BRIEFING

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The Impact of Canadian Wheat Imports on Regional U.S. Wheat Prices

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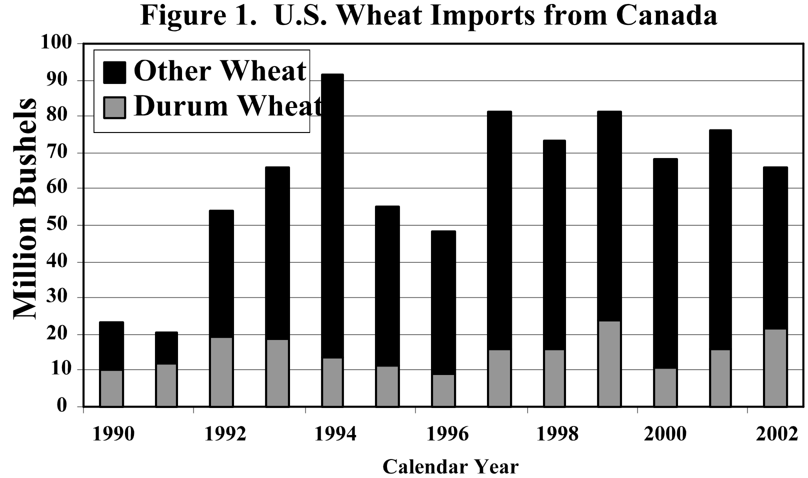
There has been considerable debate about the impact of Canadian wheat imports on U.S. wheat prices, especially with the recent surge in imports. For example, from 1991 to 1994, wheat imports from Canada to the United States went from 23 million bushels to 91 million bushels (see figure 1). Although lower since 1994, Canadian wheat imports to the United States continue to be in the 60 to 80 million bushel per year range, well above what was experienced prior to the early 1990s.

Even though imports have increased substantially, some argue that Canadian imports remain relatively small in comparison to the entire U.S. wheat market, thereby having limited impact on U.S. prices. While it is true that at their highest point in 1994 Canadian wheat imports represented only 3 percent of total wheat supplies in the United States, this does not necessarily mean that the impact on U.S. wheat prices is small for several reasons.[1]

First, wheat is categorized into different classes. In the U.S., there are 5 classes of wheat: white wheat, soft red wheat, hard red winter wheat, hard red spring wheat and durum. Each class of wheat has different end uses in terms of milling and baking characteristics, making substitution between wheat classes far from perfect (Antle and Smith). Thus, even though total Canadian wheat imports are relatively small in comparison to total U.S. wheat supplies, when one examines the class of wheat being imported, the comparison is much different.

Figure 1. U.S. Wheat Imports from Canada



[1] Total U.S. wheat supplies are defined as stocks of wheat at the beginning of a year, plus U.S. production plus imports from foreign countries.

For example, in the smaller durum and hard red spring wheat markets, Canadian durum imports represent as much as 13 percent of total U.S. durum wheat supplies and Canadian spring wheat imports represent as much as 10 percent of U.S. hard red spring wheat supplies during the period 1990 to 2002. Therefore, the impact of Canadian imports of certain wheat classes on U.S. wheat prices in certain classes could be significant.

Second, imports of Canadian wheat into the U.S. are geographically concentrated in two main port regions: Duluth, MN and Pembrina, ND. In 2002, nearly 75 percent of the Canadian wheat flowing into the U.S. came through these two ports (see figure 2). In addition, Minnesota and North Dakota represent significant producing areas for U.S. hard red spring wheat and durum wheat, the primary class of wheat being shipped from Canada. Because Canadian wheat imports are largely coming into the primary production area for In what follows, we present estimated impacts of Canadian wheat imports on U.S. hard red spring and durum wheat prices. The analysis is based on monthly wheat imports into key U.S. ports for these two classes of wheat during the period September 1997 through December 2002. U.S. prices are observed in 57 different hard red spring wheat markets and 23 durum wheat markets during this period. Regression analysis is used to estimate the price impact on these markets from Canadian wheat imports. U.S. hard red spring and durum wheat, it seems likely that the price impact to farmers of these classes of wheat could be large.

