Do Interest Rates Explain Disaggregate Commodity Price Growth?

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Abstract

The storage at a loss paradox—inventories despite an inadequate spot-futures price spread to cover storage costs—is an unresolved issue of long-standing interest to economists. Alternative explanations include risk premiums for futures market speculators, convenience yields from holding inventories, and mismeasurement/aggregation of data. Statistical analyses of regional- and elevator-level data suggest that aggregation can impact results, and that soybean price behavior is generally consistent with inter-temporal arbitrage conditions, while corn price behavior points to convenience yields at longer horizons.

Key Words: storage at a loss, aggregation, regional and elevator data, inter-temporal arbitrage, convenience yield, corn, soybeans

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Seasonal production and geographically-dispersed agricultural commodity markets imply that temporal and spatial dimensions are relevant to storage decisions. When and where to store is of chief concern to those involved in the production, processing and marketing of storable commodities, and to policymakers overseeing market performance. Empirical anomalies of inventories despite an inadequate futures-spot price spread to cover storage costs (i.e., warehousing plus interest opportunity costs) appear to violate inter-temporal arbitrage conditions. What causes the *storage at a loss paradox* is an unresolved issue of long-standing interest to economists.

As an alternative to conventional explanations, i.e., risk premiums (Keynes, 1930) and convenience yields (Kaldor, 1939; Working, 1948, 1949), some researchers (Wright and Williams, 1989; Benirschka and Binkley, 1995; Brennan, Williams, and Wright, 1997) suggest that data aggregation may produce the empirical anomalies.[1] More specifically, it is argued that the evidence for storage at a loss would disappear with precise definition of inventories and prices. The reason is that similar yet economically distinct commodities are often reported in the same data category, though they differ by time-varying costs of transformation (e.g., transportation, processing, and merchandising).[2] Notably, Benirschka and Binkley (1995) dismiss alternative explanations, claiming that all empirical deviations from the theory of storage can be remedied by disaggregating the data:

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[1] Risk premiums, compensation for futures market speculators bearing risk, may downwardly bias futures prices as estimates of expected spot prices, making storage appear unprofitable. A convenience yield is an inventory's inherent replacement value, a consequence of costly short-run inflexibilities in transporting, processing, and trading commodities, which may offset apparent losses from storage.

[2] Wright and Williams (1989) offer several examples of related, but economically distinct, commodities: the same grade of wheat at two different elevators, dirty and clean corn at the same elevator, and certified and uncertified stocks of coffee. There is a trade-off between transforming the currently abundant commodity into the currently scarce commodity, and retaining inventories of the abundant commodity, as it may become scarce in the subsequent period.

> (T)he ‘storage at a loss’ paradox is no paradox at all. By discouraging storage where (interest opportunity) costs are relatively high, it provides the mechanism whereby the market brings about efficient stockholding over space and time (p. 523).

In their model of optimal storage, spot price growth exactly covers interest opportunity costs of storage at inventory-holding locations, and hence, is faster in the north where inventories exist than at more southern locations that deliver earlier to the Gulf of Mexico export market. However, like many studies on storage at a loss, Benirschka and Binkley were hampered by a paucity of quality data. Further, their variable of primary interest (producer price received) was often insignificant, and the authors were able to offer only indirect empirical evidence in support of their theory of optimal storage.

This research employs a unique dataset to investigate the existence of *price growth-interest rate relationships* that, in conjunction with transportation costs, drive Benirschka and Binkley’s (1995) theoretical model of optimal storage. More generally, this research addresses whether the returns from holding commodities and financial assets are in fact equal. Two implications of Benirschka and Binkley’s (1995) findings are tested for Illinois corn and soybean spot markets for the marketing years 1975 through 2004.

First, Benirschka and Binkley’s (1995) claim that spot prices grow faster further from their central market, the Gulf of Mexico, is assessed using pairwise t-tests of north-south mean differences in price growth net of physical storage costs. Their argument is that higher transportation costs reduce commodity prices, and hence the interest opportunity costs of storage, at distant locations. Consequently, nearby locations deliver the commodity to the central market earlier than distant locations.[3] Significantly faster (slower) relative price growth at a northern location supports (contradicts) Benirschka and Binkley's (1995) notion that interest opportunity costs explain spatial price growth differences.

Second, we consider Benirschka and Binkley's (1995) assertion that spot price growth must exactly cover the interest opportunity costs of storage where inventories are held.[4] The validity of this inter-temporal arbitrage condition is assessed using pairwise t-tests of mean differences between price growth net of physical storage costs and three-month Treasury bill annual interest rates. Based on this assertion and the fact that corn and soybean inventories are continuously held across Illinois, price growth should consistently equal the interest rate.

Though expected and not realized prices should govern storage behavior, a lack of transportation cost data and a desire to test differences in price growth across locations necessitate the substitution of spot prices for futures prices in our analyses. An implied assumption of our empirical framework is that if futures prices, as unbiased predictors of future spot prices, cover storage costs, then so too should spot prices on average. As Benirschka and Binkley (1995) also utilized spot prices in their empirical analyses, our work is directly comparable.

Cumulative corn and soybean spot price growth net of physical storage costs, plotted over time from harvest (Figures 1 and 2, respectively), call into question the *price growth-interest rate relationships* suggested by Benirschka and Binkley (1995). Soybean price growth from harvest exceeds interest rates only in certain periods, while that of corn never attains such levels.

