72, with a negative income elasticity of price protection, and Japan, with a consistently negative import-dependency elasticity of price protection.

2. The magnitude of the expected elasticity coefficients differs clearly between countries and between sub-periods. The income elasticity of the nominal protection coefficient for wheat is the highest in Japan, and only for Japan is this elasticity coefficient above unity. The income elasticity is in all periods higher for industrialized than for developing countries and higher in Northern non-EC countries than in the EC. Within developing countries, it is higher for Asian NICs than for the other countries. The income elasticity of the nominal protection coefficient is generally higher in the period of the commodity price boom than in the other years.

3. The import-dependency elasticities vary less between countries and between periods than the income elasticities of protection[9]. For those country groups with a positive import-dependency elasticity, the coefficient is in no case higher than 0.3.

Note that the magnitude of the elasticity will become higher in absolute terms if price protection is measured by the nominal rate of protection instead of the nominal protection coefficient[10]. The reason is that the regression coefficient in the linear model will remain constant, but the mean value of protection in the denominator of the elasticity coefficient will fall by 100.

Table 4: Income and Import Dependency Elasticities of Nominal Protection Coefficients for Wheat, 38 Countries, 1968-80[a]

Period/Country or Country Group	Income Elasticity of Wheat Price Protection	Import Dependency Elasticity of Wheat Price Protection
Period 1968-80:		
All countries:	0.31	0.20
Industrialized countries:	0.84	0.19
Developing countries:	0.10	0.15
Period 1968-72:		
All countries:	0.17	0.13
Industrialized countries:	0.85	0.13
Developing countries:	-0.11	0.12
Japan:	2.36	-1.82
Northern countries:	0.31	0.06
Asian NICs:	0.17	0.12
EC countries:	0.08	0.02
Period of 1973-75 (commodity price boom):		
All countries:	0.24	0.26
Industrialized countries:	0.91	0.15
Developing countries:	0.04[b]	0.30
Japan:	4.06	-2.91
Northern countries:	0.61	0.09
Asian NICs:	0.28	0.16
EC countries:	0.16	0.06
Period 1976-80:		
All countries:	0.52	0.30
Industrialized countries:	1.05	0.24
Developing countries:	0.39	0.17
Japan:	1.95	-1.04
Northern countries:	0.61	0.06
Asian NICs:	0.57	0.12
EC countries:	0.47	0.04

[a] The income and import dependency elasticities are evaluated at mean values. They are taken or derived from Tables 1 to 3 and footnote 8 in the text. For the definitions of wheat price protection, income and import dependency in wheat, see Table 1. On the country sample and the country groups used here, see Table 2 and footnote 2 in the text. The elasticities for all countries, all industrialized and all developing countries are taken from Table 1 and are calculated for 1973-75 from the equations in footnote 8 in the text. The elasticities for Japan are calculated from equation 2 in Table 3. The elasticities for the Northern non-EC countries and the EC countries are computed from equation 4 in Table 2. The elasticities for the Asian NICs are calculated from equation 4 in Table 3. - [b] The underlying regression coefficient is not statistically different from zero.

Source: Own computations.

4 Conclusions for Future Research

This paper has addressed specific questions within the much broader discussion on the levels and determinants of agricultural protection. It will be a task for future research to extend the findings of this paper:

1. In this contribution, only some determinants of agricultural price protection were considered. The level of development, the import status and structural differences between regions and periods were stressed as important determinants of the international pattern of protection. Anderson/Hayami (1986) and Honma/Hayami (1986) have examined other determinants. They have argued that the comparative advantage of agriculture, the share of agriculture in the national economy and the terms of trade between agriculture and industry are important determinants of agricultural protection. A relatively high share of the variation in the levels of protection were explained here and in the papers of Anderson/Hayami and Honma/Hayami. Therefore, it seems promising to combine these variables in order to test comprehensively for the major determinants of protection. Of course, some problems of data availability and estimation have to be solved in such a comprehensive approach[11].