Data and Methodology

Imports of wheat into the United States were obtained from the U.S. Census Bureau's Foreign Trade Statistics Division. These data provide the quantity of wheat being shipped from specific countries, which arrives in a certain U.S. port district. In the case of Canada, the majority of the wheat arrives at two primary U.S ports: Pembrina, ND and Duluth, MN (see figure 2). Of the wheat being shipped from Canada to theses two ports, nearly all is durum and hard red spring wheat. Therefore, our analysis of Canadian wheat imports focuses on the U.S durum and hard red spring markets. These markets are mostly confined to the Northern Plains and the Pacific Northwest, coinciding with the U.S. production of these wheat classes. In addition to the two ports listed above, we also consider the flow of Canadian wheat into the Seattle, WA and Great Falls, MT port districts, although the amount of wheat into these ports is significantly less. For durum wheat, there were no shipments into the Seattle, WA port area during the study period.

The total monthly shipments of wheat from Canada to these U.S. ports are presented in figure 3 for durum wheat and hard red spring wheat. As can be seen, Canadian wheat imports exhibit considerable variation over a short time period. For example, hard red spring wheat imports from Canada rose from 1 million bushels a month at the start of 2000 to nearly 5 million bushels a month by the start of 2001. A significant decline in imports also occurred in 2002, as imports of other wheat fell from nearly 6 million bushels a month at the start of 2002 to no imports at the start of 2003. This decline was largely a result of a poor Canadian wheat crop in the summer of 2002 that limited their supplies.

Figure 2. Canadian Wheat Imports by U.S. Port of Entry, 2002

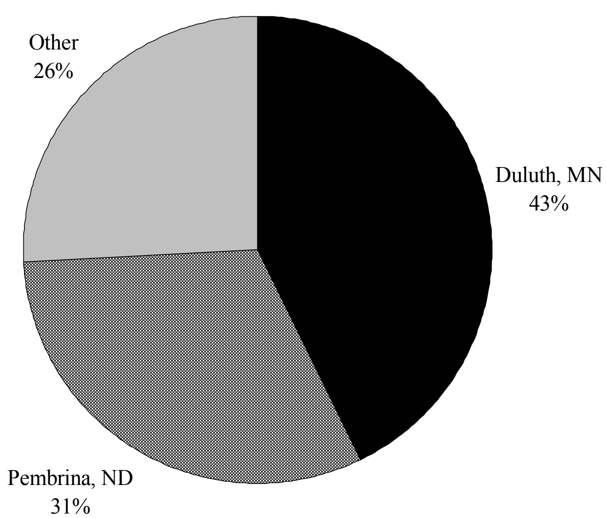
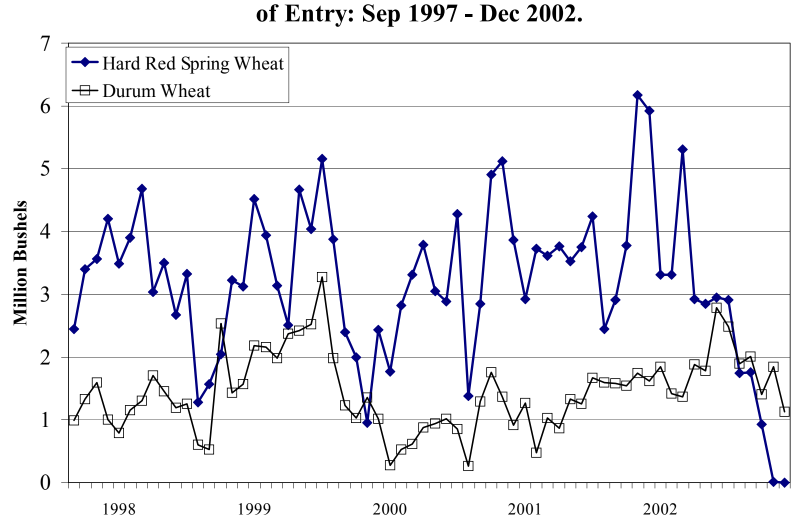


Figure 3. Canadian Wheat Imports into Select U.S. Ports of Entry: Sep 1997 - Dec 2002.