[3] Northern locations in U.S. corn and soybean markets also receive lower harvest prices, because harvest occurs later than in more southern locations. In corn, not only does this translate into a comparative advantage for storage in northern locations in terms of interest charges, but also in terms of shrink charges. Hence, producers at southern locations sell before prices hit harvest lows with completion of harvest at northern locations. At such depressed prices, producers in northern locations elect to store some portion of the crop, anticipating price to appreciate.
[4] In frictionless (i.e., zero transaction cost) markets, returns on commodity inventories (i.e. price growth net of physical storage costs) equal those on financial assets (Benirschka and Binkley, 1995). Departures from this are arbitrage opportunities, exploitation of which continues until rates of return are equalized.

Further, price growth for both commodities is often faster at the Benton and Mt. Vernon elevators than at the Belvidere and Maroa elevators, which are further from the Gulf of Mexico.

Literature Review

Researchers posit several explanations for the existence of inventories when markets are in backwardation.[5] Evidence from existing research is limited by a paucity of quality data, especially on inventories and prices at their locations, which led to the prevalent use of market-level and government prices and aggregated inventories or proxies. Keynes' (1930) risk premiums only account for instances when the observed loss from storage is small (Wright and Williams, 1989), and evidence on their existence is mixed (Benirschka and Binkley, 1995). The weight of the literature leans on convenience yields (Kaldor, 1939; Working, 1948) as the primary explanation for apparent storage at a loss (Wright and Williams, 1989). Theoretically, the marginal convenience yield decreases, approaching zero, as aggregate inventory increases. Though convenience yields are theoretically plausible, empirical support is modest (Wright and Williams, 1989), and inferences of their existence in the presence of large carryover stocks are particularly perplexing (Benirschka and Binkley, 1995).

Wright and Williams (1989) insightfully suggest that storage at a loss may be inferred from aggregated prices and inventories if one commodity is profitably stored, while a related yet economically distinct commodity is not stored, as the latter's expected price indicates backwardation. Significant inventories under backwardation diminish with more precise

[5] Backwardation (cantago) is the industry term for spot-futures price spreads indicating negative (positive) returns to storage (Garcia and Leuthold, 2004). While the difference between the expected future price and that for immediate delivery is less than total storage costs in markets in backwardation, the expected future price is below that for immediate delivery in an inverted market. Inversion implies backwardation, but not necessarily the converse. Backwardation has no negative price spread limit and is interpreted as a price premium for early delivery. Keynes (1930) referred to futures prices underestimating the true expected spot price as normal backwardation.

measurement, as evidenced by comparison of two supply of storage curves—total U.S. coffee stocks and stocks certified for futures contract delivery plotted against coffee futures price spreads.[6] This result was taken as evidence that market-level findings of storage at a loss are an illusion of aggregation.

Benirschka and Binkley (1995) echo that sentiment. In their model, prices, and hence interest opportunity costs of storage, decrease with increasing transportation costs to locations further from the central market, prompting sequential delivery with remote production areas holding long-term inventories and delivering later than those nearby.[7] Citing data limitations, they offer indirect evidence that storage capacity, especially on-farm, increases with distance to the Gulf export market, and that U.S. grain prices grow faster further from this central market and at a decreasing rate as the end of the marketing year nears. Despite negligible significance in regressions on their proxy for producer price received, Benirschka and Binkley (1995) suggest the calculation of interest opportunity costs with market prices (as opposed to prices received) as the source of the disparity between interest rates and commodity price growth.[8] Brennan, Williams, and Wright's (1997) analysis of Australian wheat markets provides stronger empirical support of the spatial aggregation argument (i.e., storage at a loss was remedied with proper measure of local prices).

Frechette and Fackler (1999) caution that additive storage costs impose faster price growth at locations further from the central market if transportation bases are constant year-round, and hence, that "the relative rate of change is lower in the higher-priced demand center,

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[6] This is really a joint test of the theory, data quality, and market competition. Wright and Williams (1989) find that "(S)torage of one subaggregate is consistent with backwardation of the other" (p. 8). Furthermore, the dispersion of supplies across subaggregates affects their synthetic supply of storage curves.
[7] Transportation costs decrease the price received, and hence the interest income from immediate sale.
[8] Benirschka and Binkley (1995) offer that a one-tailed test may be used to obtain a level of significance near 5% in the model for total storage capacity.

even if no backwardation occurs" (p. 764). Their finding that location effects are substantially smaller than the negative effect of aggregate inventory levels on far-near corn futures spreads contradicts Benirschka and Binkley's (1995) claim that the location of inventories explains backwardations.[9]

Yoon and Brorsen (2002) found a significantly positive influence of inventory levels on far-near corn, soybean, and wheat futures spreads, which they attributed to convenience yields; as inventories decrease price growth may fall into backwardation. Peterson and Tomek (2005) explicitly modeled convenience yields in the U.S. corn market using a rational expectations model that doesn't allow backwardation to depend on stock-outs which never occur in this market. Their relatively simple model, reflecting efficient markets and rational decision makers, successfully simulated spot and futures price behavior throughout much of the 1990s.

Cornell and French (1986) show that the change in nominal interest rates in response to monetary shocks during 1980-1982 was greater than that for far-near commodity price spreads. Regressing commodity futures price growth on interest rates and seasonal dummies, Fama and French (1987) find that that price growth of precious metals closely tracks nominal interest rates, while the relationship is generally insignificant for agricultural commodities, with the exception of soybeans and soybean meal.[10] The result is intuitive, as precious metals are closer substitutes for other financial assets than agricultural commodities which generate value in processing rather than as investments.[11] Kitchen and Rausser (1989) attribute findings of significant nonstochastic

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[9] The statistical significance of the location effects varied substantially across models and its economic significance was typically much lower than that of the inventory level effects (Frechette and Fackler, 1999). Inventory level effects were consistently significant at the 5% level.

