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POLICY RESEARCH WORKING PAPER 1778

How Government Policies Affect the Relationship between Polish and World Wheat Prices

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Government intervention is the main reason for the low correlation between cash prices for Polish wheat and wheat futures prices in Chicago and London. Polish government policies reduce incentives for Poland's private sector to use existing wheat futures contracts in foreign exchanges to hedge against price risks and impede the development of a Polish wheat futures exchange.

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Summary findings

Cash prices for wheat in Poland are not closely related to futures prices in Chicago and London, for several reasons: differences in seasonality, fluctuations in exchange rate, poor dissemination of information in Poland, and most important the Polish government's intervention in wheat markets.

Polish wheat prices generally move to expected intervention prices (set by ARR, the agency for agricultural markets) and then stay there until the next intervention level becomes known. The exception was in 1994/95, when sharply higher world prices raised prices in Poland.

A wheat futures exchange in Poland could give the private sector a tool for hedging against price risk, improving efficiency and price discovery in Poland. It would be difficult to develop, however, under present interventionist policies. This situation could be improved by reducing the protection of prices and by making any intervention rules-based (reducing uncertainty about policies).

Should intervention be reduced or rationalized, the next question is whether Poland needs its own wheat futures exchange or whether Poland's private sector can use futures exchanges in London and Chicago to hedge against risk. The answer to that question is not an easy one.

This paper — a product of the Commodity Policy and Analysis Unit, International Economics Department — is part of a larger effort in the department to analyze commodity pricing policies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Jean Jacobson, room N5-026, telephone 202-473-3710, fax 202-522-3564, Internet address jjacobson@worldbank.org. June 1997. (35 pages)

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1. Introduction

Since 1990 when Poland began to introduce free market economy reforms, price volatility of agricultural commodities has become a major source of risk for agribusiness firms. At the same time, the Polish economy has been more open to international economic and trade linkages which have led to greater observed price convergence between certain Polish and Western commodities. Development of predictable price relationships might create opportunities for Polish firms or market institutions to use risk management tools such as derivatives that are available in Western markets. However, effective use of such risk management strategies depends heavily on the existence of a fairly stable price relationship between considered markets. In this sense, establishing whether a true economic relationship exists between Polish and Western prices is a fundamental question when considering the future development of Polish financial infrastructure.

In recent years there has been an explosion in the development of new contracts on existing exchanges and the interest in developing new exchanges in emerging economies. By 1997, it has been estimated that 18 developing countries will have active futures exchanges.[1] In addition to interest in establishing local exchanges, there is growing interest in countries without futures markets to use established contracts on existing Western exchanges. In 1991 the CFTC reported that more than 2100 traders from 96 countries used US futures and options markets.[2] In the agricultural commodity area, countries that have a strong price relationship between a particular commodity and the corresponding futures contract use existing contracts extensively for risk management purposes. A good example is the use of the Chicago Board of Trade (CBOT) soybean futures market by Argentine and Brazilian soybean exporters. The US, Brazil and Argentina all are extensive participants in world soybean export markets. This creates a linkage between prices in the three countries and this linkage creates hedging possibilities for South American exporters.

In the emerging markets of Central Europe there has been a growing awareness and increased interest in the use of derivatives as a risk management tool. Western exchanges are participating in this process and are contributing to the awareness and actual development of exchanges.[3] To date, active exchanges have developed in Hungary and Russia. Because of infrastructural problems, however, most of the contract liquidity is in financial contracts, especially foreign exchange contracts. With agricultural contracts, development is inhibited by the lack of support mechanisms such as warehouse receipt systems and a reliable physical cash market that includes forward cash contracts. In Poland there has been considerable interest in developing a futures market that would trade both agricultural and financial futures contracts. With the support of the CBOT, a Warsaw Commodity Exchange (WCE) has been established with the objective of developing futures contracts in Poland.[4]

The core issue for all countries or markets exploring the establishment of a new futures market is whether or not local physical cash markets have a strong price relationship to existing futures

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[1] "Futures, Futures Everywhere". *Business Week*, April 8, 1996.
[2] "Monthly Volume Report". *Futures Industry Organization*, December, 1991.
[3] "Despite Skid, Futures Exchanges Ready Emerging Markets Push". *Wall Street Journal"*, January 17, 1995.
[4] Grede, Frederick J. "CBOT to Assist in the Creation of Warsaw Commodity Exchange". *Financial Exchange*, December, 1994.

contracts. If a strong price correlation exists (as in the case of South American soybean prices and CBOT futures) local interests might be best served by trading an existing contract (assuming one exists). If a strong price correlation does not exist, the development of a contract based on local needs might be the best way to satisfy local price risk management interests. For example, the lack of price correlation between Malaysian palm oil markets and the CBOT soyoil futures contract has supported the development of palm oil futures on the Kuala Lumpur Commodity Exchange (KLCE). Similarly, the establishment of an exchange that would trade coffee futures is being considered in Indonesia as local prices often are moving in divergence to prices traded in coffee futures markets in New York and London.

The purpose of the study is to analyze relationships between Polish wheat cash prices and wheat futures prices in selected international futures markets. Specifically, it was assumed to be relevant to examine such relationships in reference to the wheat futures contracts traded at the CBOT and London International Financial Futures Exchange (LIFFE).[5] Establishing whether price relationships exist will determine whether or not viable price risk management programs can be developed by Polish entities engaged in buying and selling wheat using existing futures contracts. The answer to this question will have practical value to Polish businesses considering the use of futures markets. Moreover, this analysis has policy implications with regard to whether or not a futures exchange in Poland that has a wheat contract is needed. If the hypothesis is correct (that there is a price correlation) it suggests that hedging on existing exchanges of Polish wheat is possible. This does not preclude development of a local Polish wheat futures contract. In fact, a strong price correlation between Polish and world prices could support a new contract through arbitrage activities between markets. This is in fact the case in the US where the larger and much more liquid CBOT contract is arbitraged against the Minneapolis Grain Exchange and Kansas City Board of Trade contracts. In the near term, the main implication of a strong price correlation would be that Polish entities could immediately begin risk management practices using existing futures contracts. If the hypothesis is negative (no correlation) then Poland will need to consider alternatives other than existing futures contracts in developing price risk management strategies. If there is no price correlation, it will be important to establish what factors separate the Polish wheat economy from other international prices.

1.1. Wheat Price Series Selection

Within the US there are three exchanges that trade wheat futures contracts; the Minneapolis Grain Exchange (MGE), the Kansas City Board of Trade (KCBOT) and the CBOT. The MGE contract is Hard Red Spring wheat, a high protein wheat primarily grown in the northern plains region of the US.[6] The KCBOT contract is based on Hard Red Winter Wheat primarily grown in the central plains region. The CBOT contract is based on Soft Red Winter Wheat[7] grown primarily in the plains area east of the Mississippi River. Because of the high liquidity at the CBOT and the

[5] In September 1996, LIFFE merged with the London Commodity Exchange (LCE) which was trading the wheat futures contract.

[6] The MGE also trades a Western White Wheat contract however this contract is relatively low volume.

[7] Hard Red Spring Wheat and Hard Red Winter Wheat are also deliverable against the CBOT contract at certain price differentials.

delivery possibilities of other classes of wheat, the CBOT contract is considered more reflective of global wheat conditions. In addition, the class of wheat traded at the CBOT most closely resembles the type of wheat grown in Poland. For these reasons, the CBOT contract was chosen as the price to be used in this analysis. Outside the US, the most liquid wheat futures contract is the LIFFE wheat futures. This futures contract was also included in the analysis.[8]

The analysis was carried out over a period of 6 years, i.e., from 1990 to 1995. This period represents the time during which Poland experienced a liberalized economic structure. Despite the beginnings of a free market system, finding a representative price series in Poland to compare against futures prices is somewhat problematic. While several grain exchanges exist where physical cash wheat is traded, the volume of trade is erratic and quoted prices might not be representative of the overall market. In addition, most of these exchanges were created only recently, thereby limiting the time frame available for analysis. The Polish price series chosen for the analysis was average monthly wheat prices for Poland as reported by the Central Statistical Office (GUS). This price represents prices paid to farmers by commercial enterprises. Price analysis was conducted on both a calendar year and crop year (August-September) basis as both have some merit in terms of looking at impacts of various factors.