Ports of Entry for Other Wheat are Duluth, MN; Pembrina, ND; Great Falls, MT and Seattle, WA while Ports of Entry for Durum Wheat are the same ports except Seattle, WA.

Figure 4. U.S. Spring Wheat Markets Used in Analysis

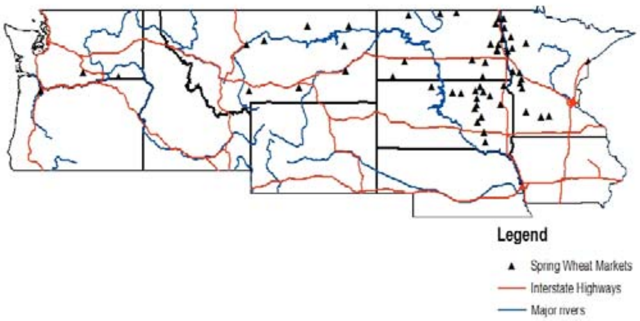
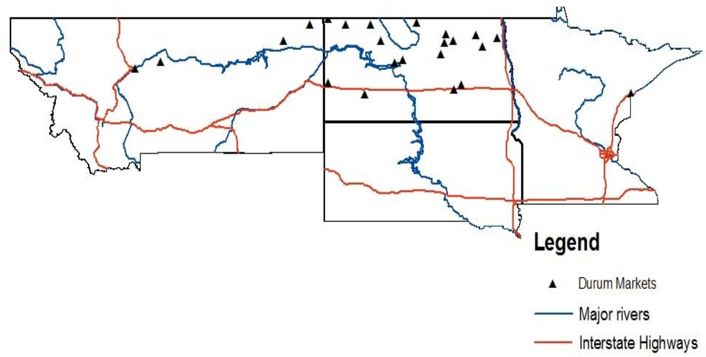


Figure 5. U.S. Durum Wheat Markets Used in the Analysis



To examine whether these variations in Canadian wheat imports impact U.S. wheat markets, prices paid to farmers at various country elevators and grain terminal markets were collected over the period September 1997 through December 2002. Although wheat prices are quoted in most states in the country and for various classes of wheat, for this study attention was focused on prices for durum and hard red spring classes in the Pacific Northwest and Northern Plains region of the United States.

These regions are the predominant production areas in the U.S. for these two classes of wheat. In addition, only those markets that reported continuously over the sample period September 1997 through December 2002 are used. This resulted in 23 durum markets and 57 spring wheat markets. The specific locations are displayed in a map on figures 4 and 5.

To quantify the impact of Canadian wheat imports on U.S. wheat prices it would be empirically appealing to simply compare U.S. wheat prices with Canadian wheat imports. If imports went up, one would expect the U.S. price to decline and vice versa. However, in practice, other economic factors also influence prices over time making a direct comparison of prices and imports problematic.

Year to year changes in grain production play a large role in determining U.S. grain prices. In addition, utilization of grain domestically or exports of grain to foreign countries can also change quite prominently over time leading to large changes in prices. To control for variation in supply and demand over time, we utilize a measure of relative U.S. wheat ending stocks for the marketing year, as projected by USDA on a monthly basis. This measure takes ending stocks of wheat for the marketing year and divides it by total usage of wheat. The projections for ending stocks are perhaps the single most important statistic because it measures the surplus to be carried forward to the next crop year (Purcell and Koontz). One would expect lower prices of wheat in times of higher stocks and vice versa.

Figure 6. Price Impact on Spring Wheat Markets from a One Million Bushel Increase in Canadian Imports