[10] Fama and French's (1987) futures price growth rates, which neglected physical storage costs and were not adjusted to an implied annual rate, were regressed on annual interest rates and seasonal dummies.

[11] Investors may also shy away from agricultural commodities due to payments on margins.

commodity own-rates to convenience yields and suggest that arbitrage (transaction) costs may explain the imperfect relationship between commodity price growth and nominal interest rates.

Data and Variable Construction

Weekly corn and soybean spot prices for 19 grain elevators and seven Illinois regions (Figure 3) for the 1975 through 2004 marketing years were obtained from the Illinois Ag Marketing Service. The regional prices are publicly available, while the elevator spot prices were assembled for the analysis and reflect the most disaggregate data available to investigate the research questions. Three-month maturity Treasury bill interest rates, corresponding to the same period, were acquired from the Commodity Research Bureau, Inc. Physical commercial storage cost schedules for corn and soybeans (Table 1) in the Central Illinois Crop Reporting District (Figure 3) were compiled from personal communication with Dr. Darrel Good of the University of Illinois for 1975 through 1979, from Hill, Kunda, and Rehtmeyer (1983) for 1980 through 1988, and Irwin, et. al. (2005) for 1989 through 2005.[12] Monthly storage costs, accruing after the upfront fixed costs, are prorated to the number of days in storage.

Summary statistics for the raw data are presented in Table 2. Consistent with their closer proximity to the central market (i.e., the Gulf of Mexico), southern locations (e.g., Mt. Vernon and Benton) generally exhibited higher average, maximum, and minimum corn and soybean prices than northern locations (e.g., Belvidere and Avon). All price series were correlated at 0.98 or greater. The three-month Treasury bill annual interest rate averaged 6.62 percent, varying

[12] Irwin, et. al. (2005) note that physical storage charges in central Illinois, as measured by phone surveys, have not changed from 1995 through 2003 and the cite similar rates in Hill, Kunda, and Rehtmeyer (1983). Irwin, et. al. (2005) also note that in the long term little difference exists between elevator and farmer storage (variable plus fixed) costs.

between a maximum of 16.76 percent on December 12, 1980 and a minimum of 0.81 percent on June 19, 2003, with a standard deviation of 3.12 percent.

Variables used in analyses are defined in Table 3. All spot price growth rates are calculated net of physical storage costs and adjusted to an implied annual rate (not compounded) to allow equitable comparisons with annual interest rates. Price growth rates are computed over cumulative storage horizons (within any year, each horizon begins at harvest with successive horizons encompassing previous horizons) and consecutive storage horizons (successive horizons begin on the date that the previous horizon ends) for comparison.[13] Cumulative storage horizons begin with the approximate completion of harvest at the beginning of November and conclude at the end (instead of the beginning) of the closing months in Yoon and Brorsen's (2002) spreads, so that price growth may, with time, surpass the high initial fixed costs of storage (Table 1) to attain a level commensurate with interest rates (Figures 1 and 2). For instance, the price growth rate for the horizon denoted by Nov → Jan is the January 1 - November 1 logarithmic price difference, net of physical storage costs for that period. Price growth rates over consecutive storage horizons are computed analogously. The annual interest rate is the close of day three-month Treasury bill interest rate at the start of the storage horizon.

Summary statistics for and correlations between interest rates and price growth at representative elevators for horizons covering the traditional storage period are presented in Table 4. Inconsistent with Benirschka and Binkley (1995), price growth for corn and soybeans is generally greater in the southern locations (e.g., Mt. Vernon and Benton) for each horizon. For corn, these are less than the interest rate, while they are often greater than the interest rate for soybeans. The small correlations between corn price growth and interest rates are consistent

[13] Neglecting interest charges, cumulative horizons reflect the profitability of storage from harvest onward, while consecutive horizons are consistent with an inventory-holder revisiting the storage decision under revised expectations each storage horizon or with an agent purchasing post-harvest and storing.

with previous findings that interest rates have little influence on corn price growth (Cornell and French, 1986; Fama and French, 1987; and Kitchen and Rausser, 1989). The larger negative correlations between soybean price growth and interest rates are rather perplexing, especially given Fama and French's (1987) finding of a significantly positive relationship. The following empirical analysis provides further insight.

Methods and Results

Much of the preceding research on backwardation in commodity markets has relied on simple graphing (e.g., scatter-plots, etc.) and regression (e.g., least squares and maximum likelihood) techniques. Cumulative corn and soybean price growth rates net of physical storage costs plotted over time from harvest (Figures 1 and 2, respectively) illustrate examples contrary to Benirschka and Binkley's (1995) assertion that prices grow faster at locations further from the Gulf of Mexico. Specifically, prices for corn and soybeans grow fastest at Benton in the southernmost Little Egypt region for much of the traditional storage period. Price growth at Mt. Vernon in the Wabash region also generally outpaces that at Belvidere and at Maroa in the Northern and South Central regions, respectively. That price growth at Belvidere is often greater than that at Maroa is consistent with their assertion. Price growth converges across locations as the new crop year nears with price growth at more northern locations ultimately overcoming that at more southern locations. Thus, storing for nearly a year in the north is more profitable than in the south, and yet a losing proposition on both counts neglecting convenience yields. T-tests of price growth net of physical storage costs provide deeper insight on the validity of purported positive north-south price growth differences and the arbitrage condition that price growth should exactly cover interest opportunity costs.

