



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**Deficiency Payments and Market Power: Effects of Imperfect  
Competition on Welfare Distribution and Decoupling**

**Carlo Russo**

*Department of Agricultural and Resource Economics  
University of California, Davis, USA  
Social Science and Humanities Building  
One Shields Avenue, Davis, CA, 95916  
email: russocar@primal.ucdavis.edu*

*Dipartimento Istituzioni, Metodi Quantitativi e Territorio  
Università degli Studi di Cassino, Italy*

*Selected Paper prepared for presentation at the American Agricultural Economics  
Association Annual Meeting, Portland, OR, July 29-August 1, 2007*

*Copyright 2007 by Carlo Russo. All rights reserved. Readers may make verbatim copies of  
this document for non-commercial purposes by any means, provided that this copyright  
notice appears on all such copies.*

# **Deficiency Payments and Market Power: Effects of Imperfect Competition on Welfare Distribution and Decoupling**

**Carlo Russo**

**Abstract:** Despite the increasing importance of market power in the food industry, most policy models assume perfect competition. Ignoring market power may lead economists to make incorrect, or at least misleading, policy recommendations. In this paper I develop a theoretical model in which market power can alter conclusions regarding the welfare effects of a specific policy change: replacing deficiency payments with decoupled payments to farmers, and apply it to the U.S. wheat market and milling industry. The main conclusions of the theoretical model are that, middlemen's market power may cause i) an increase in public expenditure, ii) an extraction of policy rents from the taxpayers by the middlemen, and iii) a reduction of the social benefit from decoupling deficiency payments.

I develop an econometric model to investigate if the U.S. wheat milling industry is gaining a rent from the federal loan deficiency payment program, using its market power. The results suggest that the wheat milling industry exhibit a moderate degree of oligopsony power and no oligopoly power. Due to the inelastic demand and supply, even a low level of market power has relevant effects. In the average year, the per-unit increase of public expenditure for the deficiency payments reaches 14.5% of the wheat price, and the potential benefits from removing the policy are reduced by 21.3%.

**JEL codes:** Q18, L13

**Keywords:** Decoupling, Deficiency Payments, Market Power

## **Introduction**

Despite the increasing importance of market power in the food industry, most policy models assume perfect competition, especially if a general equilibrium approach is followed (Rude and Meilke, 2004). Ignoring market power may lead economists to make incorrect or misleading policy recommendations. Since imperfect competition may affect the industry equilibrium significantly, it should be carefully considered in policy analysis (Bucirossi, et al., 2002, McCorrison, 2002, Sexton, 2000). In this paper I develop a theoretical model in which market power can alter conclusions regarding the welfare effects of a specific policy change: replacing deficiency payments with decoupled payments to farmers. The conventional textbook analysis of replacing deficiency payments with decoupled support predicts that social welfare will increase, because farmers will reduce their output to the socially optimal, perfectly competitive level. I demonstrate that the presence of middleman market power, either oligopsony power in the farmgate market or oligopoly power in the output market, might reduce or eliminate this social benefit, or even result in a net social cost.

I apply the model to the U.S. wheat market and milling industry. This application is particularly relevant. Decoupling was one of the major achievements from the 1994 Uruguay round of GATT negotiations and further reduction of coupled measures is one of the major issues in the current Doha Round of WTO talks. Both price floors and deficiency payments are “amber box” measures and governments are expected to cut them significantly in the next future. However, the model presented in the next sections suggests that, in presence of market power, decoupling might not be as beneficial as expected.

Moreover, the model indicates that middleman market power might increase public expenditures for any given level of farmer support. Consequently, reducing market power in the middleman market can reduce public expenditures without decreasing farmer support.

### **The Theoretical Framework**

A deficiency payment scheme consists of direct government payments to farmers who participated in an annual program. The payment rate is based on the difference between an established target price and average market price for the commodity. The total payment to the farmer is calculated multiplying the payment rate and, the farm's eligible production. As a consequence, a farmer participating to the program receives a price for his product that is always at least equal to the target price (e. g., Wallace, 1962).

Deficiency payments have been one of the cornerstones of U.S. agricultural policy in the wheat, feed grain, rice and cotton sectors. Over the years, the policy governing this program has been reformed several times, creating a complex set of regulations. In my analysis, I will focus on the simple definition provided in the previous paragraph, ignoring the features of the actual U.S. program. In particular, I will ignore the difference between the Deficiency Payment Program (abolished in 1996) and the Loan Deficiency Payments (LDP), currently in use. I will also assume that all farmers participate in the program and all cropland is eligible acreage. These restrictive assumptions allow me to develop a simple model, and are consistent with previous literature (e. g., Alston and James, 2001)

In the model, I describe the interaction across three groups of agents: consumers, farmers and processors (the millers). Consumers and producers behave competitively, while

processors (acting as middlemen) may have oligopsony and/or oligopoly power. I assume that the processors use a fixed-proportions, constant-returns-to-scale technology. There is no uncertainty, no international trade and all agents have perfect information. These restrictive assumptions allow me to address the problem in the simplest possible way, focusing the analysis only on the interaction between policy and market power.

The main conclusion of the model is that, middlemen's market power may cause i) an increase in public expenditure, ii) an extraction of policy rents from the taxpayers by the middlemen, and iii) a reduction of the social benefit from decoupling support payments.

In the presence of a deficiency payment program, the production exceeds the output level in the non-subsidized market, and the final consumer price falls in order to ensure that the procurement and final product markets clear. Since in this framework output is determined by the level of the target price, supply is perfectly inelastic with respect to the market price obtained by farmers. Thus, the farm price in the presence of both buyer oligopsony power and a producer target price is not uniquely determined and, instead, depends upon the relative bargaining power of farmers and middlemen. If the farm price is expected to be below the target price, then producers' incentives to bargain aggressively are attenuated because, regardless of the bargained price, their final price is set by the target. In these settings the market farm price may fall considerably below the target, and the government expenditure necessary to sustain the target price may be much higher than would be necessary with a perfectly competitive procurement market. By lowering the price in the procurement market, the middlemen are able to appropriate part of the benefit from the policy. In fact, the difference between the consumer price and the procurement market price can be considered a per-unit transfer from the taxpayers to the

middlemen. In this case, part of the expenditure for a measure designed to support farmers is actually subsidizing the processors.