2. The pattern of price protection across countries and over time could be explained for other agricultural markets. A procedure along the lines of this paper or an extended approach could be adopted.

3. There is an important discussion on the appropriate measure of agricultural protection[12]. This branch of the literature has not been touched here. It remains to be worked out how the influence of income and import dependency on protection depends on the measure of protection used.

4. Recent empirical evidence suggests that the major impact on the agricultural sector in developing countries stems from general economic policy rather than agricultural price policy [Krueger (1988), Krueger/Schiff/Valdés (1988), Schiff (1988)]. Therefore, a comprehensive approach to examining agricultural price protection or discrimination would have to include indirect as well as direct agricultural policies.

Summary

This article has quantitatively analyzed determinants of agricultural price protection for one important product, wheat. A pooled cross-country and time-series analysis for 38 wheat-importing countries in the period 1968-80 has been carried out. Major results are:

1. The level of economic development, the import dependency in wheat and structural differences between countries and regions are important determinants of the level of wheat price protection.

2. Wheat price protection increased for the aggregate sample with a rising PPP-corrected GDP per capita and with a growing import dependency in wheat. This general pattern is also valid for most sub-samples.

3. The income elasticity of wheat price protection differs clearly between countries and sub-periods. This, to a lesser extent, also holds true for the import-dependency elasticity of wheat price protection. The income elasticity of wheat price protection is clearly higher for industrialized than for developing countries. It is highest in Japan and higher in Northern non-EC countries than in the EC. If protection is measured with the nominal protection coefficient, the income elasticity of wheat price protection is below unity both for the total sample and in all sub-samples except Japan.

4. The extensive use of qualitative independent variables provides a promising tool for measuring structural differences in the international pattern of protection. They have been introduced here as intercept-dummy and slope-dummy variables. By this means, it can be tested for differences in the regression coefficients across countries and over time within a single econometric model. The approach presented here can be fruitfully applied in future studies of the determinants of agricultural protection.

Notes

1 de Haen/Schäfer (1987) report that their estimates yield no statistically significant results when they exclude the industrialized countries.

2 The countries included are: Algeria, Bangladesh, Brazil, Chile, Colombia, Egypt, India, Iran, Iraq, Korea, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Sri Lanka, Tunisia, Turkey, Venezuela, Yemen A.R., France, F.R. Germany, Italy, the Netherlands, Ireland, United Kingdom, Finland, Hungary, Norway, Portugal, Switzerland, Yugoslavia, Israel, Japan, Saudi Arabia, Singapore.

3 A linear model specification is used throughout this paper as the linear model outperformed a loglinear one in nearly each case. For all countries in 1968-80, e.g., the estimated regression equation for the determinants of wheat price protection is in the loglinear case:

$$\ln PR = \underset{(-4.55)}{-0.94749***} + \underset{(4.35)}{0.11251***} \ln INCOME + \underset{(3.64)}{0.06700***} \ln IMPORT\ DEPENDENCY$$

$(\bar{R}^2 = 0.07;\quad F = 15.73;\quad DF = 412)$

The variables and the test statistics are defined in Table 1. *** indicates the 0.1% level of statistical significance. It can be seen that the $\bar{R}^2$, F and t statistics worsen compared with the corresponding linear equation in Table 1. The elasticity coefficients have the same sign in both specifications of the model, but are slightly smaller in the loglinear model.

4 There are several studies available dealing with the particular hypotheses in more detail. Peterson (1979) argues that industrialized countries protect agricultural producers more than developing countries. Agricultural protectionism in Japan is comprehensively surveyed in Fitchett (1988). On agricultural protection in the Northern countries, see OECD (1987a) within an international perspective. The OECD (1987b) and the Bureau of Agricultural Economics (1985) deal with agricultural protection in the EC, and Anderson/Hayami/Honma (1986) discuss agricultural protection in East Asia over time and in the context of an international comparison.