Price growth must be positive to cover interest opportunity costs. Results for t-tests of the null hypothesis that price growth is non-positive are reported in Tables 5 and 6 for corn and soybeans. Statistically significant positive price growth is never found for corn, but is for soybeans over some storage horizons. In the interest of space, results for the remaining pairwise t-test analyses are reported only for horizons within the traditional storage period.

Pairwise t-tests of mean differences in price growth between paired elevators are reported for corn (Table 7) and soybeans (Table 8). Benirschka and Binkley's (1995) and Frechette and Fackler's (1999) claims of faster price growth further from the central market suggest a one-tailed test. However, given the limited geographical distance between locations, we employ a more conservative two-tailed test, as mean differences not significantly different from zero may be interpreted as indicating that the sites in question are two price centers in essentially the same location. Alternatively, such findings may be interpreted as weak evidence against both claims.

Consistent with Benirschka and Binkley (1995), several of the spatial differences in price growth for corn and soybeans are statistically significantly positive at the ten percent level or better, particularly for soybeans differences between elevators in Northern and North Central or South Central regions during Nov → April and Nov → June storage horizons.[14] These findings also corroborate Frechette and Fackler's (1999) point that additive (physical) storage costs impose faster relative price growth further from the central market.[15]

However, findings of statistically significantly negative spatial differences in price growth (e.g., the Belvidere -Benton and Belvidere -Mt. Vernon spatial differences over various

[14] The two-tailed test implies much fewer elevators with statistically significantly slower price growth than at Belvidere for corn than for soybeans. Using the less stringent and more theoretically appealing one-tailed test for corn, spatial differences between Belvidere and Gridley, Chestnut, and Maroa elevators, as well as between their encompassing regions, during Nov → Apr and Nov → Jun horizons attain statistical significance at the ten percent level or better. Positive spatial differences for elevators in these horizons are consistently statistically significant for both commodities when Belvidere is replaced in the calculations by Erie, the other elevator in the Northern region.

[15] Frechette and Fackler's (1999) model reveals that even without backwardations, which can not exist if interest rates or transportation costs equal zero, relative price growth must be lowest at the central market.

storage horizons for corn and soybeans) contradict Frechette and Fackler (1999), and also appear inconsistent with Benirschka and Binkley (1995). Tables 7 and 8 also evidence that aggregation effects are a potential concern. Over the Nov → Jun storage horizon for both, corn and soybeans, the spatial difference in price growth for the Northern-Wabash regional pair was statistically significantly negative, while it was not different from zero for the underlying Belvidere-Mt. Vernon elevator pair. Positive and significant differences for corn between Northern-North Central and Northern-South Central for Nov → April at the aggregate level that do not emerge at the elevator level appear to contrast with Benirschka and Binkley's aggregation explanation. The varying statistical significance of spatial differences in soybean price growth across the Northern-North Central regional pair and their underlying elevators pairs also suggests that averaging across elevators produces an aggregation effect at the regional level.

Tables 9 and 10 contain the results of pairwise t-tests of mean differences between price growth and interest rates for corn and soybeans. Here, we use a two-tailed test of the equivalence between price growth and interest rates. Consistent with inter-temporal arbitrage conditions, price growth generally is not statistically significantly different from the interest rate for either commodity, with only one exception—storing corn for the Nov → Jul horizon which may imply a convenience yield. In contrast to the spatial analysis, aggregation does not change the inference of storage at a loss, as results are consistent across regional- and elevator-level series.

Comparisons of the relationships over time and space suggest inconsistencies in the results. For example, we find in most cases that t-tests support the inter-temporal arbitrage condition of equivalence between interest rates and price growth for all elevators. Yet, over space numerous statistical differences in growth rates exist between elevators. In general, these findings are explained by the fact that prices over space move together systematically as a function of an effective marketing system, implying that the existence of little statistical noise that might cloud differences in price growths. However, over time interest rates and price growths are less well correlated (Table 4, Figures 4 and 5), resulting in larger variances which make it more difficult to reject the null of equality of price growth and interest rates. Interestingly, when the null for price growth and interest rates is rejected (e.g. Belvidre for the corn Nov → July storage horizon) it mainly occurs in the Northern and Central areas of the state and suggests that price growth is less than the interest rate. During this period, spatial differences in price growth do not exist among these elevators, but spatial price differences emerge for the elevators in the more Southern area. The pattern is consistent with a faster price growth rate in the Southern area that does not differ statistically from the interest rate. Clearly, these findings fail to support Benirschka and Binkley's contentions.

Discussion and Conclusions

Using a unique and highly disaggregate set of weekly regional and elevator corn and soybean prices for the 1975 through 2004 marketing years, this paper investigates explanations for the storage at a loss paradox. In particular, two implications of Benirschka and Binkley's (1995) model supporting the illusion of aggregation explanation are examined. Specifically, we test the inter-temporal arbitrage condition of price growth and interest rate equivalence where stocks are held and whether prices grow faster further from the Gulf of Mexico due to lower interest opportunity costs of storage. All empirical analyses employ price growth rates net of physical storage costs. Overall, the evidence is mixed. We find that results vary over the level of data aggregation (i.e., regional- vs. elevator-level series) for pairwise t-tests of spatial differences in price growth, but are consistent for pairwise t-tests of the differences between price growth and interest rates. We do not find that price growth necessarily increases with distance from the Gulf of Mexico. Nor do we find that price growth must exactly encompass interest rates. Where we find prices growing less than interest rates we also find that price growth in Northern and Central areas is less than in the South which grow at the interest rate. These results undermine Benirschka and Binkley's (1995) argument that all empirical observations of storage at a loss can be remedied by disaggregating the data.