2. Wheat Price Variation in Poland in Years 1990-95

The first analytical task chosen was to gain insight into the price variation in Poland with respect to variation over time and spatially within Poland. The primary objective of examining variation over time was to gain insight into the degree of Polish price volatility. The basic methodology used was to quantify the spread of minimum and maximum prices and the coefficient of variation (standard deviation divided by average prices for each year).

The purpose of the spatial variation analysis was to determine if prices within Poland showed any significant variation between regions. This has implications from a risk management standpoint as large variations between regions would suggest that there are variations in the basis risk that individual firms might encounter. Measuring the spatial variation in prices also gives insight into the level of integration of the Polish wheat market. If the market is operating efficiently, there should be a relatively stable price relationship between regions in Poland. The general method of looking at spatial variation was to observe minimum and maximum prices for each month throughout the 49 voivodships of Poland and to create a ratio of maximum versus minimum prices.

2.1. Variation over Time

As is shown in Table 1, there is a great deal of variation observed over time in wheat prices in Poland. Prices tend to be very volatile especially in years of shortages when supply of wheat is considerably lower compared with average years. As can be seen in the Polish wheat balance table in Table 3, the 1992/93 and 1994/95 production years were characterized by low production due to drought and low ending inventories. These years correspond to greater than normal price volatility.

[8] As noted later in the paper, LIFFE wheat futures contract prices are influenced by the EU's agricultural policies (CAP) for grains.

When compared with prices on the CBOT and the LIFFE, Polish wheat prices exhibited strong changes in variation from year to year. For example, during the time period covered, price variation as measured by the coefficient of variation ranged from 4.2% to 27.7% in Poland while the coefficient of variation over the same period of time on the CBOT was 8.0% to 15.1%.
This price variability over time represents great price risk for those who operate on the Polish wheat market. It also indicates a need for using effective risk management tools. Clearly under such conditions alternatives such as hedging with derivatives that are already available in Western markets should be examined.

2.2. Spatial Variation

Figures in Table 2 show that based on measures of spatial variation of the wheat prices, considerable differences between voivodships can be observed. The main observations are as follows:

a) Price differentiation among the 49 voivodships is very high. This can only partly be explained by the cost of grain transportation which within Poland usually does not exceed roughly 8% to 10%[9] of the total value of the grain transported. The measured difference between the lowest and highest price for any one month is very often over 20% and in fact, the overall average price differential for the 1990-1995 period is 40%. This level of price difference would indicate that prices within Poland are not integrated to the degree that normal efficiencies would suggest.

b) Large differences in price levels could especially be observed in 1990. This is understandable as it was the first year of free market economy reforms in Poland, and different markets which started to develop showed very little stability.

c) During the whole period of analysis, 1990-95, the spatial variation of the wheat prices has been declining, although, it still remains very high. This declining trend might imply that there are some improvements in the market efficiency, but this process is not progressing well enough to assure for a quick spatial price adjustments.

d) Price levels in certain months differ much more than in some others; generally prices in winter months as well just before harvest time are more volatile than during and after the harvest time. There are, however, some exceptions depending on the particular year.

3. Basis Risk Analysis

Basis risk analysis refers to the risk associated with price risk management practices whereby a firm will hedge the physical cash price risk in a derivative futures market. For example, a firm that has purchased physical cash wheat will sell an equal and offsetting amount of futures contracts in an established futures exchange. This enables a firm to protect itself from potential price declines. If there is a strong price relationship between the physical cash market and the futures market, price changes in the physical cash market will be reflected in the futures market. In essence, the firm has shifted its risk of declining prices to the futures market (of course, the firm has also foregone the opportunity to benefit from price increases). This risk shifting process is one of the primary values

[9] Based on interviews with industry participants and transportation firms.

of a futures market. Of course, not all of the risk can be shifted as there is never a perfect relationship between cash and futures markets. There is always some *residual risk* associated with the hedging process. This residual risk (the price risk that can not be shifted to futures markets) is commonly referred to as the basis risk. Put another way, the basis risk is the price variation in the physical cash market that can not be explained by futures price variation. A low level of variation in the basis implies that there is a strong price relationship between cash and futures markets and viable risk management strategies can be devised. A high level of basis variation indicates that the relationship between the physical cash market and the futures market is not strong and that not enough risk can be shifted to make the hedging operation worthwhile. This section examines the basis relationship between Polish wheat prices and prices of wheat on the CBOT and LIFFE.

3.1. Relationships between Polish Wheat Cash Prices and CBOT and LIFFE Wheat Futures Prices

Ordinary least square regression was used to assess the correlation between cash prices in Poland and the corresponding futures prices on the CBOT and the LIFFE. The equation used is of the following form:

$$s(t) = a + b^* f(t)$$

where: s(t) is the cash price for wheat in Poland at time t, and f(t) is the futures price for wheat in CBOT or LIFFE at time t. We used three forms of the variables. First, the variables were expressed in levels. Second, the variables were deseasonalized to assess the impact of seasonality on the relationship between futures and cash prices. The deseasonalized prices were created by regressing each of the prices on twelve monthly dummies plus a time trend. The estimated residuals from that regression are the deseasonalized prices. Third, the variables were differenced.

The adjusted R squared can be viewed as one way of measuring the residual risk inherent in the basis.[10] That is, the adjusted R squared indicates the percentage of the variability in cash prices that is not explained by the futures prices. The percentage of the cash price changes that is unexplained (1-R squared) is an estimate of the basis risk. The higher the unexplained variability, the lower the value of the adjusted R squared (the higher the basis risk), and the lower the usefulness of the particular wheat futures contract in hedging Polish wheat cash price risks.

The estimation of the R squared using the regression analysis described above was performed for the overall period 1990 to 1995 and for each individual year. R squares were computed for both calendar and crop years.

3.1.1. Correlation of Prices in US Dollar Terms

Polish and LIFFE wheat prices were converted to US dollar equivalent prices. In addition to the correlations with prices in levels, the impact of seasonality on prices was assessed by using a deseasonalized data series as well as the first differences of the respective price series. Correlations

[10] See Labuszewski and Nyhoff (1988), and Smith, Smithson and Wilford (1989).

were for the full period, 1990-95, and for each individual year. Table 4 shows the result of Polish wheat prices against CBOT and LIFFE wheat prices. The results were most promising for the deseasonalized prices in 1993 (especially for the LIFFE prices) and for the 1993/94, 1994/1995 marketing years. While these results are more promising than the previous correlations, the results are still very inconsistent from one year to the next.

In general, there was poor correlation among the price series examined in this section. This could be explained by:

a) International and Polish wheat prices have increased over the past two years, generally rising above government support levels.
b) In the 1994/95 crop year Poland was a significant importer of wheat. This activity would create greater links between the Polish wheat market and international wheat markets.
c) Due to budgetary constraints, the ARR was less active in interventions in the Polish wheat market during the 1994 harvest. This apparently enabled Polish prices to better reflect conditions in the open market.

More data available only with the passage of time will be needed in order to asses whether this stronger positive correlation can be sustained.

3.1.2. Correlation of the Lagged Prices in US Dollar Terms

Tables 5 and 6 show the results of correlations of Polish wheat prices in US dollar terms lagged against CBOT and LIFFE (US dollar terms) prices. The lagging process improves the correlation results for CBOT futures prices, especially when prices are lagged three or four months. This suggests that there could be inefficiencies related to the transmission of information to the Polish grain markets. In other words, it takes up to three or four months for factors readily apparent to those trading at the CBOT to be fully discounted into the Polish wheat market. Lagging Polish wheat prices against LIFFE prices did not improve the correlation results.