**Figure 1:** Market Equilibrium under Deficiency Payment Scheme and Market Power

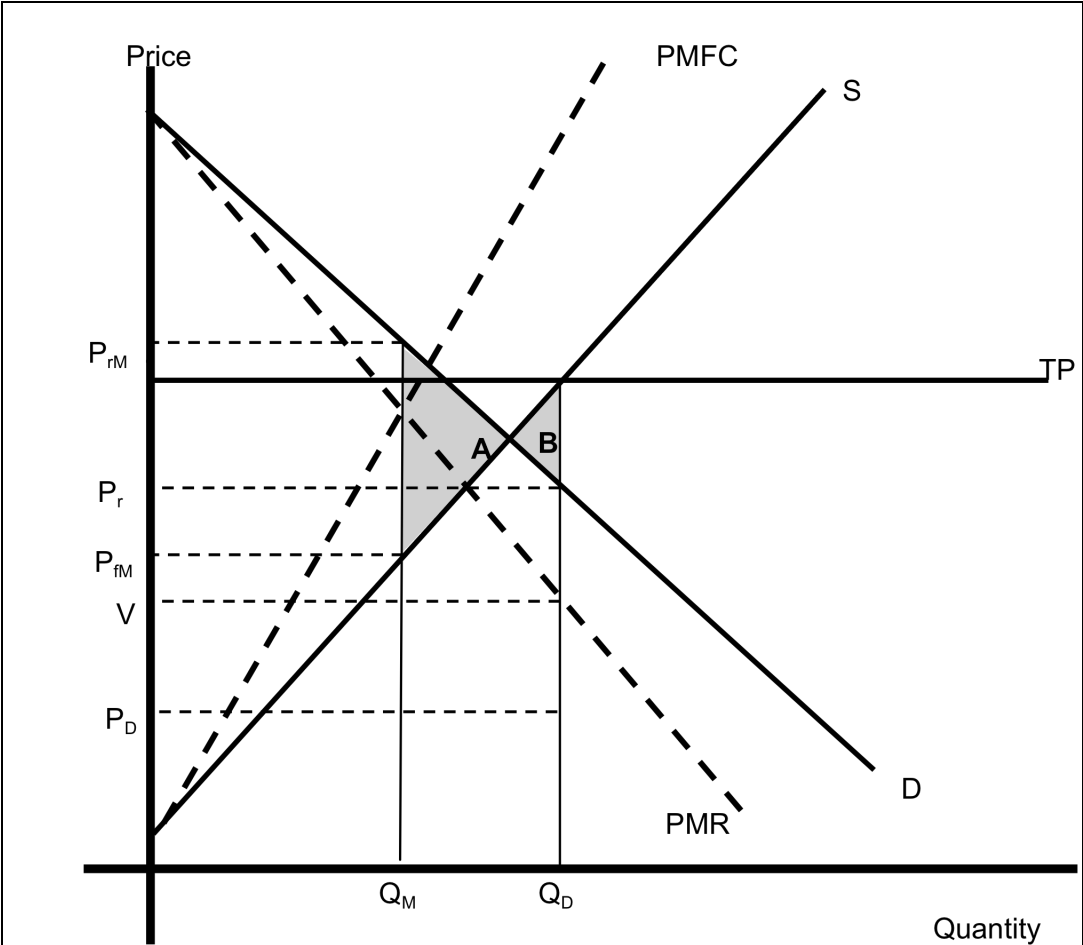


Figure 1 illustrates the model describing the effects of imposing a deficiency payment scheme with an exogenously determined target price (TP) and processors holding oligopsony and oligopoly power. In absence of this policy, the equilibrium quantity ( $Q_M$ ) is determined by the intersection of the perceived marginal factor cost curve (PMFC) and the perceived marginal revenue (PMR) curve (Sexton and Zhang, 2001). From the inverse

demand and supply curve, the equilibrium prices in the procurement and final markets are  $P_{fM}$  and  $P_{rM}$ , respectively. The deadweight loss from market power with respect to the perfectly competitive equilibrium is the shaded area A.

If the regulator imposes a target price  $LR$ , the output increases from  $Q_M$  to  $Q_D$ . In order to clear the market, the price in the final market must fall to  $P_r$ . Conjectural variation theory cannot determine the price in the procurement market, but the expectation is that it falls between zero the value of the marginal unit sold in the final market (the value  $V$  in Figure 1). The actual price is determined by the relative bargaining power of farmers and processors. However, since the farmers have little incentive to bargain, the price decrease and the consequent increase in public expenditure can be severe. This additional expenditure can be considered as a transfer from the taxpayers to the processors and does not affect the total social welfare, if the opportunity cost of taxation is equal to the amount of the transfer. In this case, the deadweight loss from the policy with respect to the perfectly competitive equilibrium is the shaded area B.

The theoretical model shows that, in presence of market power, the usual textbook conclusions about deficiency payments may not hold. The analysis suggests that the gain from decoupling may be lower than under perfect competition. In fact, the policy measure may be welfare enhancing, if the loan rate is set between the unregulated farm price and the perfect competition. Also, the processors may capture part of the payments by lowering the farm price, so that part of the policy expenditure does not provide any benefit to farmers. The magnitude of the impact of market power on the policy outcome is, of course, an empirical question. In the next section I provide an illustrative estimation using the U.S. wheat market as a case study.



### **Empirical Application: Who is the U.S. Supporting in the Wheat Market?**

The theoretical model concluded that processors holding market power might capture part of the surplus from a deficiency payment policy by lowering prices in the procurement market. In this section I develop an econometric model to investigate if the wheat milling industry used deficiency payments as an opportunity to gain profits. If this is the case, then a policy measure that is supposed to benefit farmers is actually in part subsidizing the milling industry. Moreover, the US could reduce its policy expenditure by preventing the exertion of market power, benefiting the public budget and strengthening its position in trade negotiations. In fact the U.S. could reduce the expenditure for an amber box measure without decreasing the support received by farmers.