Pairwise t-tests were performed to evaluate whether spot price growth is faster in northern Illinois, due to lower interest opportunity costs of storage, than in southern Illinois where prices are higher. Price growth is often statistically significantly faster in more northern locations for corn and soybeans, but Frechette and Fackler (1999) caution that additive (physical) storage costs alone impose faster relative price growth further from the central market. Observations of statistically significantly slower price growth in the north contradict Frechette and Fackler's (1999) point perhaps suggesting that storage costs are not completely additive and appear to be inconsistent with Benirschka and Binkley's (1995) claim of faster relative price growth in the north stemming from a comparative advantage in interest opportunity costs.

Overall, t-tests render support for inter-temporal arbitrage conditions in both markets, with the exception being the Nov → Jul storage horizon for corn. This is consistent with Fama and French's (1987) finding that soybean (but not corn) price growth generally tracks interest, implying relatively stronger support in soybean markets for inter-temporal arbitrage conditions. While their conclusion follows from the "well-known implication of the theory of storage … that (far-near futures) basis for any stored commodity should vary one-for-one with the … interest rate" (p. 56), ours follows from direct tests finding mean equivalence between price growth and interest rates. Clearly, these inter-temporal findings are influenced by the conservative three-month Treasury bill interest rate we chose for the analysis. The three-month rate was selected because of its use in the literature and because it reflects well the decision framework used by Benirschka and Binkley—the choice between investment in storage or in a risk-free instrument. If a higher interest rate is more appropriate, then we may have underestimated the backwardation and convenience yields in both markets.

Despite the conservative interest rate, corn results support the hypothesis that other factors besides interest rates drive price growth in the Nov → Jul storage horizon, but not in soybeans. These results are consistent with Peterson and Tomek's (2005) strong evidence for convenience yields in that market, where the presence of higher fuel ethanol production in recent years may also be a contributing factor. Another potential explanation for the willingness to store when price growth is less than interest rates and even when it is less than zero is the prevalence of government programs for corn particularly during the early part of the sample period. In this case, spot prices may be less relevant to storage decisions in the presence of additional government assistance. For soybeans, one might suspect that the convenience yield has disappeared in soybean markets with increasing year-round availability from Brazilian production. In a somewhat similar vein, Chavas, Despins, and Fortenbery (2000) offer that Brazil's increasing soybean production decreased storage incentives for the spring and summer in the U.S because of changing transaction costs.[16] However, examination of the interest and net price growth rates for both corn and soybeans over the Nov → Jul horizon (Figures 4 and 5)

[16] Convenience yields typically are realized by agents that use the inventory as an input, whereas transaction costs are relevant to all would-be participants in inventory management. In contrast to convenience yields, which are generally thought to depend on inventory levels, Chavas, Despins, and Fortenbery (2000) find that marginal transaction costs depend on expected changes in inventory.

suggests a fairly consistent pattern through time that does not appear to be influenced systematically by these factors.

Finally, while some spatial differences in storage costs may exist, it seems improbable that our cost estimates influenced the results significantly. Storage technology throughout the state is similar so that the magnitudes of any cost differences are small and not likely to affect the overall findings. Clearly, further investigation of the observed differences in corn and soybean price behavior is warranted. Future research may examine more thoroughly the relevant tests of inter-temporal arbitrage conditions using futures and spot prices, and/or employ regression analyses to explore more deeply the impacts of interest rates and inventories on commodity price growth.

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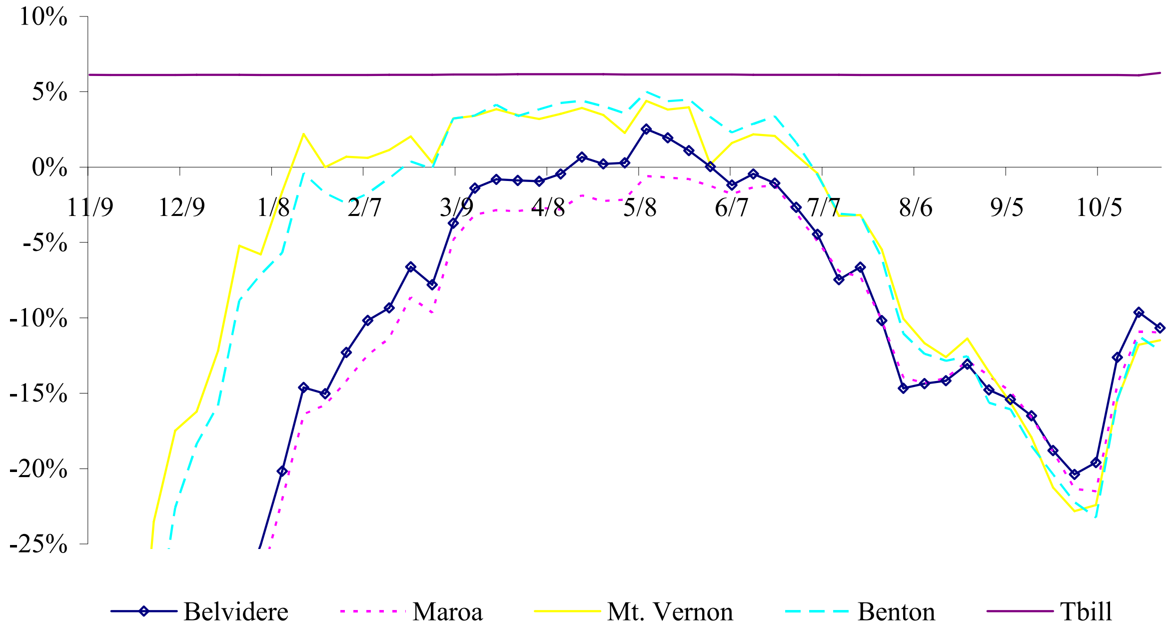