3.1.3. Cointegration analysis of Polish and CBOT and LIFFE prices

Cointegration analysis indicates whether there is a stable long-term relationship between two (or more) price series. Thus, prices can show short-run deviations, but in the long-run they move together. We tested for pairwise cointegration between the Polish and CBOT prices and between the Polish and LIFFE prices. The test used is the ADF test and its results are shown below.[11]

	Polish-CBOT	Polish-LIFFE
Nominal Prices	-2.71	-2.23
Deseasonalized Prices	-2.65	-2.21

The ADF statistics are calculated for the period 1990 to 1995 using monthly data, for a total of 72 observations. The ADF statistics are below the 90% critical level (-2.84) thus the hypothesis of cointegration is rejected. This means that according to the ADF test and for the period tested,

[11] ADF is theAugmented Dickey Fuller test (see Dickey and Fuller, 1979).

Polish and CBOT and Polish and LIFFE prices do not move together in the long-run. In other words, there is not a stable long-run relationship between the wheat price pairs tested.[12]

4. Assessment of the Price Basis over Time

After examining the numerical correlations in the previous section, it is worthwhile to take a more graphical look at the relationship between Polish wheat prices and wheat prices on the CBOT and the LIFFE. In Graph 1, the prices of Polish, CBOT and LIFFE wheat prices in dollar terms are shown as a time series. The graph shows in a visual fashion what the correlation statistics implied: that is that there appears to be a convergence in the price of Polish wheat with international wheat prices beginning somewhere in mid to late 1994.

As noted earlier, when engaged in hedging activities, a commercial firm thinks in terms of residual risk or more commonly a basis risk. This risk is the fluctuation of the price differential between cash and futures prices, also known as the basis, and can be described by the simple formula:

physical cash price - futures price = basis; and
basis risk = fluctuation of the basis

In the case of our analysis the physical cash price is the Polish wheat price and the futures price is either the CBOT or the LIFFE price. A graphical display of these relationships is shown in graph 2. This graph shows visually the strong basis risk of the Polish wheat basis using both CBOT and LIFFE futures prices as a base. It can also be seen, however, that the magnitude of the variation appears to be declining during the last two years of the time series (see Tables 7 and 8). As with the correlation analysis, this suggests that some price convergence is occurring in recent marketing years.

5. Discussion of the Primary Reasons for Lack of a Stable Basis

The analysis contained in this report suggests that while the correlation between Polish and LIFFE and CBOT wheat prices might be improving, there is still a considerable amount of basis risk inherent in these relationships. As a result, commercial firms in Poland that operate in physical cash wheat markets are not likely able to utilize existing futures markets as a price risk management tool. This puts Polish firms at a disadvantage vis-à-vis their Western counterparts who regularly use futures markets to manage their price risk. Lack of effective price risk management tools are likely to increase the cost of (higher interest rates) or restricts access to working capital loans due to the increased risk profile of the firms. In addition, market activities are somewhat restricted for these firms as accumulating inventories and making forward sales might place the firm in a position of taking on untenable price risk. Ultimately the producer will bear much of the cost of this lack of price risk management as prices in this type of environment tend to be more volatile and the price

[12] It should be noted that the sample size maybe small for the ADF test to have adequate power.

spread between producer and consumer will be greater than if price risk management instruments were available.

For the benefit of the entire economy it is desirable to look at ways to improve the price risk management environment. In order to do this, the factors leading to poor correlation of Polish wheat prices versus CBOT and LIFFE prices must be identified. The analysis conducted in this study suggested several factors that are summarized below:

5.1. Currency Exchange Rate Risk

If Polish processors, traders, and farmers use wheat futures contracts at CBOT or LIFFE they are exposed to exchange rate fluctuations as they need to hedge wheat cash prices denominated in local currency (zloty) using futures contracts denominated in US dollars or British pounds. Generally, this exchange rate has been increasing (depreciating) over the period analyzed with variations within a particular year (see table 9). Unless Polish firms are able to use a derivative instrument denominated in local currency, they will need to manage an exchange rate risk when dealing with Western futures markets.[13]

5.2. Market Inefficiencies

The spatial and lagged analysis sections indicated that there were inefficiencies in the Polish market that led to price differences within Poland and poor correlation between Polish prices and those of the CBOT and LIFFE. It is not hard to understand why there would be inefficiencies within Poland related to poor access to information. The typical firm in Western economies has access to a broad array of both public and private information sources. These sources are available almost instantaneously to market participants via electronic services such as quote machines, faxes, e-mail etc. Generally the technology is available in Poland. What is lacking are information products tailored to the Polish market and an understanding on the part of market participants regarding the use of information. It is also worth noting that the existence of futures markets in Western countries has provided much of the incentive for the development and use of market information. As this information is widely disseminated, it benefits all participants and not just those directly involved in futures market operations.

5.3. Seasonality Differences

Under normal market conditions a seasonal wheat price pattern should be observed that reflects costs of storage and handling from the harvest period forward. In the case of Polish wheat prices, seasonal price movement is different in each year observed. In addition, only the year 1994/95 reflects what could be considered a normal seasonal pattern of price movement. In the balance of the years certain deviations from the expected seasonal pattern can be observed. These deviations are especially apparent in 1991/92 and 1993/94. Comparing these years with ARR wheat market

[13] In an integrated world wheat market, the existence of a Polish wheat futures contract could create arbitrage operations between Polish and US or UK wheat futures contracts to hedge currency risks.

involvement in particular years leads to the conclusion that higher intervention levels, as they were in these years, could result in major distortions of expected seasonal wheat price patterns.

5.4. Policies of Western Governments

Both the US and EU have extensive agricultural policy activities that could have a distorting impact on wheat prices in their respective countries. In the case of the US, since 1985 an export subsidy called the Export Enhancement Program was applied to US wheat exports. The intent of this subsidy was to enable US wheat producers to compete with export subsidies from other countries, especially those from the EU. One possible impact of these subsidies was to create an artificial price difference between export markets and US wheat futures markets. In effect, during the time these subsidies were in place the US wheat futures market was likely less representative of global supply demand conditions than would normally be the case. Table 10 shows monthly average EEP subsidies from 1989 up to the present. As can be seen, EEP subsidies were particularly heavy during late 1991 and early 1992 and 1993. In early 1994 and 1995 the level of subsidy began to decline and the program was eventually discontinued in mid 1995 due to extremely low US and world wheat supplies. This period of decline coincides with at least a slight improvement in the correlation between CBOT and Polish wheat prices suggesting that these subsidies likely played some role in the poor price relationships experienced in the early 1990's.

With regard to EU policies that might impact LIFFE wheat prices, the EU operates an export restitution program enabling it to maintain relatively high internal wheat prices while at the same time exporting surpluses into the world market. The impact on domestic EU prices (as reflected on the LIFFE wheat futures) is similar to the impact of the US EEP program: futures prices that are somewhat detached from world prices. It should be noted that in 1995 due to impending EU and world shortages (similar to the US situation) export restitutions were discontinued. In fact, late in 1995 licenses were not being issued for grain exports and eventually a tax was placed on the export of wheat and other grains.

It is clear that agricultural policies in the US and the EU are likely to have some impact on price correlations between futures markets in these economies and wheat prices in Poland. But as has also been noted, for now some of the prime distorting factors, at least in the US have been removed (the export tax on EU grain could have the continued effect of isolating prices in that region from other world prices). To asses how positive these developments will be with regard to price relationships between Poland and the West, the agricultural policies within Poland must also be examined.

5.5. Polish Government Intervention Policies

The Agency for Agricultural Markets (the Polish acronym is ARR) is one of the primary government agencies charged with implementing government agricultural policy in Poland. ARR was established in 1990 with the purpose of stabilizing agricultural markets as a way to protect farmers' incomes. The ARR's objective is to conduct intervention purchases when the supplies are high, so as to absorb market surpluses, and to sell these accommodated stocks in the periods of

relative market deficits. Also, ARR is responsible for maintaining state reserves of certain agricultural commodities.