The existence of market power in the wheat milling industry is a hotly debated topic, motivated by the industry's high level of concentration. One of the largest firms (Archer Daniels Midland) was implicated in a price-fixing case in the U.S. lysine market, suggesting that the industry may be willing to collude as sellers, exercising oligopoly power. In 1999, the U.S. Department of Justice filed a complaint against Cargill's acquisition of Continental Grain, claiming that the merger would substantially lessen competition for grain purchasing services to farmers, due to the increased capacity to exercise oligopsony power.

Econometric studies on the topic have given conflicting answers. Brester and Goodwin found that the degree of cointegration of the price time series across markets and across the vertical wheat chain was negatively correlated with the CR4 index, and argued that the increase in concentration was lessening competition. However the authors noticed that "the

price series remain highly cointegrated”, supporting the notion that the industry might be in fact still competitive (Brester and Goodwin, 1993). Kim et al. (2001) used a Poisson regression model to investigate the change in the industry structure and found evidence of oligopoly with price leadership. Stiegert tested for upstream and downstream market power in the US hard wheat milling industry and found that the null hypothesis of perfect competition could not be rejected (Stiegert, 2002).

Previous studies have mostly ignored government intervention and as a result, the representation of the industry behavior might be biased. In fact, the theoretical model suggests that, in presence of oligopsony power, changes in the policy regime may trigger changes in the pricing strategies of the milling industry. In this case, econometric models not accounting for the change in the regime might fail to detect market power. Thus, the main contribution of my estimation of market power in the wheat milling industry is that I explicitly account for the effect of agricultural policy.

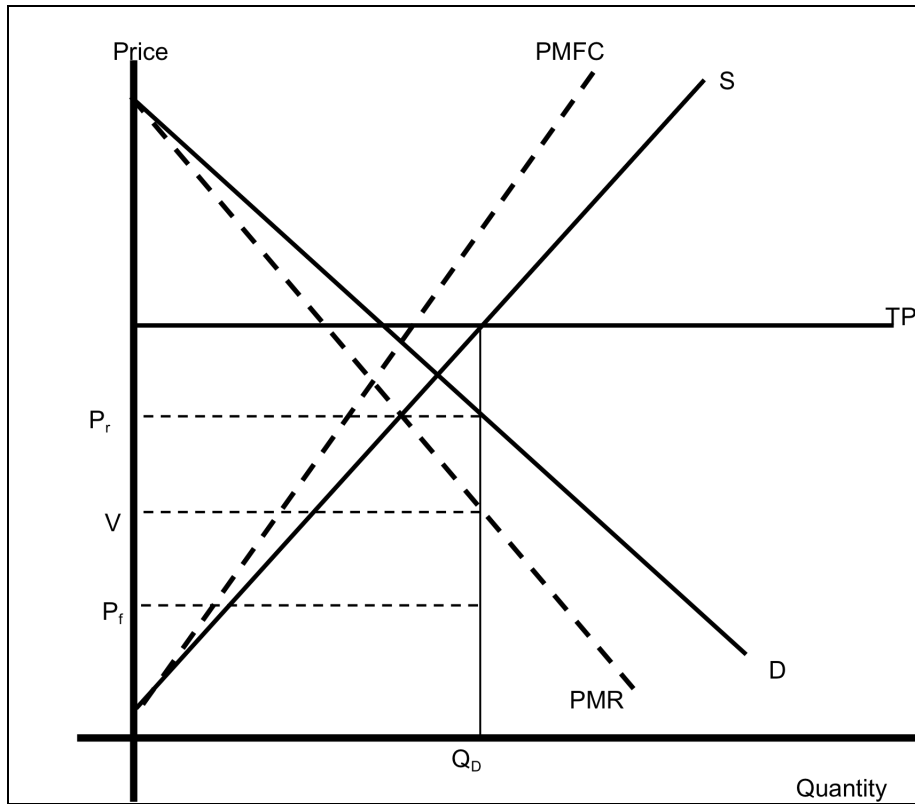
Since my goal is to provide an illustration of the theoretical framework, I impose in the estimation the same assumption that I maintained in the model. These restrictions introduce the possibility of model specification bias, which may be severe. As a consequence, the empirical analysis should be considered just as an illustrative example of the theoretical model, rather than a definitive study precisely replicating the demand, supply and structure of marginal costs in the milling industry. In particular, the assumptions of linear demand and supply and constant marginal costs may drive the results.

*The estimation strategy.*

The objective of the analysis is to measure the increase in public expenditure (if any) for a deficiency payment program due to milling industry market power. Figure 2 illustrates the point: our objective is to measure the vertical distance between  $P_r$  (the price of the wheat flour under the policy regime minus the millers' marginal cost) and  $P_f$  (the farmer price of wheat under the policy regime). If the milling industry uses marginal cost pricing, then this difference should be zero. In addition, it is possible to break down the increase in government expenditure into two components: the oligopoly effect (the distance between  $P_r$  and  $V$ ) and the oligopsony effect (the distance between  $V$  and  $P_f$ ). This distinction may have relevant policy implications, since the measures to deal with the two types of market power may be different.

I address the problem using two different methodologies. First I test for the existence of market power using a non-parametric approach. This step allows me to assess the presence of milling industry market power without imposing any assumption about the functional form of the processing industry marginal cost or about the economic model describing the industry behavior. Given the mixed results from the literature, this test allows for a first general result. In fact, the theoretical model concludes that the existence of market power always implies an increase of public expenditure for the deficiency payment program. The limitation of this approach is that it does offer a measure the extent of the market power.