Figure 1. Annual Average Interest Rates and Net Corn Price Growth from Harvest, 1975 – 2004 Marketing Years.

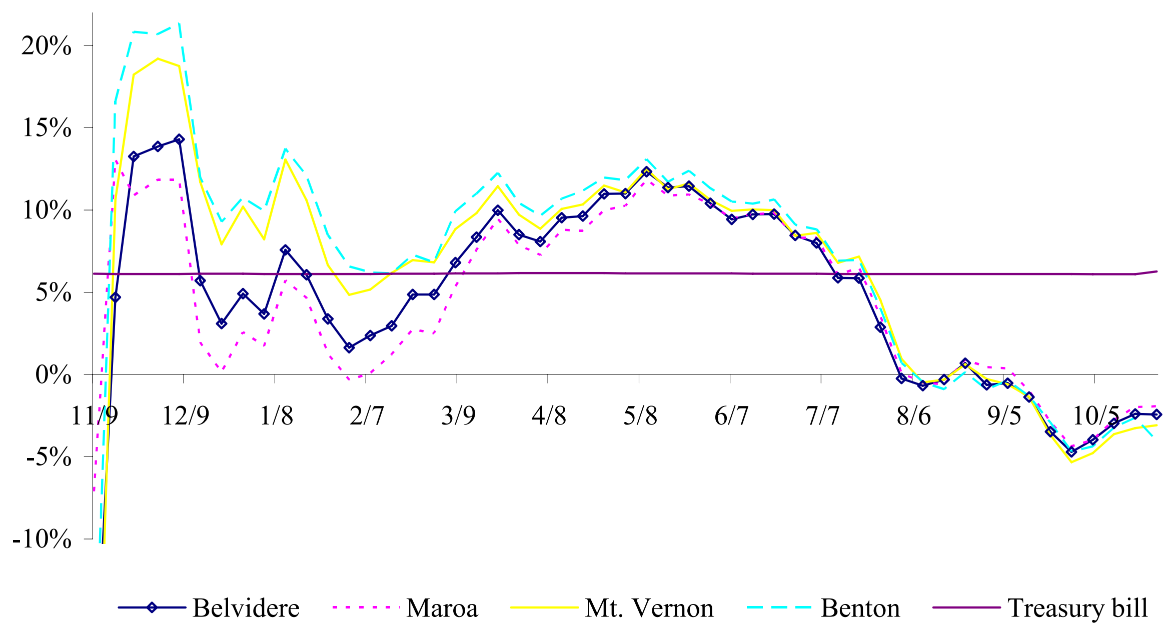

Figure 2. Annual Average Interest Rates and Net Soybean Price Growth from Harvest, 1975 – 2004 Marketing Years.

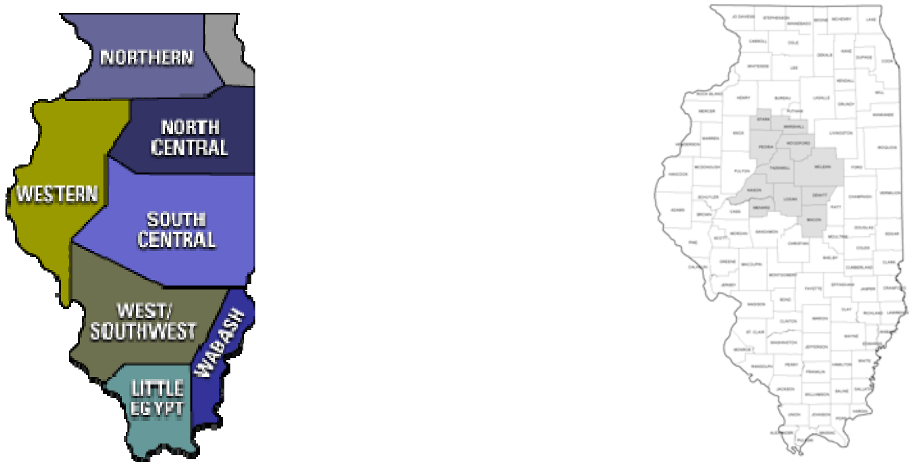

Figure 3. Illinois Price Reporting Districts and Central Illinois Crop Reporting District.