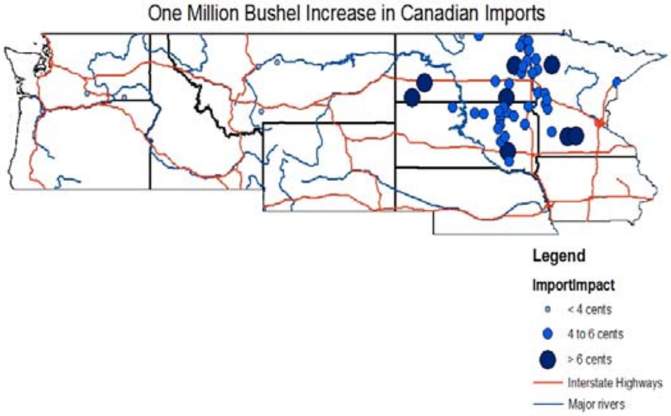
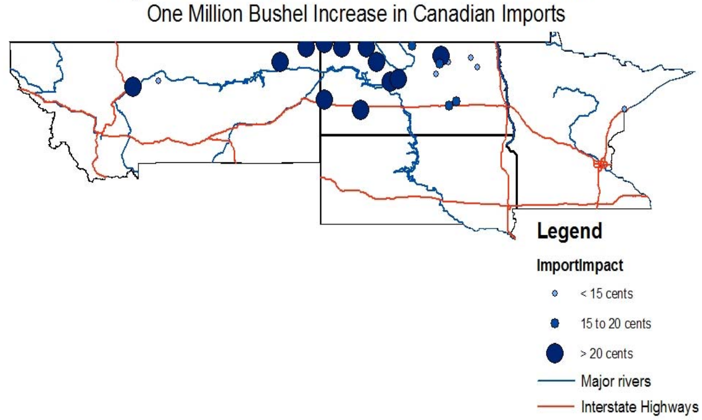


Figure 7. Price Impact on Durum Wheat Markets from a One Million Bushel Increase in Canadian Imports



In addition to variations in stocks, exchange rates between foreign countries can influence grain prices. Wheat is extensively traded in international markets and the U.S. ships a sizable portion of its crop to international markets. Therefore, changes in U.S. currency values relative to foreign currencies can have important consequences for wheat prices. As the U.S. dollar strengthens against foreign currencies, this makes U.S. wheat more costly for foreign buyers. Thus, one would expect a higher U.S. currency value to cause wheat prices to decline to remain competitive in world markets. For this analysis, the U.S. dollar and Canadian dollar exchange rate is used to account for variations in currency values over time. Although seasonality may also influence grain prices, a model using month dummy variables was found to not have statistically significant seasonal effects.

In full, the model estimated is:

(1) $$P_{it} = \alpha_i M_i + \beta SUR_t + \delta E_t + \gamma_i I_t + e_{it}$$

where P_{it} is the price in market i in time period t, M_i is a market dummy variable for market I which accounts for spatial price variations. The variable SUR_t is the projected ending stocks of wheat relative to total use of wheat in period t. This variable is projected monthly by the World Agricultural Outlook Board of USDA. The exchange rate, E_t, measures the U.S. dollar relative to the Canadian dollar. Finally, I_t is the Canadian wheat imports into the 4-port region of the U.S. for spring wheat and the 3-port region for durum wheat.

In equation (1), we assume that the impact of Canadian wheat imports vary by market based on the parameters γ_i, but the effect of stocks and exchange rates is the same across all markets, as represented by the common parameters β and δ. A general model which allowed for different β_i and δ_i yielded similar results to the more parsimonious version presented here. In addition, hypothesis tests of a common parameter for each market (i.e., $\beta_i = \beta$ and $\delta_i = \delta$) could not be rejected.

Because of the spatial nature of the data, it is likely that the errors in equation (1) are correlated. Specifically, for any two markets i and j, the $\text{cov}(e_{it},e_{jt})>0$, which violates the classical assumptions of linear regression. However, there are appropriate methods for dealing with spatial auto correlation, relying on maximum likelihood methods. See Appendix A for a discussion of the estimation procedure used here.

Results

This section presents the parameter estimates from equation (1) for the hard red spring and durum wheat markets. In general, estimated parameters from the model conformed to expectations. First, the parameter estimate on the SUR variable is negative and statistically significant, indicating that higher stocks resulted in lower wheat prices. Second, the parameter estimate associated with the exchange rate variable, E_t, was also as expected with a stronger Canadian dollar against the U.S. dollar leading to higher U.S. wheat prices.

As for the parameter estimates associated with Canadian wheat imports, the results were mostly consistent across markets and types of wheat. Higher imports lead to lower U.S. wheat prices. However, the magnitude of the impact and the statistical significance of the results varied spatially, with markets closer to the large import areas of North Dakota and Minnesota having greater impacts.