ARR purchasing activities are financed by the government within a budget approved on a yearly basis. [14] Its activities focus on grains, meat and milk markets. The activities of this agency are relatively extensive in several commodities, one of which is wheat. In 1992 a minimum price system was introduced. The price serves a reference point to define intervention price at which intervention purchases are made to defend the minimum price level. Intervention purchases are conducted in three ways: (1) direct purchases, (2) purchases through authorized warehouses (3) indirect intervention through commodity loans to larger farms. It is believed that "effective" intervention can take place when the level of grain stocks accumulated by ARR reaches 0.7 - 1.0 million. Graph 3 shows the ARR's intervention price levels and wheat cash prices in Poland.

In addition to the minimum price set by ARR, the Polish government uses import tariffs to discourage imports of "cheaper" wheat into the Polish market. Imports at international prices would undermine efforts to set domestic minimum prices.

The next section is a general description of the ARR's activities as they relate to Polish wheat markets. The section that follows is an interpretation of the impact of these policies on Polish wheat prices based on the analysis contained in this study.

5.5.1. Mechanics of ARR Policies

With regard to wheat, one of the primary objectives of the ARR is to protect a minimum wheat price through direct intervention activities (purchases) in the wheat market. The minimum wheat price is set by the government. The minimum price that goes into effect in August of a particular crop year is typically announced during the proceeding March. In order to keep prices from falling below this minimum price, the ARR is allowed to pay an intervention price that can be up to 20 % higher than the minimum price. Historical intervention levels are shown in Table 3. In addition to these price support activities, the ARR also purchases wheat on behalf of the government for a strategic reserve. Besides direct purchases at the intervention price, the ARR might also accumulate stocks from producers who deliver grain at a facility and are not able to sell grain at a price higher than the minimum price. In these cases the ARR is in effect a market of last resort for producers.

By looking at total wheat procurements in Poland (in this terminology procurements represent wheat purchased by commercial entities and the government through the ARR) and the percentage of ARR purchases of the total crop, the percentage of wheat purchased by the ARR that reaches commercial channels can be calculated. This is shown in Table 3. As is shown, the percentage of ARR purchases of total procurements has been increasing over time.

[14] Through its activities, ARR has also built-up significant resources independently of the yearly budget transfers it receives. These amounts are not published and some elements sush as expenses to replenish the strategic reserves remain strictly confidential.

5.5.2. Impact of ARR Policies

When looking at ARR policies, it is helpful to view the intervention prices within the context of market prices in Poland. Graph 3 shows nominal Polish wheat prices and ARR intervention prices. As can be seen, there has been a dramatic increase in the level of both of these prices over the past four years. A hard question to answer is whether Polish market prices are following ARR intervention prices or whether the reverse is the case. It should be kept in mind that minimum prices (on which intervention prices are based) are announced in the March prior to August implementation. It is almost certainly true that the market will react upward and seek an intervention price that is higher than current market prices.

With the exception of the announcement of minimum and intervention prices, the activities of the ARR are generally not disclosed to the market place. This doubtless contributes to uncertainty with regard to price expectations. Moreover, activities of the ARR are so large that market participants contacted within the course of preparing this report expressed the opinion that ARR market activities were the prime driving force behind wheat price movements in Poland. This opinion seems to be supported by the pattern of price behavior relative to intervention prices shown in Graph 3.

Over the time period examined in this study ARR intervention activities were so prevalent in each year that it was not possible to measure the impact of intervention activities in any one year. Even the ARR recognizes that it is perceived as a "mega-institution" with regard to perceptions of its activities in the market place[15]. It is interesting to note that the year of heaviest ARR intervention activities, 1994/95, was a year in which Polish grain prices showed a high correlation with CBOT and LIFFE prices on a deseasonalized basis. During this year global grain prices began a rapid escalation that culminated in near record prices in 1996. It can be said that market prices overran intervention prices and under these conditions Polish prices became linked to those on the CBOT and LIFFE. If world prices decline back to intervention levels, Polish wheat prices will once again be primarily influenced by ARR intervention activities.

5.5.3. ARR Policy Objectives and Methods

While current ARR policies are a primary distortion to the wheat market in Poland, it must be kept in mind that the objectives of the ARR are similar to analogous government organizations in other countries. For example, the Commodity Credit Corporation (CCC) in the United States has historically undertaken intervention activities in the market place using the loan rate mechanism as the intervention tool. For example, loan rates for various commodities are established by the United States Department of Agriculture. These loans are known as "non-recourse loans" in that the farmer pledges the commodity as collateral. After a nine month period, the farmer can either repay the loan (plus interest) or forfeit the commodity to the CCC. Obviously if market prices

[15] "Doœwiadczenia i perspektywy dzia³alnoœci Agencji Rynku Rolnego (Experiences and prospects for ARR activities)", Konferencja n/t: Interwencjonizm Na Rynku Rolnym-Doœwiadczenia i Perspektywy (Conference: Intervention in the Agricultural Markets-Experiences and Perspectives),Pu³tusk, Poland, October 3-5, 1995.

available to the farmer are not enough to repay the loan plus interest, the farmer turns the loan over to the CCC. Obviously, the loan levels act as a "floor" for prices as the government will take ownership of the commodity at these levels.

The US experience in implementing wheat price support activity in the past has not been dissimilar to Poland's current experience. For example, from roughly 1975 to 1984 wheat loan levels (in effect price support levels) steadily increased. With wheat prices supported by strong export demand during the latter half of the 1970's, high loan rates had little impact on wheat market prices. By the 1980's, however, competition in export markets intensified and the high US support prices became a severe hindrance to US exports and generally to price discovery within the US. During the early 1980's, US wheat exports declined while inventories held by the CCC increased to burdensome levels. Not until government policy changed in 1985-1986 when lower loan rates were instituted did US wheat export recover and government held stocks decline. The prevailing policy in the US is to keep loan rates at "safety net" levels and let market price float to levels where they are able to attract or ration demand.

5.5.4. Policy Lessons Learned

The experience in both the US and Poland suggests some factors critical to effective agricultural policy implementation[16]. Some of these factors can be summarized as follows:

1) Although no government intervention is the preferred policy scenario, it is understood that governments for political reasons feel that they need to provide some price support in certain agricultural sectors. It is important to note that several developed and developing economies have been providing a safety net to producers of certain commodities. In this sense, the overall concept behind the ARR activities is not by itself the main distorting factor. Several countries have similar structures. It is the method and level that creates distortions and impedes markets to function properly.
2) If intervention activities are deemed necessary, they should provide a "safety net" and not distort the market. It follows from point 1) above that it is the level of support that is significant and to a lesser extent the mechanism itself that is critical. In the case of the US in the early 1980's and Poland since 1989, the price support levels were too high and market prices were distorted. Also, intervention in the EU's wheat market has been one of the key reasons as to why there was not a well developed European wheat futures contract.
3) Intervention activities need to be predictable. Markets do not like uncertainty, especially if there is one entity such as the ARR that has such an enormous impact that all sectors will be effected by its activities. Interventions on the part of government agencies must have parameters that everyone in the market understands and can plan around. If market participants operate in an environment that is unpredictable from a policy standpoint, free market activity comes to a virtual halt.

[16] Because the US is most similar to the Polish experience in the use of floor prices, it was used as an example. It must be pointed out that he EU is undergoing a similar metamorphasis in its agricultural policy as its recourses that high support prices in the form of "intervention prices" are very costly and result in severe price distortions.

5.5.5 Is Price Support Crucial for Agricultural Development in Poland?

In several counties in transition, including Poland, farmers tend to believe, and policy makers to accept, that higher price support is in itself an answer to farmers' problems. This is a problem because it tends to divert attention and public funds away from making necessary changes in factors that are essential to improving the productivity and prosperity of agriculture in these countries. According to Gardner (1996), the experience of economies in transition to date has shown that what happens in agriculture crucially depends on matters other than price support. For example, macroeconomic policies affecting inflation, real interest rates, exchange rates, trade policies, the economic organization of farming and land ownership, the input supply situation and structure, credit availability and costs, and constraints upon the domestic marketing of agricultural commodities.