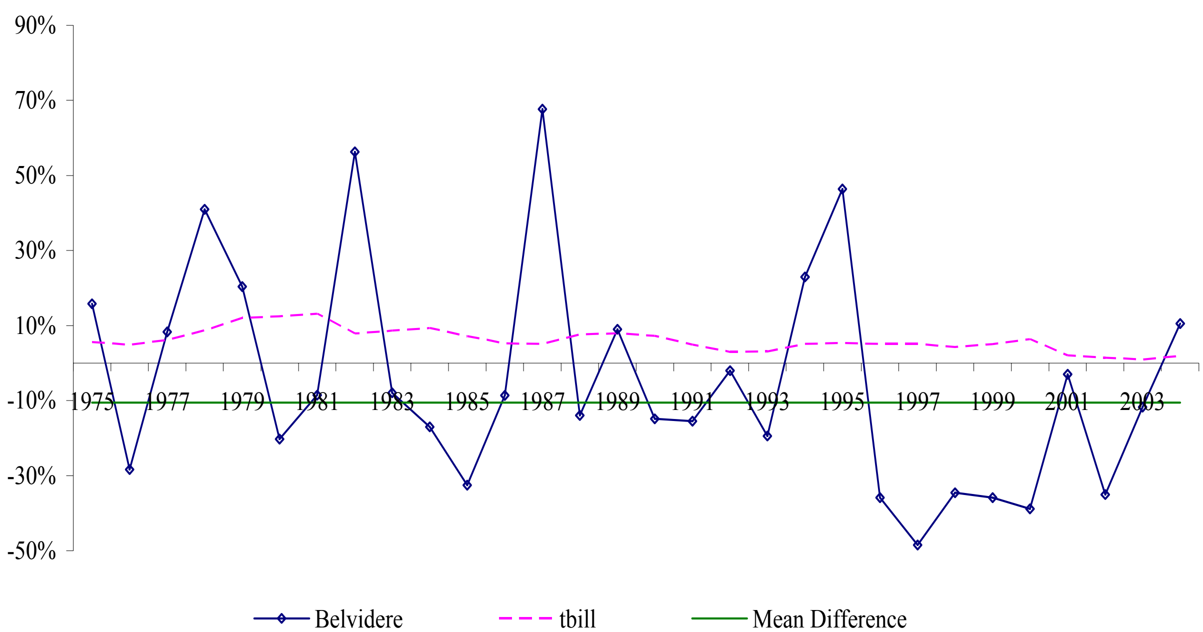

Figure 4. Net Corn Price Growth, Interest Rates and the Mean Difference for the Nov → Jul Storage Horizon, 1975 – 2004 Marketing Years.

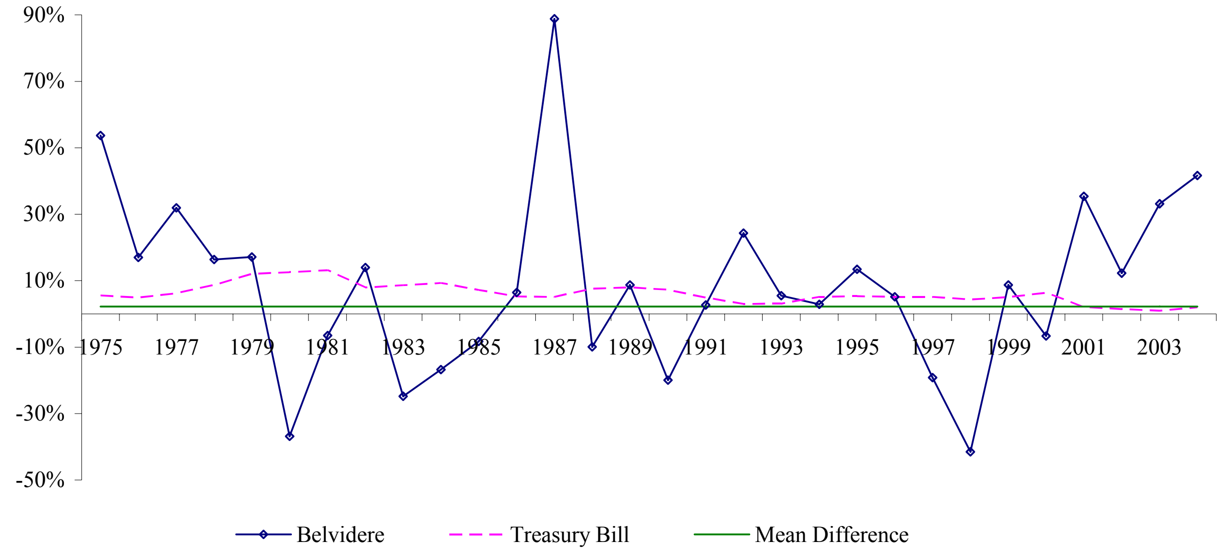

Figure 5. Net Soybean Price Growth, Interest Rates and the Mean Difference for the Nov → Jul Storage Horizon, 1975 – 2004 Marketing Years.

Table 1. Commercial Physical Storage Cost Schedules.

	Corn ($/bu)				Soybeans ($/bu)	
Period	Warehousing		Drying	Shrinkage	Warehousing	
	Harvest → Jan 31	Monthly (after Jan 31)			Harvest → Jan 31	Monthly (after Jan 31)
1975 - 1979[†]	0.100	0.015	0.010	1.30%	0.100	0.015
	Harvest → Jan 31	Monthly (after Jan 31)			Harvest → Jan 31	Monthly (after Jan 31)
1980 - 1988[‡]	0.129	0.021	0.023	1.30%	0.142	0.024
	Harvest → Dec 31	Monthly (after Dec 31)			Harvest → Dec 31	Monthly (after Dec 31)
1989 - 2005[F]	0.130	0.020	0.020	1.30%	0.130	0.020

[†] Personal communication with Dr. Darrel Good, University of Illinois at Urbana-Champaign.
[‡] Hill, L., E. Kunda, and C. Rehtmeyer. (1983). "Price Related Characteristics of Illinois Grain Elevators, 1982," AE-4561, Department of Agricultural Economics, University of Illinois at Urbana-Champaign.
[F] Irwin, S.H., D.L. Good, J. Martines-Filho, L.A. Hagedorn. (2005). "The Pricing Performance of Market Advisory Services in Corn and Soybeans Over 1995-2003." *AgMAS Project Research Report 2005-01*.