For spring wheat, the estimated price impact from a one million bushel change in Canadian wheat imports are presented in table 1.[1] For the 57 markets examined 48 of the markets showed a significantly negative impact at the 10 percent level from higher Canadian wheat imports. The 9 markets that showed no significant impact were geographically concentrated in Oregon, Washington and Montana. There are two reasons these regions saw limited to no impact from Canadian spring wheat imports. First, the majority of the spring wheat from Canada comes into North Dakota and Minnesota, and only a limited amount enters Washington and Montana. Thus, the direct impact of Canadian wheat imports entering Montana, Washington or Oregon is limited. Second, U.S. spring wheat trading patterns are such that spring wheat from Montana to the West Coast will move through the Port of Portland, OR, while spring wheat in North Dakota, Minnesota and South Dakota tends to move to Minneapolis for milling or to the Mississippi River for export through the Gulf. Therefore, changes in relative supplies of spring wheat in North Dakota, Minnesota or South Dakota as a result of more imports from Canada should have little influence on spring wheat prices in the Pacific Northwest.

For the 48 markets that were significantly impacted, the impacts ranged from a low of 3.7 cents a bushel in Southwest, MT to a high of 7.7 cents a bushel in Morgan, MN. On average across these 48 markets, the impact was 5.3 cents a bushel.

In the model for durum wheat prices and imports, the model results were qualitatively similar for the SUR variable and the exchange rate variable. However, estimated impacts of Canadian durum wheat imports were significantly larger in comparison to the spring wheat markets.

[1] All estimates presented here are based on the U.S. standard of bushels. For the international standard of metric tons, there is 27,216 metric tons of wheat in one million bushels of wheat.

Table 1. Price Impact on U.S. Spring Wheat Prices from a One Million Bushel Increase in Canadian Other Wheat Imports.

State	City	Market Dummy	Imports	P-Value on Imports
MN	Duluth	257	-5.6	0.001
MN	Lafayette	192	-6.8	0.001
MN	Cottonwood	205	-5.5	0.001
MN	Herman	209	-5.7	0.001
MN	Morgan	197	-7.7	0.001
MN	Morris	204	-5.2	0.001
MN	Ada	203	-5.2	0.012
MN	Breckenridge	214	-5.1	0.009
MN	Elbow Lake	204	-4.6	0.001
MN	Fergus Falls	205	-5.0	0.005
MN	Fosston	206	-6.6	0.001
MN	Perley	200	-5.0	0.031
MN	Alvarado	198	-5.0	0.015
MN	Crookston	202	-5.0	0.015
MN	Kennedy	190	-5.5	0.012
SD	Watertown	203	-5.4	0.001
SD	Bristol	201	-4.6	0.021
SD	Sisseton	207	-4.8	0.016
SD	Mitchell	198	-6.7	0.001
SD	Alpena	197	-5.4	0.009
SD	Huron	200	-4.8	0.011
SD	Tripp	193	-5.8	0.001
SD	Aberdeen	198	-4.5	0.034
SD	Columbia	191	-4.6	0.037
SD	Groton	199	-5.1	0.021
SD	Java	191	-5.2	0.011
SD	Mellette	198	-5.1	0.016
SD	Redfield	199	-4.9	0.015
SD	Roscoe	193	-4.5	0.031
SD	Tulare	199	-4.8	0.018
SD	McLaughlin	186	-4.8	0.032
ND	Galesburg	196	-5.4	0.024
ND	Hunter	196	-5.4	0.023
ND	Kathryn	193	-5.4	0.018
ND	Drayton	192	-5.9	0.004
ND	Finley	201	-6.1	0.005
ND	Grafton	193	-5.7	0.004
ND	Mayville	196	-5.1	0.024
ND	Thompson	197	-5.9	0.004
ND	Bottineau	184	-3.6	0.092
ND	Rolla	174	-4.6	0.019
ND	Jamestown	219	-5.5	0.008
ND	Oakes	219	-7.2	0.002
ND	Gladstone	196	-6.2	0.012
ND	Scranton	205	-6.2	0.014
ND	Bowbells	172	-1.5	0.519
MT	Billings	200	-3.3	0.115
MT	Northeast	186	-2.5	0.312
MT	Circle	183	-2.5	0.298
MT	Southeast	183	-3.1	0.184
MT	Great Falls	213	-3.6	0.114
MT	G. Triangle	218	-3.7	0.075
MT	N. Central	206	-2.6	0.218
MT	Southwest	243	-3.7	0.089
OR	Portland	305	-3.4	0.135
WA	Toppenish	261	-3.9	0.095
WA	Walla Walla	259	-3.8	0.133
		SUR	-5.45	0.001
		Exchange Rate	4.73	0.001
		Rho[1]	0.936	0.001
		R-Squared	0.9769	