In Poland, for example, existing efforts to develop commodity markets, whether wholesale markets, cash commodity exchanges and/or futures markets, and the development of a warehouse receipt system will likely contribute to the reduction of marketing margins, improve competition, and mobilize credit to the agricultural sector. However, the effectiveness of several of these efforts will crucially depend on the level and predictability of the price support policy. For example, high levels of price support and unpredictability in setting price support levels remove the incentive to hedge and inhibit the development of a futures exchange. High, panseasonal and panterritorial prices remove incentives to store commodities and undermine efforts to develop a warehouse receipt system.

Government policies can still support prices. However, price support policies need to be modified as to provide a safety net to farmers. That means that the level of price support needs to be such that market prices will clear above the price support level most of the times. Also, government policies need to be predictable and anticipated by market participants. Uncertainty related to government pricing policies, including price support levels, will likely increase marketing margins as traders need a "cushion" to protect their profit margins from unanticipated changes in pricing policies. Uncertainty related to government policies also undermines the development of local futures markets for agricultural commodities, such as wheat.

5.5.6 Price Support and Future EU Accession

Although Polish price support levels for wheat are above world market levels, they are still below those levels in the EU. Harmonization of Polish wheat prices with those prevailing now in the EU will require an increase in price support. However, several studies have estimated that the cost to the government budget and to the Polish economy, as a whole, will increase significantly if Poland harmonizes its price support level to the current CAP levels (see Tangermann, 1996 and Orlowski, 1996). In addition, there are indications that by the time of the Polish accession, the EU will likely continue reducing its cereal support price level and increase emphasis on market non-distorting support, such as direct payments decoupled from production and hectarage. This, along with the suppression of export subsidies for cereals, will likely increase the correlation between European wheat prices and world wheat prices. Already, the

reduction in EU price support has increased interest in the development of futures contracts for agricultural commodities, and in particular wheat. [17] LIFFE in England, MATIF in France, and the new commodity exchange in Hannover, Germany, all aspire to develop a European wheat futures contract. So far, these efforts have not developed fully because there is still a level of wheat price support in the EU that, presently, reduces the incentives to hedge wheat price risks and thus inhibits the development of a European wheat futures contracts.

Assuming that price support for wheat is reduced in both Poland and EU and Polish and EU wheat prices not only move closely together but also closely to world market prices, such as the CBOT wheat futures price, is there a need to develop a wheat futures contract in Poland? For example, if there is a liquid forward or futures contract for the zloty-dollar or zloty-British pound exchange rate, market participants could use the CBOT or LIFFE wheat futures contract to hedge their zloty denominated wheat cash prices. However, even if the correlation between Polish and European, US prices increases, it could still be the case where existing or newly developed European wheat futures contracts leave a basis risk, enough to justify the development of a Polish wheat futures contract. At present it is very difficult to determine whether there is a need for a Polish wheat futures contract as both Polish and EU price support policies for wheat are likely to evolve. The evolution of pricing policies will determine how closely Polish and EU wheat prices move together and also move closely to world prices.

6. Conclusions and Discussion

This study found that over the period covered, Polish wheat prices were generally unrelated to wheat futures prices on CBOT and LIFFE exchanges. Differences in seasonal price patterns seemed to play a role in the lack of correlation. Exchange rate fluctuations seemed also to be a factor, especially with regard to comparisons with LIFFE prices. Poor information dissemination within the Polish wheat market is an additional factor leading to poor price correlations as indicated by the improvement in results when looking at lagged prices. The greatest price distortions, however, can be attributed to extensive ARR market intervention activities. During the years examined, the ARR on average purchased an estimated 25% of the wheat that moved in commercial channels. Local Polish wheat prices generally moved to expected ARR intervention prices and stayed there until the next intervention level became known. The exception to this was the 1994/95 year when global and Polish wheat prices moved sharply higher in response to historically low wheat stock levels.

Under this market environment, it is not anticipated that hedging activities on the CBOT or the LIFFE would be viable risk management practices. The basis risk is extremely high for most years and generally can not be explained by normal market factors. While the results from 1994/95 are encouraging, it must be recognized that they are likely the result of high world prices that enabled Polish wheat prices to rise well above established intervention prices. While a hedging program in this environment might be temporarily effective, it must be recognized that once prices fall back to intervention levels, the price relationship will once again break down.

[17] Following the 1992 reforms of the CAP, the intervention price for wheat was reduced by one third.

Given that Polish market participants do not have the option to manage risk on existing exchanges, the next question is: would the development of a wheat futures contract in Poland (or one based on the Polish wheat market) enhance price risk management opportunities for the Polish sector? If the lack of correlation were simply a matter of seasonal, currency and information dissemination factors this idea might have merit. In fact, it could be argued that the development of a wheat futures contract would greatly enhance market efficiency and price discovery in Poland. Unfortunately, the primary price distortion factor appears to be the intervention policies of the ARR. In particular, the high level of price protection offered by ARR's intervention prices. Under these conditions, it would be difficult to develop a Polish based futures contract as a futures market would have as much difficulty establishing market value for wheat as the physical market currently has.

Certain changes in Polish wheat price intervention policies could greatly assist in the development of physical and futures markets for wheat in Poland. These changes need to have the following two features. First, price protection needs to be such as to allow market prices to clear above the intervention prices for most of the times. That is, intervention policies need to provide a safety net that is low enough to let market prices reflect supply and demand conditions and allow them to reflect market seasonality. The latter will encourage the development of a profitable storage industry and contribute to the privatization of grain storage in Poland. Second, the rules of intervention have to be well known and anticipated by market participants. For example, intervention prices could be linked to some kind of a discounted moving average of border (international) prices. Discounting will ensure that market prices clear above the intervention prices. If intervention is unanticipated, market participants will likely not use futures markets because of the uncertainty of government (or ARR) actions.

Another important element for the development of physical and futures markets in Poland is the development of a warehouse receipt system for grains. A pilot project has already started financed by USAID with VOCA the executing agency. The development of a warehouse receipt system will have the following benefits in terms of market development. First, warehouse receipts contribute in improving the efficiency of grain trading, and provide for a mechanism for physical delivery against futures contracts. That is, if futures contracts are not closed prior to expiration, physical delivery takes place (this is necessary to keep physical or spot prices closely linked to futures prices). The mechanism for the physical delivery is usually (in most grain exchanges worldwide) the warehouse receipt system. Second, a warehouse receipt system can be used by ARR to carry-out its intervention without participating in the physical (spot) market. Simply, ARR will set the intervention price and if market prices fall below this intervention price, farmers or traders will give their warehouse receipts to ARR. By doing this, the cost of market intervention will be reduced and will contribute to market efficiency. The private sector will be responsible for storage of grains. ARR's inventories will be handled by the private sector and they will be acquired and released based on the pre-announced rules of intervention. The type of intervention and the use of warehouse receipts as described above are not only found in the US, but now also in the EU. Other Eastern European countries are considering and preparing to apply such systems. Among them are Croatia, the Czech Republic, Hungary, Slovakia, and Turkey.

With changes in the level and method of intervention in the Polish wheat market, it is likely that Polish cash wheat prices will move closer to wheat futures prices in Chicago and London. If this is the case, is there any need to develop a wheat futures contract in Poland? The answer is not obvious. Even with the policy changes described above the correlation between Polish wheat prices and wheat futures prices in Chicago and London may still not be high enough. This could be due, for example, to seasonality, fluctuations in the foreign exchange, dissemination of information, and contract specifications (including quality specifications and delivery locations). Thus, a Polish wheat futures contract could provide a closer correlation with cash prices than a foreign based contract and hence could attract liquidity (sufficient number of trades). It is likely that the trade-off between a Polish wheat futures contract and existing futures contracts in Chicago and London will be basis (higher correlation with cash prices) versus liquidity. A Polish futures contract will likely be more correlated with cash prices but existing futures contracts in Chicago and London will have higher liquidity. Traders might also use existing wheat contracts in Chicago and London to arbitrage a Polish wheat futures contract. It should be noted that worldwide there can be more than one futures contract for a commodity. In the United States alone there are three wheat futures contracts that co-exist.