5 Honma/Hayami (1986), e.g., include various intercept dummies in their explanation of the structure of agricultural protection in industrialized countries, but no slope dummies. They report in footnote 8 that experiments with slope dummies were not successful.

6 This procedure is also superior to the Chow test in order to test for structural differences within a pooled regression model. Only one regression is needed, a variety of hypotheses can be tested with it, and the source of structural differences is clearly shown. See Gujarati (1988), section 14.8.

7 Note that the results from equation 1 in Table 2 are consistent with those shown for the same period in Table 1. If one adds the coefficient of the slope dummy, (D1 x INCOME), to the coefficient of the income variable, this yields 0.02618 (-0.00635 + 0.01983). This is precisely the regression coefficient of the income variable in Table 1 for industrialized countries in the period 1968-80.

8 Additionally to the conclusions of Table 1, regression equations had to be estimated for the period of the commodity price boom (1973-75). The result is for all countries:

$$PR = \underset{(5.89)}{42.519***} + \underset{(4.51)}{0.00793***}\ INCOME + \underset{(6.06)}{0.469***}\ IMPORT\ DEPENDENCY$$

($\bar{R}^2 = 0.28$; $F = 23.12$; $DF = 111$)

The estimated regression equation for the industrialized countries is:

$$PR = \underset{(-0.28)}{-6.606} + \underset{(3.81)}{0.01794***}\ INCOME + \underset{(4.88)}{0.503***}\ IMPORT\ DEPENDENCY$$

($\bar{R}^2 = 0.57$; $F = 19.81$; $DF = 30$)

For the developing countries, the following regression was run:

$$PR = \underset{(5.56)}{53.519***} + \underset{(0.56)}{0.00211}\ INCOME + \underset{(4.19)}{0.441***}\ IMPORT\ DEPENDENCY$$

($\bar{R}^2 = 0.16$; $F = 8.81$; $DF = 78$)

The variables and the test statistics are defined as in Table 1. *** indicates the 0.1% level of statistical significance.

9 Note that these elasticities may differ between groups and between periods although the regression coefficients in Table 2, which characterize the influence of import dependency on protection, do not. The reason is that the elasticities are also affected by the mean values of the dependent and independent variables.

10 Balisacan/Roumasset (1987, p. 238) calculate an income elasticity of 3.23 for agricultural price protection in a cross-country analysis for 68 market economies. This finding is not necessarily inconsistent with those in Table 4, as Balisacan/Roumasset use the nominal rate of protection and we utilize the nominal protection coefficient. This will necessarily lead to a different elasticity. The reason is as follows: The regression coefficient in the linear model ($\partial PR/\partial GDPC$) will remain unchanged when the nominal rate of protection is used as dependent variable instead of the nominal protection coefficient. However, the mean value of the protection measure is also needed in order to calculate the income elasticity of protection. The mean value of the nominal rate of protection is by 1 lower than the mean value of the nominal protection coefficient or by 100 if both measures are expressed in percentage terms. Therefore, the income elasticity of price protection

$$\left(\frac{\partial PR}{\partial GDPC} \Big/ \frac{GDPC}{PR} \right)$$

is clearly higher when the nominal rate of protection instead of the nominal protection coefficient is used.

11 Several explanatory variables in the approach of Anderson/Hayami (1986) and Honma/Hayami (1986) are not readily available as time series. Hence, it is difficult to include them in a pooled time-series and cross-country analysis. In order to test for many determinants simultaneously, pooling seems necessary to get sufficient degrees of freedom. A joint introduction of all important determinants of protection will also cause severe multicollinearity problems. This is at least so when structural differences between countries and periods are modelled along the lines of this paper.

12 Seminal contributions on the measurement of protection include Balassa and Associates (1971) and Corden (1971). On the measurement of the protective impact of non-price interventions, see Deardorff/Stern (1984). The measurement of agricultural protection is discussed in Scandizzo/Bruce (1980) and Tangermann/Josling (1988).

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