**Figure 2:** *Deficiency Payment Scheme under Milling Industry's Market Power*

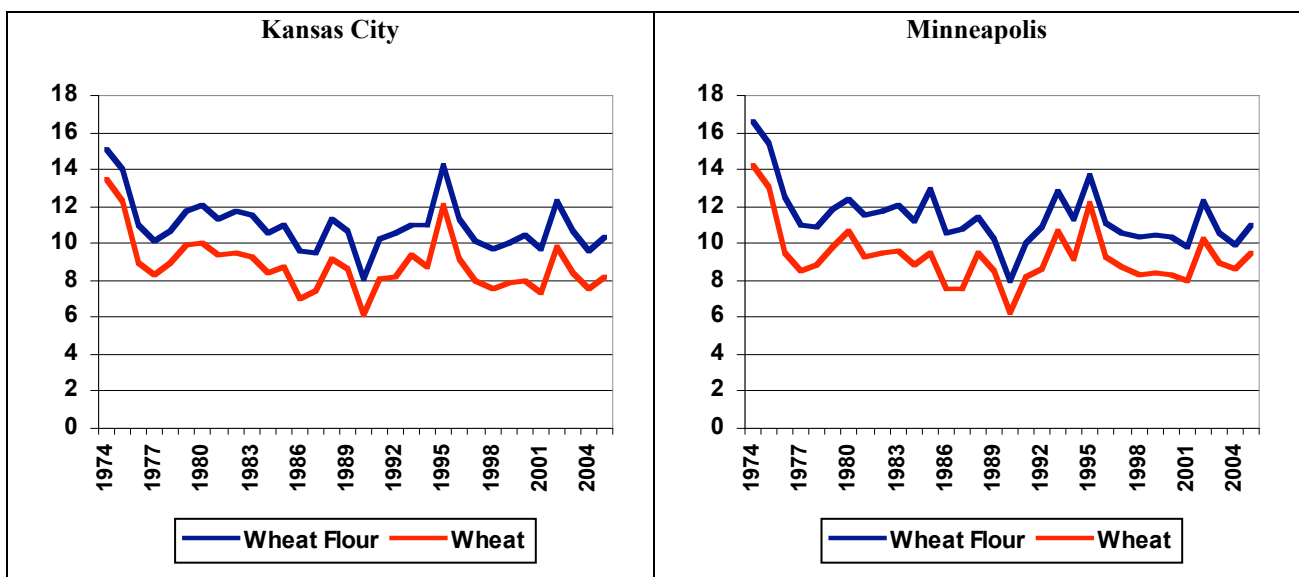


The second approach follows the standard methodology of imposing a specific structure on demand and supply, and estimating market power as a “conjectural variation” on the  $[0,1]$  interval (Appelbaum, 1982, Bresnahan, 1989, Genesove and Mullins, 1998). The estimation imposes a specific structure to the data assuming linear demand and supply, constant marginal cost milling technology and a static framework. The results from this model assess the extent of oligopoly and oligopsony power, at the expenses of more restrictive assumptions. Given the relevance of Corts’ critique of the conjectural variation methods, the non-parametric approach may be used to validate the results of the parametric estimation (Corts, 1999).

*The data.*

The analysis is based on the 1974-2005 time series of the prices of wheat and wheat flour in the Kansas City and Minneapolis wheat markets that are published in the USDA Wheat Yearbook. The data series report the price of wheat flour and byproducts and the cost of wheat to produce 100 lbs of flour. Thus, the data are immediately comparable, because they represents the total revenues from the production of 100 lbs. of wheat flour and the corresponding costs for the farm input. Figure 3 illustrates the data and Table 1 reports the key descriptive statistics for the Kansas City and Minneapolis time series of real prices of wheat, wheat products and of the price difference (defined as the difference between the price of 100 lbs. of flour and the price for the equivalent quantity of wheat). Data have been deflated using the producer price index with base 1982 provided by the Bureau of Labor Statistics.

**Figure 3:** 1974-2005 Real Prices of Wheat and Wheat Products in Kansas City and Minneapolis (\$/100 lbs of flour, deflated using a Producer Price Index with base 1982).



The data in Table 1 show that the average prices in Minneapolis are higher, although the difference with respect to the Kansas City market is not statistically significant at the 90% confidence level. The real price differences are similar in the two markets: the average was equal to 2.14 dollars per 100 lbs of flour in Minneapolis and 2.11 dollars in Kansas City. In 1993, USDA reported in Kansas City an unusually high relative price of wheat: the value was higher than the flour price and close to the total wheat product price. Since the time series from Minneapolis do not show the same shock, I considered this observation an outlier and corrected by using mean imputation for both the wheat and the wheat product prices.

**Table 1:** *Descriptive Statistics for the 1974-2005. Time Series of Real Prices of Wheat, Wheat Products and Price Difference (data are expressed in \$/100 lbs. of flour, deflated using a Producer Price Index base 1982)*

	Wheat Price		Wheat Products Price		Price Difference	
	Minneapolis	Kansas City	Minneapolis	Kansas City	Minneapolis	Kansas City
Mean	9.30	8.87	11.44	10.98	2.14	2.11
Std. Error of Mean	0.28	0.27	0.29	0.25	0.09	0.04
Median	9.04	8.67	11.02	10.71	2.03	2.11
Sample Std. Dev.	1.57	1.51	1.64	1.43	0.49	0.24
N. Observations	32	32	32	32	32	32

Source: USDA Wheat Yearbook 2006

As expected, there is evidence of a strong link between the two markets. A Dickey-Fuller cointegration test allows us to reject the null hypothesis of no cointegration both for the wheat prices and the wheat product prices at 90% confidence level. The analysis confirm the results by Brester and Goodwin (1993) showing a strong link between the two markets. As a consequence it is possible to pool the two data series using a panel data approach, in order to gain efficiency in the estimation. In particular, I will assume the existence of a fixed effect across the two data series. Since in this case the number of individuals is low compared to the number of time periods (two compared to 32), I model the fixed effect using a dummy variable identifying the data from the Kansas City market. I used the Kansas City data only to calibrate the model, so that the pooled analysis should be immune from pre-test bias.

#### *The Non-Parametric Approach*

In this section I use a non-parametric regression model to assess the existence of market power in the wheat milling industry. The test is based on a two-step procedure. In the first step I regress the price difference (defined as the difference between the price of flour and the price of wheat) on a set of variables  $\mathbf{X}$  that describes the milling industry marginal cost and I obtain a vector of residuals  $\mathbf{u}$ . In the second step I test for any systematic component in the residuals using as regressors a set of variables  $\mathbf{Z}$  that, according to the theoretical model, might be correlated with the mark-up from the milling industry market power. If there the market is competitive, the residuals  $\mathbf{u}$  should be just white noise and should be uncorrelated with  $\mathbf{Z}$ .