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List of Exhibits

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Table 1: Variation over time of monthly nominal wheat prices in Poland

Time Period	Variation Measures							
	Min	Max	Spread Max-Min	Average	Standard Deviation	Coefficient of Variation [%]		
						Poland	CBOT	LIFFE
Calendar Years:								
1990	73.1	88.3	15.2	79.0	4.1	5.2	15.1	na
1991	76.0	88.2	12.2	83.0	3.5	4.2	13.5	na
1992	94.0	210.9	116.9	150.5	41.6	27.7	8.6	5.3
1993	233.1	264.9	31.8	248.7	10.6	4.3	9.1	16.2
1994	230.1	330.9	100.8	258.9	27.2	10.5	8.0	4.3
1995	329.7	426.9	97.2	365.7	25.8	7.0	13.6	5.4
Production Years:								
1990/91	77.8	88.2	10.4	82.5	3.4	4.1	4.5	na
1991/92	76.0	170.6	94.6	103.4	27.6	26.7	9.7	4.1
1992/93	178.0	264.9	86.9	230.2	32.3	14.0	8.9	9.6
1993/94	230.1	276.0	45.9	245.2	12.4	5.0	6.5	5.4
1994/95	230.4	380.6	150.2	323.0	51.3	15.9	7.3	6.4

Table 2: Spatial variation of nominal monthly wheat prices in Poland (based on the monthly prices for 49 voivodships)

Month	Average price for Poland						Max/Min Relationship						
	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995	Average
JAN	83.6	85.6	94.0	245.6	242.6	363.5	1.9	1.3	1.4	1.5	1.4	1.5	1.5
FEB	88.3	87.6	95.7	256.3	244.2	369.0	1.6	1.3	1.5	1.3	1.5	1.2	1.4
MAR	81.8	88.2	102.7	264.9	248.2	357.1	1.6	1.4	1.4	1.3	1.3	1.8	1.5
APR	75.4	83.8	113.6	258.7	252.5	359.4	1.8	1.3	1.5	1.5	1.2	1.3	1.4
MAY	74.1	82.9	124.6	258.1	261.4	363.6	1.5	1.5	1.5	1.3	1.3	1.5	1.4
JUN	73.1	83.7	138.3	262.1	276.0	380.6	1.5	1.6	1.6	1.3	1.3	1.3	1.4
JUL	77.0	82.7	170.6	250.5	230.1	331.6	1.5	1.4	1.6	1.7	1.5	1.3	1.5
AUG	78.4	76.0	178.0	240.8	230.4	329.7	1.3	1.3	1.4	1.2	1.2	1.1	1.3
SEP	78.1	77.2	187.5	236.1	243.0	345.8	1.4	1.2	1.5	1.3	1.4	1.2	1.3
OCT	77.8	80.7	193.5	233.1	259.0	364.0	1.5	1.4	1.2	1.6	1.3	1.2	1.4
NOV	79.8	84.5	196.6	239.4	288.2	397.4	1.5	1.6	1.3	1.4	1.4	1.3	1.4
DEC	81.1	83.4	210.9	238.4	330.9	426.9	1.3	1.5	1.5	1.6	1.4	1.3	1.4
						Yearly average:	1.5	1.4	1.4	1.4	1.4	1.3	1.4

Table 2: continued

Month	Standard Deviation						Coefficient of variation [%]						
	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995	Average
JAN	10.6	6.6	6.1	20.1	16.1	22.5	12.7	7.8	6.5	8.2	6.6	6.2	8.0
FEB	10.7	6.1	7.1	18.2	16.7	16.1	12.2	7.0	7.4	7.1	6.9	4.4	7.5
MAR	9.2	7.0	6.9	15.4	14.0	27.6	11.3	8.0	6.7	5.8	5.6	7.7	7.5
APR	8.8	5.9	9.3	17.7	13.0	18.5	11.6	7.0	8.2	6.9	5.1	5.1	7.3
MAY	7.8	6.9	10.8	15.8	16.5	26.3	10.6	8.3	8.6	6.1	6.3	7.2	7.9
JUN	7.9	7.3	11.9	16.2	19.0	26.9	10.8	8.7	8.6	6.2	6.9	7.1	8.0
JUL	5.7	5.9	13.7	19.2	25.7	21.2	7.5	7.2	8.1	7.7	11.2	6.4	8.0
AUG	3.1	4.6	9.9	10.5	11.2	8.3	4.0	6.1	5.6	4.4	4.9	2.5	4.6
SEP	4.7	3.3	12.0	12.9	12.3	13.2	6.0	4.2	6.4	5.5	5.0	3.8	5.2
OCT	5.5	5.9	10.1	16.5	13.1	14.3	7.1	7.4	5.2	7.1	5.0	3.9	6.0
NOV	7.3	6.9	11.7	17.7	18.1	20.1	9.2	8.1	5.9	7.4	6.3	5.1	7.0
DEC	6.1	7.0	15.2	19.3	24.7	24.8	7.5	8.4	7.2	8.1	7.5	5.8	7.4
Yearly average:							9.2	7.3	7.0	6.7	6.4	5.4	7.0

Table 3: Wheat supply demand balance for Poland in 1989/90 - 94/95 [thousand MT]

Item	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
Begining Inventory	904	1788	2098	1097	436	788
Production	8462	9026	9261	7368	8243	7659
Imports	2565	697	200	764	500	760
Total Supply	11931	11511	11559	9229	9179	9207
Domestic Usage	10139	9206	9561	8766	8358	8459
Exports	4	207	900	27	33	10
Ending Inventory	1788	2098	1097	436	788	739
Inventory/Usage [%]	17.6	22.8	11.5	5.0	9.4	8.7
ARR Intervention Price [zl/MT][a]	-	70.0	82.0	175.0	240.0	250.0
Market Price in August [zl]	-	78.4	76.0	178.0	240.8	230.4
Intervention/Market Price	-	0.89	1.08	0.98	0.99	1.08
Procurments [thousands MT][b]	-	2256.5	2315.3	2107.4	2114.2	2046.2
ARR Purchases [thousands MT][c]	-	180	650	295	495	1073
ARR Market Ratio [%]	-	8.0	28.1	14.0	23.4	52.4

Source: GUS, ARR, IERiG

[a] - intervetion price is the minimum price plus a percentage applied by ARR.

[b] - procurements for 1990/91 and 1991/92 were estimated based on production and normal procurements percentage.

[c] - based an data contained in Wei A., *Market efficiency in the Polish markets for wheat and other grains*, World Bank draft report, December, 1995.

Table 4: Correlation of US dollar term wheat prices in Poland regressed against respective US dollar term CBOT and LIFFE nearby futures prices

Time Period	R^2 coefficients of Polish prices					
	US dollar terms against:		Deseasonalized US dollar term against:		First differences of US dollar term against:	
	CBOT	LIFFE	CBOT	LIFFE	CBOT	LIFFE
Calendar Years:						
1990-95	0.17	0.01 (-)	0.02 (-)	0.03	0.01 (-)	0.12
1990	0.09	na	0.01	na	0.01 (-)	na
1991	0.30 (-)	na	0.58	na	0.02	na
1992	0.54 (-)	0.44 (-)	0.91 (-)	0.62 (-)	0.03 (-)	0.01
1993	0.00	0.89	0.28	0.86	0.00 (-)	0.12
1994	0.07	0.05	0.01	0.07	0.01	0.05
1995	0.02	0.34	0.16	0.35	0.09 (-)	0.44
Production Years:						
1990/91-94/95	0.09	0.01 (-)	0.06 (-)	0.04	0.02 (-)	0.01
1990/91	0.19 (-)	na	0.01 (-)	na	0.05 (-)	na
1991/92	0.00 (-)	0.16	0.28 (-)	0.04 (-)	0.07 (-)	0.08 (-)
1992/93	0.00 (-)	0.03	0.54 (-)	0.43 (-)	0.00 (-)	0.27
1993/94	0.19 (-)	0.00	0.34 (-)	0.36	0.00 (-)	0.22
1994/95	0.00 (-)	0.50	0.11 (-)	0.17	0.16 (-)	0.27