[1]Spatial autocorrelation coefficient.

Table 2. Price Impact on U.S. Durum Wheat Prices from a One Million Bushel Increase in Canadian Durum Wheat Imports.

State	City	Location Dummy	Imports	P-Value on Imports
ND	Benedict	-104	-20.1	0.001
ND	Bottineau	-108	-18.7	0.001
ND	Bowbells	-100	-24.3	0.001
ND	Buchanan	-129	-15.2	0.004
ND	Churchs Ferry	-123	-11.4	0.041
ND	Cleveland	-122	-15.4	0.003
ND	Dahlen	-109	-14.5	0.011
ND	Fairdale	-125	-14.1	0.011
ND	Garrison	-96	-21.1	0.001
ND	Gladstone	-85	-25.6	0.001
ND	Grafton	-150	-7.3	0.171
ND	Maddock	-126	-10.7	0.033
MT	Wolf Point	-98	-25.5	0.001
ND	Berthold	-96	-20.2	0.001
ND	Crosby	-99	-22.4	0.001
ND	Fortuna	-99	-23	0.001
MN	Duluth	-24	-12.3	0.019
ND	Beach	-93	-24.9	0.001
ND	Bisbee	-97	-21.8	0.001
ND	Harlow	-106	-17.7	0.001
MT	Golden Triangle	-121	-13	0.065
MT	Great Falls	-91	-21.8	0.001
MT	NorthEast	-99	-23.7	0.001
		SUR	-9.48	0.001
		Exchange Rate	12.42	0.001
		Rho[1]	0.828	0.001
		R-Squared	0.925	

[1]Spatial autocorrelation coefficient.

Table 2 presents the results for the 23 durum markets considered in this analysis. Only 1 of the 23 markets showed an insignificant impact from Canadian durum wheat imports at a significance level of 10 percent. On average across the 22 markets that exhibited a statistically significant impact, the average price impact was 19.0 cents a bushel from a one million bushel increase in Canadian durum wheat imports. Given that the durum wheat market is much smaller than the spring wheat market, it is not surprising that the impacts of durum imports are larger in the U.S. durum market than the same magnitude of imports in the spring wheat market.

APPENDIX A: Estimation with Spatial Autocorrelation

The empirical model estimated in this study is likely to exhibit spatial autocorrelation in the errors, u_{it}. That is, for a given time period t any two markets i and j will likely have positive correlation ($E[u_{it}u_{jt}]>0$) which violates the assumptions of least squares regression. Advances in spatial econometrics provide a framework for dealing with this problem. Anselin (1988) provides a maximum likelihood method for a general regression model of the form:

$$y = X\beta + e$$
$$e = \rho We + u$$
$$e \sim N(0,\sigma^2 I)$$

where y is a vector of dependent variables and X represents the data matrix containing explanatory variables. W is a known spatial weight matrix and the parameter ρ is a coefficient on the spatially correlated errors analogous to the serial correlation problem in time series models. The weight matrix W quantifies the spatial aspect of the data by signifying which observations are linked. There are numerous means of constructing a spatial weights matrix, with the appropriate method being primarily an empirical matter. [3]

We utilize a distance-based method to construct the spatial weight matrix, such that markets that are relatively close to each other will have a larger weighting in the spatial weights matrix. The exact computation routine of the spatial weight matrix is available from the author.

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[3] For a good treatment of spatial weight matrix issues, see Appendix 1 of Kelejian and Robinson