Note that this test requires that the variables  $\mathbf{Z}$  must be uncorrelated with any omitted variable in the first stage regression. The requirement is less restrictive than the fundamental assumption of parametric models, which usually require that the marginal cost function is correctly specified. This implies that the test is robust with respect to other forms of deviation from marginal cost pricing than market power (such as capacity constraints, imperfect information, etc.) that are not explicitly modeled in the first stage regression as long the variables  $\mathbf{Z}$  are uncorrelated with these omitted determinants.

The choice of the variables  $\mathbf{Z}$  is critical for the interpretation of the test. In order to infer the existence of market power, it is necessary to use a set of regressors that is associated with industry market power but it is independent from millers' marginal cost or any deviation from the marginal cost-pricing rule due to other causes. The theoretical model suggests that, if the milling industry has no market power, the price difference should be equal to the marginal cost and should be independent from the policy regime. Then I will use as auxiliary regressor matrix  $\mathbf{Z}$  variables that describe the public support at any given time period. The choice is based on two assumptions: i) the level of public support for farmers does not affect the millers' marginal cost and ii) the policy variables are exogenous, i.e., the regulator set the support price independently from the price difference (but can be dependent on the absolute level of the farm prices).

Table 2 summarizes the variables utilized in the  $\mathbf{X}$  matrix, defining the determinants of the milling industry marginal costs, and in the  $\mathbf{Z}$  matrix, containing the variables for market power detection. The primary regression describes the milling industry marginal cost as an unknown function of input prices, quantity produced and the fixed effect summarizing the differences between the Kansas City and the Minneapolis markets. The



quantity produced is approximated using total US flour production, rather than the quantity traded in each of the two markets, which was not available. In order to avoid the curse of dimensionality, I summarized the prices of the milling industry input factors using a principal component analysis of a matrix composed of transportation costs (the real retail price of unleaded gas), labor costs (the real hourly wage for manufacturing sector) and a time trend. Since the variables are strongly correlated, the first component alone summarizes the 99% of the total variance. Thus, the **X** matrix, identifying the determinants of the industry marginal costs, is composed of three variables: the first component of the input price matrix (**V**), the flour quantity (**QF**) and a fixed effect dummy variable (**K**), identifying the Kansas City market.

**Table 2:** *The Structure of the Two-Step Non Parametric Test*

First Step: Primay Regression		Second Step: Auxiliary Regression	
Dependent Variable	Explanatory Var.	Dependent Variable	Explanatory Var.
<b>y</b>	<b>X</b>	<b>u</b>	<b>Z</b>
Price Difference	First Component of the input price matrix ( <b>V</b> )	Residual from Primary Regression $\mathbf{u} = \mathbf{y} - E(\mathbf{y} \mathbf{X})$	Constant ( <b>C</b> )
	Dummy for Fixed Effect ( <b>K</b> )		Dummy for Binding Policy Regimes ( <b>BIN</b> )
	Quantity ( <b>QF</b> )		Support Price ( <b>SP</b> )
			Interaction term ( <b>SP*BIN</b> )
			Income ( <b>RINC</b> )

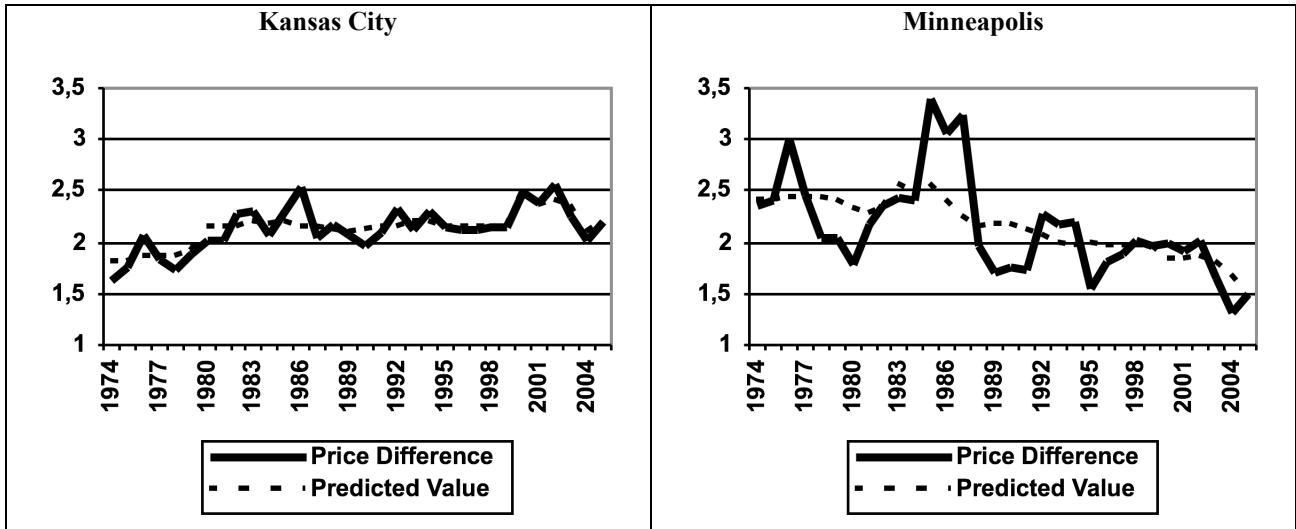
The secondary regression tests for the existence of market power by checking the correlation between  $\mathbf{Z}$  and  $\mathbf{u}$ . Given the theoretical model, I use policy related variables as regressors in order to verify if there is any systematic component in the error term from the primary regression. I summarized the policy in three variables: i) the support price (SP), defined as the highest price rate from the coupled policy measures, ii) a binary variable (BIN) which is equal one if the policy is binding and zero otherwise and iii) an interaction term calculated as the product of the SP and BIN. Following the theoretical model I assume that the policy is binding if the support price of the coupled measures is higher than the market price.

If the policy variables are jointly significant, there is empirical evidence that the data generating process changes when the deficiency payment program is in effect. I interpret this result as evidence of millers' oligopsony power, given the conclusions of the theoretical model. As shown in Figure 2, if the millers hold oligopsony power then the policy regime affects the determination of the price difference. If the policy is not binding the price difference is determined by the intersection of the perceived marginal revenue curve (PMR) and the perceived marginal factor cost curve (PMFC). Under the policy regime, the price difference is determined by the relative bargaining power of farmers and millers. The test on the policy variables captures this change in the data generating process.