Note: a) (-) represents a negative relationship
b) calculations for LIFFE refer to period of August 1991 through December 1995

Table 5: Correlation of lagged US dollar term wheat prices in Poland regressed against respective US dollar term CBOT futures prices

Time Period	R^2 coefficients of Polish prices lagged by:					
	1-month	2-month	3-month	4-month	5-month	6-month
Calendar Years:						
1990-95	0.19	0.21	0.25	0.29	0.31	0.31
1990	0.00 (-)	0.40 (-)	0.77 (-)	0.87	0.55 (-)	0.04 (-)
1991	0.07 (-)	0.01 (-)	0.01 (-)	0.31	0.60	0.74
1992	0.61 (-)	0.58 (-)	0.51	0.50 (-)	0.52 (-)	0.56 (-)
1993	0.05	0.15	0.26	0.38	0.44	0.61
1994	0.31	0.52	0.68	0.66	0.35	0.11
1995	0.03	0.12	0.28	0.59	0.78	0.28
Production Years:						
1990/91-94/95	0.13	0.19	0.28	0.38	0.45	0.46
1990/91	0.51 (-)	0.71 (-)	0.59 (-)	0.26 (-)	0.04 (-)	0.03
1991/92	0.01 (-)	0.01 (-)	0.00	0.02	0.10	0.20
1992/93	0.14	0.58	0.79 (-)	0.73	0.40	0.23
1993/94	0.03 (-)	0.00	0.05 (-)	0.09	0.00	0.13
1994/95	0.02 (-)	0.01 (-)	0.04	0.50	0.62	0.18

Note: (-) represents a negative relationship

Table 6: Correlation of lagged US dollar term wheat prices in Poland regressed against respective US dollar term LIFFE futures prices

Time Period	R^2 Coefficients for the Prices Lagged by:					
	1-month	2-month	3-month	4-month	5-month	6-month
Calendar Years:						
1991-95	0.00 (-)	0.00 (-)	0.00 (-)	0.00	0.00	0.01
1990	na	na	na	na	na	na
1991	na	na	na	na	na	na
1992	0.35 (-)	0.40 (-)	0.51 (-)	0.60 (-)	0.61 (-)	0.53 (-)
1993	0.93	0.86	0.71	0.53	0.37	0.19
1994	0.08	0.05	0.03	0.05	0.16	0.37
1995	0.07	0.10 (-)	0.42 (-)	0.21 (-)	0.05	0.92
Production Years:						
1990/91-94/95	0.00 (-)	0.00 (-)	0.00 (-)	0.00	0.00	0.01
1990/91	na	na	na	na	na	na
1991/92	0.17	0.16	0.16	0.21	0.28	0.41
1992/93	0.21	0.24	0.16	0.13	0.12	0.11
1993/94	0.00	0.12 (-)	0.49 (-)	0.26 (-)	0.01	0.21
1994/95	0.24	0.05	0.00 (-)	0.02 (-)	0.03	0.24

Note: a) (-) represents a negative relationship
b) calculations for LIFFE refer to period of August 1991 through December 1995

Table 7: Variation measures of wheat basis in Poland using CBOT futures calculated in US dollar terms

Time Period	VariationMeasures				
	Min	Max	Spread Max-Min	Average	Standard Deviation
Calendar Years:					
1990-95	-76.03	46.98	123.01	-16.20	28.38
1990	-57.78	-9.56	48.22	-34.09	17.00
1991	-67.34	-1.34	66.00	-32.66	21.28
1992	-76.03	16.32	92.35	-25.33	33.31
1993	-21.95	46.98	68.93	17.01	20.74
1994	-38.41	1.41	39.82	-17.95	12.06
1995	-35.58	21.06	56.64	-4.16	21.90
Production Years:					
1990/91-94/95	-76.03	46.98	123.01	-11.78	28.54
1990/91	-31.57	-1.33	30.24	-16.32	9.23
1991/92	-76.03	1.81	77.84	-50.72	20.38
1992/93	-6.42	46.98	53.40	20.86	15.67
1993/94	-27.25	46.98	74.23	5.47	21.16
1994/95	-38.41	21.06	59.47	-4.06	22.47

Table 8: Variation measures of wheat basis in Poland using LIFFE futures calculated in US dollar terms

Time Period	VariationMeasures				
	Min	Max	Spread Max-Min	Average	Standard Deviation
Calendar Years:					
1991-95	-153.21	-19.63	133.58	-65.39	39.38
1990	na	na	na	na	na
1991	na	na	na	na	na
1992	-144.46	-69.75	74.71	-107.11	29.72
1993	-65.86	-20.15	45.71	-41.92	14.39
1994	-64.53	-30.74	33.79	-49.05	10.74
1995	-46.62	-19.63	26.98	-34.57	8.88
Production Years:					
1990/91-94/95	-153.21	-19.63	133.57	-68.53	40.03
1990/91	na	na	na	na	na
1991/92	-153.21	-89.13	64.07	-131.55	15.36
1992/93	-87.84	-20.15	67.70	-60.54	17.76
1993/94	-58.74	-20.15	38.59	-47.65	15.28
1994/95	-64.53	-19.63	44.89	-41.34	44.89

Note: calculations for LIFFE refer to period of August 1991 through December 1995

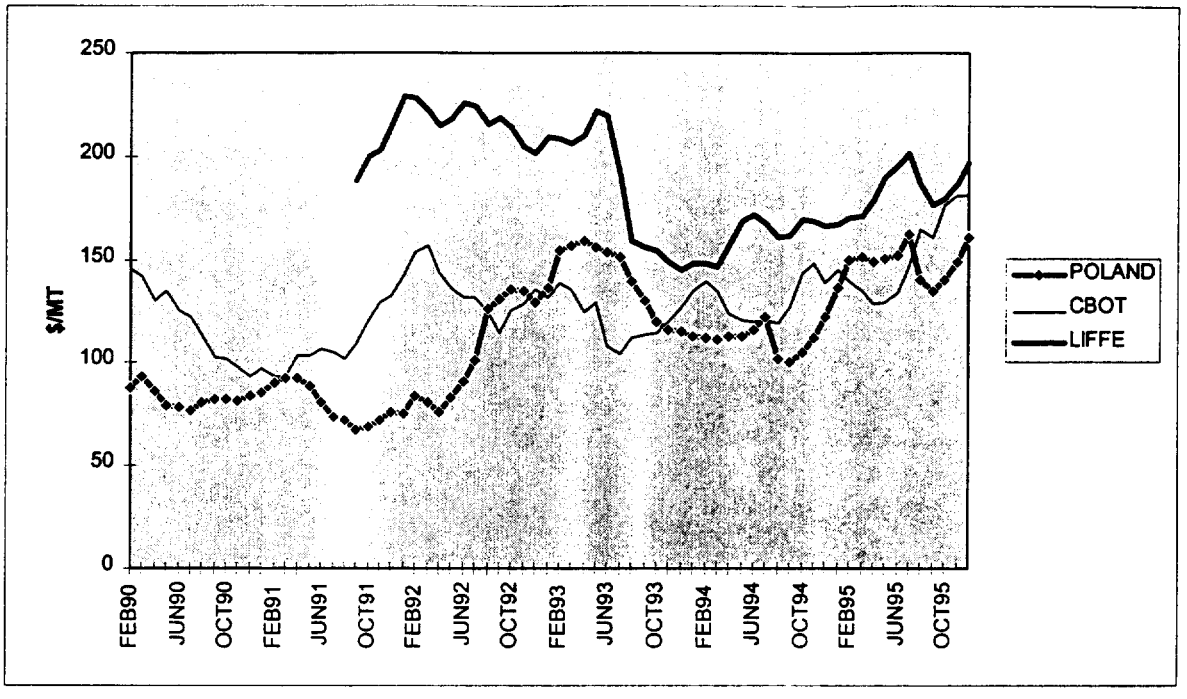
Table 9: Variation measures of the average monthly Polish zloty and US dollar exchange rates