I used a demand shifter in the auxiliary regression (annual U.S. real income) to test if shocks in demand affect the price difference, suggesting the possibility of oligopoly power. If a t-test on the parameter of the demand shifter rejects the null hypothesis, there is

evidence supporting the presence of oligopoly power. Failure to reject the null hypothesis is not a conclusive answer, because the result is consistent with two cases: either the industry has no oligopoly power or the derivative of the inverse demand is not affected by the demand shifter (i.e., the shifter affects the intercept and not the slope of the curve).

**Figure 4:** *Non-Parametric In-Sample Prediction of Real Price Difference.*



I estimated the primary regression using a Nadaraya-Watson non-parametric kernel estimator and a Silverman bandwidth. Figure 4 show the fit of the non-parametric regression for the two markets. The  $R^2$  for the pooled regression is 0.48 but the adjusted  $R^2$  drops to 0.28.<sup>1</sup>

<sup>1</sup> The  $R^2$  was calculated as  $R^2 = 1 - \frac{u'u}{y'y - N\bar{y}^2}$  and the adjusted  $R^2$  is  $\bar{R}^2 = 1 - (1 - R^2) \frac{N-1}{N-k_1}$  with

$k_1 = N - \text{tr}\{(I - S)(I - S)'\}$  where S is a NxN linear smoother matrix

The existence of market power can be tested by regressing the residuals from the primary regression on the matrix  $\mathbf{Z}$  of policy variables. I performed this step via OLS, using White's robust standard errors. In this way, I can test for correlation between  $\mathbf{Z}$  and  $\mathbf{u}$  by using a F-test on the joint significance of the explanatory variables.

Table 3 reports the results from the auxiliary regression. Since the F-test on the joint significance of all the explanatory variables can reject the null hypothesis at 99% confidence level, there is a statistical evidence of a systematic component in the residuals from the primary regression. This result implies that the marginal cost alone does not explain the price difference entirely. Given the theoretical model, it is possible to interpret this result as an indication of milling industry market power.

**Table 3:** *Results from the Auxiliary Regression*

$R^2 = 0.232$			
F-Stat = 3.565			
(p-value = 0.007)			
Variable	Coefficient	Standard Error	P-Value
Dummy for Binding Policy (BIN)	-1.370	0.445	0.003
Support Price (SP)	-0.035	0.105	0.742
Interaction Term (SP·BIN)	0.392	0.005	0.005
Real Income (RINC)	0.023	0.016	0.159
Constant	-0.080	0.336	0.813

An F-test testing the joint significance of the three policy variables (SP, BIN and the interaction term) provided an F-statistic of 5.906, rejecting the null hypothesis that the coefficients are jointly equal to zero at 99.5% confidence level. The result supports the

conclusion that the milling industry holds oligopsony power. The coefficient of the real income variable (RINC) is not significantly different from zero, and the test does not support any final conclusion about the presence of oligopoly power.

The non-parametric approach suggests that the wheat milling industry exerts oligopsony power. This conclusion is particularly relevant since under oligopsony the increase in public expenditure for deficiency payments due to market power might be severe. In the next section, I use a parametric approach to get an estimate of market power, at the cost of more restrictive assumptions. Since the non-parametric model does not exclude the presence of oligopoly power, the parametric model will test for the simultaneous presence of the two kinds of market power.

#### *The parametric approach*

The parametric estimation is based on a system of three equations describing supply, demand and the price difference. The model follows the standard conjectural variation approach, in which demand and supply are estimated in order to provide the parameters necessary for the identification of market power (Bresnahan, 1989). The measurement of market power is based on the assumption of constant marginal costs of the milling industry. Under this key assumption, in a perfectly competitive market the price difference should not depend on quantity. Then, if we regress the price difference on quantity and we find it statistically significant we can argue that the industry holds market power. The literature developed tests for market power with more flexible marginal cost

functions (e. g., Azzam, 1997). The assumption of constant marginal cost was imposed for consistency with the theoretical model and in order to simplify the analysis.

The supply equation is modeled as a linear function of the wheat market price (RWP), of the support price, in the years when the policy is binding, (SP·BIN) and the technology (represented by the time trend, T). The equation also includes a dummy variable identifying the years when the policy was binding (BIN), an interaction term with price (RWP·BIN) and a dummy variable identifying the years when the Farm Bill regulation was in place (FB). A change in the policy regime causes a shift of the intercept and a change in the supply slope with respect to the market price and the support prices. I will use this shift in supply slope to identify market power.

The demand equation is a linear combination of the wholesale price of wheat products (RPP), the real U. S. income (RINC) and the marginal cost of the retail industry summarized by the cost of labor (RHW). Demand is assumed to be independent of the policy regime.

The price difference equation regresses the wheat product price on the wheat price, the quantity of wheat flour (QF) and the first factor of the input price matrix (V). The equation includes also interaction terms allowing for a change in the slope and the intercept when the policy is binding. I restricted the wheat price coefficient to be equal to one, so that the relation describes the price difference.<sup>2</sup>

All equations include a dummy variable describing the differences between the Minneapolis and the Kansas City markets as a fixed effect. The sources of the data are the

---

<sup>2</sup> By using this restriction I do not need to introduce an additional endogenous variable (the price difference)

USDA Wheat Yearbook, the U.S. Bureau of Labor Statistics and the Energy Information Administration.

**Table 4:** *The Result of the 3-Stage Least Square Estimation*

<b>Supply</b> <i>(Equation R<sup>2</sup>: 0.892)</i>		<b>Demand</b> <i>(Equation R<sup>2</sup>: 0.956)</i>		<b>Price Difference</b> <i>(Equation R<sup>2</sup>: 0.937)</i>	
Constant Term (C)	0.086 (0.133)	Constant Term (C)	0.813 (0.000)	Constant Term (C)	0.655 (0.422)
Fixed Effect Dummy (K)	0.002 (0.779)	Fixed Effect Dummy (K)	-0.002 (0.441)	Fixed Effect Dummy (K)	-0.0171 (0.866)
Wheat Price (RWP)	0.014 (0.000)	Wheat Product Price (RPP)	-0.005 (0.001)	Wheat Price (RWP)	1.000 (restricted)
Binding Policy Dummy (BIN)	0.219 (0.017)	Real Income (RINC)	0.023 (0.000)	Binding Policy Dummy (BIN)	3.136 (0.029)
Interaction Term (RWP*BIN)	-0.026 (0.012)	Cost of Labor (RHW)	-0.034 (0.000)	Quantity (QF)	4.074 (0.084)
Interaction Term (RSP*BIN)	0.011 (0.126)			Interaction term (QF*BIN)	-8.679 (0.039)
Time Trend (T)	0.006 (0.000)			1 <sup>st</sup> Factor of Input Price Matrix (V)	0.008 (0.041)
Farm Bill Dummy (FB)	0.033 (0.000)			Interaction Term (V*BIN)	-0.013 (0.024)

*(the numbers in parenthesis are the coefficient p-values)*

The system was estimated using iterative three stages least squares, in order to account for possible correlation across the error terms and for the endogeneity in prices and quantities. Convergence was achieved after 8 iterations.

Table 4 reports the results of the estimation, showing that the estimated coefficients are consistent with the expectations from economic theory. Demand and supply are rigid: own price elasticities at mean points are -0.163 and 0.366, respectively. When the policy is binding, the supply slope with respect to market price is not statistically different from zero.<sup>3</sup> The result confirms that under the policy regime the supply is perfectly inelastic with respect to the market price.

In the price difference equation, the coefficient of the variable  $V$ , the first factor of the input price matrix, is not significantly different from zero when the policy is binding.<sup>4</sup> This result implies that the price difference under the policy regime does not vary with millers' marginal costs. The dummy variables controlling for the existence of a fixed effect difference between prices in the two markets are jointly not significantly different from zero.<sup>5</sup>

---

<sup>3</sup> An F-test failed to reject the null hypothesis of rigid supply when the policy is binding (the p-value was 0.415)

<sup>4</sup> The p-value of the F-test on the null hypothesis of zero sum of the coefficients of the variables  $V$  and  $V \cdot \text{BIN}$  is 0.328

<sup>5</sup> The p-value of the F-test of the null hypothesis stating that the three coefficients are jointly equal to zero is 0.817



I apply the standard approach of using a supply shifter, in this case the change in the policy regime, to identify market power using the following system of two equations (e.g., Bresnahan, 1989, Schroeter, et al., 2000, Sexton and Zhang, 2001):

$$-\theta \frac{\partial P_R}{\partial Q} + \xi \frac{\partial P_f}{\partial Q} \Big|_{BIN=0} = \gamma_{QF} \quad \text{if the policy is not binding}$$

$$-\theta \frac{\partial P_R}{\partial Q} + \xi \frac{\partial P_f}{\partial Q} \Big|_{BIN=1} = \gamma_{QF} + \gamma_{QF*BIN} \quad \text{if the policy is binding}$$

where  $\frac{\partial P_R}{\partial Q}$  and  $\frac{\partial P_f}{\partial Q}$  are, respectively, the slope coefficients of the inverse demand and supply,  $\theta$  and  $\xi$  are the oligopoly and oligopsony power parameters,  $\gamma_{QF}$  and  $\gamma_{QF*BIN}$  are the estimated coefficients of the variables QF and QF\*BIN from the price difference equation.

From Table 4 we have:

$$\frac{\partial P_f}{\partial Q} \Big|_{BIN=0} = \frac{1}{0.014} = 71.881$$

$$\frac{\partial P_f}{\partial Q} \Big|_{BIN=1} = \frac{1}{0.014 - 0.012} = -83.976,$$

where the two values are the estimates of the inverse supply slope when the policy is not binding and under the policy regime, respectively. The supply slope is negative under the policy regime, but the elasticity is not significantly different from zero. The inverse demand slope is:

$$\frac{\partial P_R}{\partial Q} = \frac{1}{-0.005} = -199.414$$

Thus, it is possible to recover the conduct parameters from the following two-equation, two-unknown system:

$$199.414 \cdot \theta + 71.881 \cdot \xi = 4.073 \quad \text{if the policy is not binding}$$

$$199.414 \cdot \theta - 83.976 \cdot \xi = -4.605 \quad \text{if the policy is binding}$$

The solution is  $\theta = 0.000$  and  $\xi = 0.055$ .

The milling industry exerts a moderate amount of oligopsony power and no oligopoly power, confirming the findings of the non-parametric analysis. This result has been obtained under very restrictive assumptions regarding demand and marginal costs, and should be interpreted with caution. Given this caveat, these conduct parameters suggest that the public expenditure for the deficiency payments in the wheat market may be higher than under a perfectly competitive regime. Since demand and supply are inelastic, the effects of a moderate amount of market power on welfare and public expenditure may be large.

*Calculating the impact of market power on public expenditure and social welfare.*

The results reported in Table 4 allow us to calculate the increase in the policy expenditure due to the milling industry market power. Under the assumption that the switching between the policy regimes is exogenously determined, the increase in the expenditure can be measured by estimating the increase in the price difference due to market power. The expected increase in the price difference under the policy regime is

$$E(\Delta PM_t | V_t) = (\gamma_{QF} + \gamma_{QF \cdot BIN}) \cdot QF_t + \gamma_{BIN} + \gamma_{V \cdot BIN} \cdot V_t$$

where  $\gamma_X$  is the regression coefficient for the variable X.

In 1987 (the year when the flour production was closest to the mean), the estimated increase in public expenditure due to oligopsony power was \$1.38 per lbs/00 of wheat flour, or approximately \$0.48 per bushel of wheat. The value was approximately 14.5% of

the wheat price. In 1994, the increase was \$0.44 per bushel of wheat and in 1999 it was \$0.45, suggesting that the value is approximately constant over the years.

The estimate shows that a moderate level of oligopsony power has a high impact on prices when the policy is binding. The result supports the idea that farmers may have low incentive to bargaining, under a deficiency payment scheme.

The benefit from decoupling can be estimated by comparing the deadweight loss from market power and from the policy, as shown in Figure 2. In the following calculations I will use 1987 as a representative year, because it is the year with a value of production closest to the mean.