Time Period	VariationMeasures					
	Min	Max	Spread Max-Min	Average	Standard Deviation	Coefficient of Variation [%]
Calendar Years:						
1991-95	0.95	2.51	1.56	1.65	0.58	35.0
1990	0.95	0.95	0.00	0.95	0.00	0.0
1991	0.95	1.15	0.20	1.06	0.08	7.6
1992	1.12	1.54	0.42	1.36	0.11	8.3
1993	1.59	2.11	0.52	1.81	0.18	9.7
1994	2.16	2.43	0.27	2.27	0.07	3.2
1995	2.34	2.51	0.17	2.42	0.05	1.9
Production Years:						
1990/91-94/95	0.95	2.44	1.49	1.66	0.54	32.2
1990/91	0.95	1.15	0.20	0.99	0.07	7.3
1991/92	1.11	1.37	0.26	1.22	0.12	9.5
1992/93	1.36	1.80	0.44	1.58	0.13	8.4
1993/94	1.85	2.26	0.41	2.13	0.13	5.9
1994/95	2.29	2.44	0.16	2.37	0.05	2.1

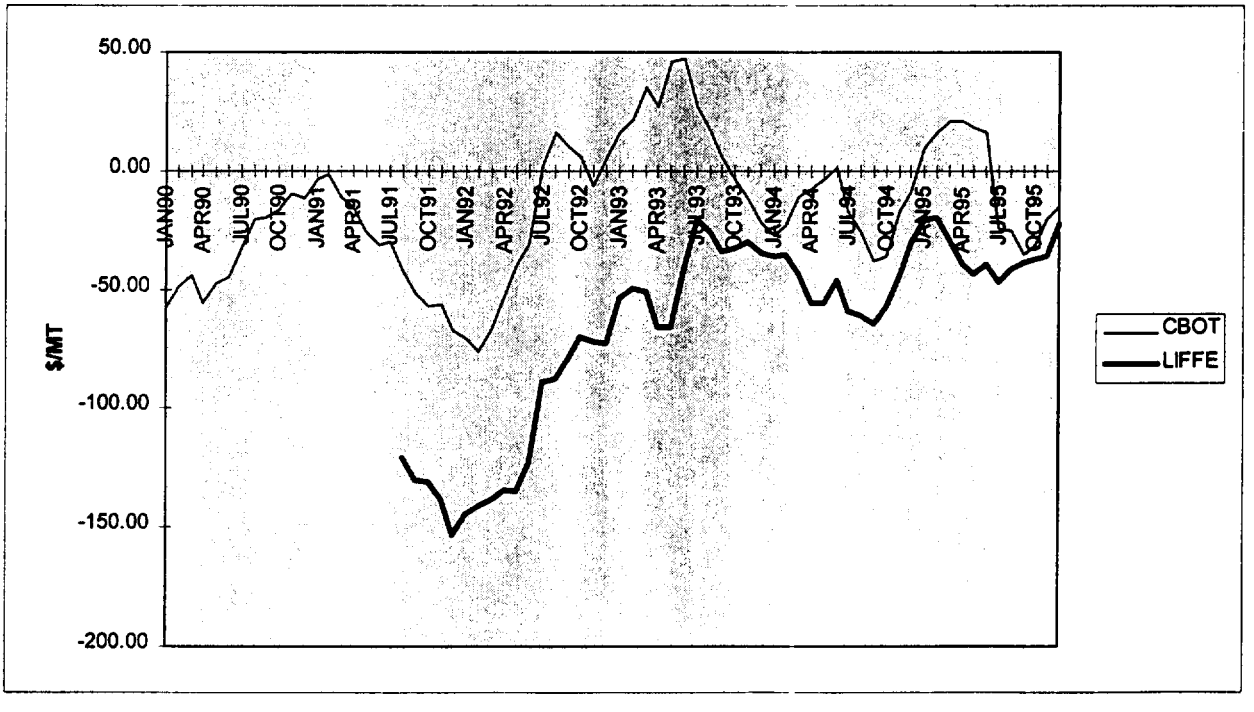
Table 10: Monthly average US EEP wheat subsidies [$/MT]

Month	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95
JUN	6.35	15.79	38.05	33.27	19.99	43.08
JUL	3.57	11.34	50.75	20.35	42.44	42.18
AUG	7.45	21.93	53.12	20.11	41.98	36.39
SEP	8.81	44.42	52.45	32.53	50.36	37.60
OCT	10.34	42.71	58.84	33.23	52.65	26.82
NOV	7.18	35.52	52.98	41.03	53.44	22.44
DEC	16.40	43.06	52.13	36.84	51.82	18.65
JAN	17.76	44.45	51.58	33.26	59.01	15.25
FEB	13.15	41.42	47.13	27.95	40.72	9.91
MAR	10.12	39.58	40.38	22.63	52.30	15.20
APR	27.99	34.25	32.26	27.02	46.50	20.52
MAY	14.99	38.27	17.68	20.18	47.40	22.15
Average	12.01	34.40	45.61	29.03	46.55	25.85

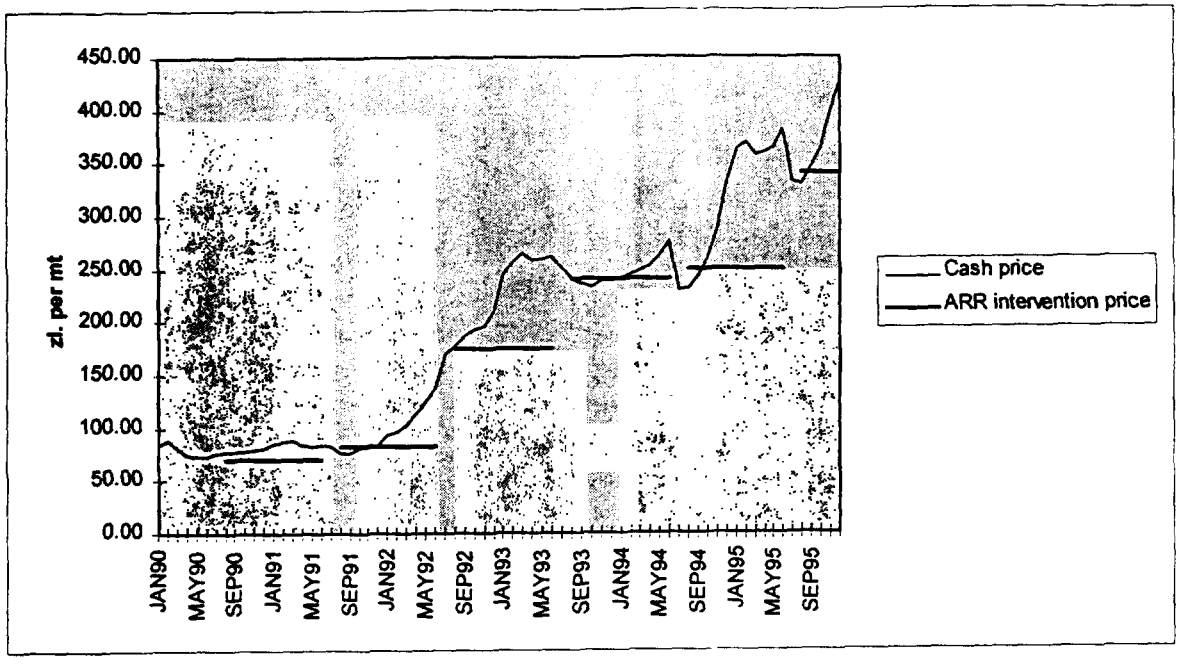
Graph 1: Wheat Prices in Poland, CBOT and LIFFE in US$



Graph 2: Basis between Polish Wheat Cash and CBOT and LIFFE Wheat Futures Prices



Graph 3: Polish Wheat Cash Prices and ARR Intervention Price Levels



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