From Table 4, it is possible to estimate the demand and supply equations and the equilibrium quantity and price under a perfect competition regime. Given the value of the variables in 1987, we obtain the following equations:

$$P_D = a + b \cdot Q_D = 78.099 - 199.414 \cdot Q_D \quad \text{inverse net demand}$$

$$P_S = c + d \cdot Q_S = -12.499 + 71.881 \cdot Q_S \quad \text{inverse supply}$$

where prices are expressed in dollars per 100 pounds of wheat flour and quantities are in billions of hundredweights of wheat flour. The milling industry marginal cost was deducted from the intercept of the inverse net demand.

From the inverse net demand and supply, it is possible to estimate the equilibria in the unregulated market (with oligopsony power) and under perfect competition (Sexton and Zhang, 2001). The equilibrium under the policy regime is observable. The deadweight loss

with respect to the perfect competition regime can be calculated as the area of the triangles A and B in Figure 2. Table 5 reports the results of the estimations.<sup>6</sup>

**Table 5:** *Equilibrium Prices, Quantity and Deadweight Loss for Three Market Regimes (year 1987)*

	Regimes		
	Perfect Competition	Unregulated Market	Regulated Market
Quantity (QF) (billions of cwt)	0.334	0.329	0.342
Wheat Price (P <sub>F</sub> ) (\$ per 100 lbs. of flour)	11.506	11.150	9.528
Net Wheat Product Price (P <sub>R</sub> ) (\$ per 100 lbs. of flour)	11.506	12.491	10.822
Support Price (SP) (\$ per 100 lbs.)	---	---	12.847
Deadweight loss (\$)	---	3,310,674	15,556,962

The result of the analysis is that the presence of market power, on average, is expected to reduce the benefit from eliminating deficiency payments by 3.3 million dollars,

---

<sup>6</sup> The difference between the net wheat product price and the wheat price in Table 5 is \$1.293 per 100 lbs. of flour. The figure is different from the previously stated 1.380. This is because 1.380 is the expected value and 1.293 is the observed value of the increase in price difference. The difference is the regression error term (which, in 1987, was -0.087)

which is approximately equal to 21.3% of the total expected benefit. A moderate amount of market power causes a significant reduction in the social gain from liberalization.

### **Summary and Conclusions**

The paper develops a simple model showing that middlemen holding market power may extract a rent from a deficiency payment program, causing an increase in public expenditure, and applies it to the U.S. wheat market. Middlemen market power may reduce the benefits of removing the policy. Since deficiency payments prevent middlemen from restricting the supply, in a regulated market farmer and consumers are protected from such strategic behavior. In contrast, in an unregulated market middlemen are free to create scarcity in order to increase their profits. In the presence of market power, the effects of decoupling on social welfare must be carefully evaluated. The regulator is called to choose the lesser of two evils: the policy distortion or the market power-induced deadweight loss.

In this framework, the benefits of decoupling are an empirical question. My analysis of the U.S. wheat market concluded that the milling industry holds a moderate degree of oligopsony power. Due to inelastic demand and supply, the millers' market power has a significant impact. On an average year, the milling industry was able to extract a rent from the policy approximately equal to 14.5% of the wheat price, and reduced the projected benefit of removing the deficiency payments by 21.3%. Although these figures were derived under restrictive assumptions, the results support the conclusion that market power should be carefully considered in policy design.

## References

- Alston, J., and J. James (2001) *The Incidence of Agricultural Policy*, ed. B. Gardner, and G. Rausser, vol. 2B, North-Holland.
- Appelbaum, E. "The Estimation of the Degree of Oligopoly Power." *Journal of Econometrics* 19, no. 2(1982): 287-299.
- Azzam, A. "Measuring Market Power and Cost Efficiency Effects of Industrial Concentration." *The Journal of Industrial Economics* 45, no. 4(1997): 377-386.
- Bresnahan, T. (1989) *Empirical Studies of Industries with Market Power*, ed. R. Schmalensee, and R. Willig, vol. 2, Elsevier, pp. 1011-1057.
- Brester, G. W., and B. K. Goodwin. "Vertical and Horizontal Price Linkages and Market Concentration in the U.S. Wheat Milling Industry." *Review of Agricultural Economics* 15, no. 3(1993): 507-519.
- Bucirossi, P., S. Marette, and A. Schiavina. "Competition Policy and the Agribusiness Sector in the European Union." *European Review of Agricultural Economics* 29, no. 3(2002): 373 - 397.
- Corts, K. "Conduct Parameters and the Measurement of Market Power." *Journal of Econometrics* 88(1999): 227-250.
- Genesove, D., and W. Mullins. "Testing Static Oligopoly Models: Conduct and Cost in the Sugar Industry, 1890-1914." *The Rand Journal of Economics* 29, no. 2(1998): 355-377.
- Kim, C., et al. "Economic Analysis of the Changing Structure of the U.S. Flour Milling Industry." *Agribusiness* 17, no. 1(2001): 161-171.

- McCorriston, S. "Why should imperfect competition matter to agricultural economists?" *European Review of Agricultural Economics* 29, no. 3(2002): 349 - 371.
- Rude, J., and K. Meilke. "Developing Policy Relevant Agrifood Models." *Journal of Agricultural and Applied Economics* 36, no. 2(2004): 369 - 382.
- Schroeter, J., A. Azzam, and M. Zhang. "Measuring Market Power in Bilateral Oligopoly: the Wholesale Market for Beef." *Southern Economic Journal* 66, no. 3(2000): 526-47.
- Sexton, R. J. "Industrialization and Consolidation in the US Food Sector: Implication for Competition and Welfare." *American Journal of Agricultural Economics* 82, no. 4(2000): 1087 - 1109.
- Sexton, R. J., and M. Zhang. "An Assessment of the Impact of Food Industry Market Power on U.S. Consumers." *Agribusiness* 17, no. 1(2001): 59-79.
- Stiegert, K. W. "The producer, the baker, and a test of the mill price-taker." *Applied Economics Letters* 9, no. 6(2002): 365-368.
- Wallace, T. D. "Measures of social costs of agricultural programs." *Journal of Farm Economics* 44, no. 2(1962): 580-594.