Table 2. Summary Statistics for Prices and Annual Interest Rates, 1975 – 2004 Marketing Years.

	Corn				Soybeans			
Price (dollars per bushel)	Mean	SD	Max	Min	Mean	SD	Max	Min
Northern Region	2.34	0.53	5.17	1.17	6.02	1.13	10.25	3.82
Belvidere	2.33	0.53	5.28	1.18	5.99	1.14	10.20	3.79
Erie	2.35	0.53	5.16	1.14	6.03	1.14	10.22	3.85
Western Region	2.36	0.53	5.16	1.10	6.05	1.14	10.25	3.87
Galesburg	2.34	0.53	5.12	1.11	6.03	1.14	10.17	3.85
Stronghurst	2.36	0.53	5.15	1.12	6.05	1.13	10.20	3.86
Avon	2.33	0.54	5.12	1.06	6.01	1.14	10.04	3.81
North Central Region	2.40	0.54	5.24	1.21	6.11	1.14	10.22	3.87
Manteno	2.39	0.54	5.31	1.26	6.09	1.14	10.21	3.84
Ashkum	2.41	0.54	5.19	1.27	6.11	1.14	10.26	3.91
Gridley	2.40	0.53	5.17	1.17	6.09	1.14	10.20	3.81
South Central Region	2.41	0.54	5.50	1.25	6.13	1.14	10.19	3.91
Chestnut	2.41	0.54	5.19	1.24	6.13	1.14	10.16	3.91
Maroa	2.42	0.54	5.21	1.24	6.14	1.15	10.19	3.92
Stonington	2.41	0.54	5.23	1.23	6.15	1.15	10.19	3.93
Jamaica	2.39	0.55	5.26	1.28	6.13	1.14	10.11	3.90
Mason City	2.40	0.54	5.19	1.12	6.09	1.14	10.23	3.88
Elkhart	2.40	0.54	5.20	1.22	6.12	1.15	10.20	3.88
West Southwest Region	2.41	0.55	5.24	1.23	6.12	1.14	10.24	3.99
Altamont	2.38	0.54	5.20	1.24	6.09	1.14	10.14	3.95
Carlinville	2.38	0.54	5.16	1.16	6.09	1.14	10.18	3.98
Nashville	2.41	0.56	5.37	1.24	6.10	1.15	10.28	3.94
Wabash Region	2.48	0.55	5.39	1.27	6.17	1.14	10.34	3.99
Mt. Vernon	2.47	0.55	5.20	1.21	6.20	1.15	10.37	4.03
Little Egypt Region	2.47	0.55	5.43	1.28	6.14	1.14	10.34	3.98
Benton	2.46	0.55	5.22	1.15	6.10	1.12	10.17	3.44

	Mean	SD	Max	Min
Three-Month T-Bill (percent)	6.10	3.12	16.76	0.81

Note: Weekly prices and three-month Treasury bill annual interest rates span from 10/30/1975 through 10/6/2005 and from 10/31/1975 through 10/6/2005, respectively.

Table 3. Definitions of Variables.

Variable	Description
Net price growth rate: $\%\Delta p_{i,t} = \frac{\left[\ln\left(p_i^{\tau} - s_t\right) - \ln p_i^{t}\right]}{d/365}$	The annualized logarithmic price difference at market *i* between the net price $(p_i^{\tau} - s_t)$ on the Thursday nearest to the beginning of the month concluding the storage period and the price p_i^t on the Thursday nearest to the beginning of the month initiating the storage period. Physical storage costs s_t accrue over the storage period, which begins and ends on Thursdays *t* and *τ*, respectively. Annualizing entails dividing the logarithmic price difference by the fraction of storage period days $d = \tau - t$ in a year.
Annual interest rate:	Three-month Treasury bill annual interest rate reported on the day closest to the beginning of the storage period *t*.

Table 4. Summary Statistics and Correlations for Price Growth and Interest Rates over Selected Storage Horizons, 1975 – 2004.

	Corn Price Growth Nov → Apr					Soybean Price Growth Nov → Apr				
Growth Rate (percent)	Mean	SD	Max	Min	Correlation with T-Bill	Mean	SD	Max	Min	Correlation with T-Bill
Belvidere	-0.93	28.63	90.73	-48.75	-0.0763	8.09	29.92	74.43	-40.27	-0.4557
Avon	-0.49	28.61	84.11	-44.86	-0.106	6.71	28.54	72.84	-34.10	-0.4689
Gridley	-2.38	28.78	82.27	-53.37	-0.0818	5.83	29.63	71.84	-41.81	-0.4656
Maroa	-2.69	29.63	83.84	-49.58	-0.0725	7.26	28.57	71.63	-43.78	-0.4640
Altamont	2.81	28.95	86.57	-44.75	-0.1171	7.70	29.03	72.82	-42.26	-0.4727
Mt. Vernon	3.19	28.12	79.17	-43.49	-0.0587	8.86	29.14	76.62	-42.10	-0.4559
Benton	3.84	28.06	81.00	-47.63	-0.0483	9.64	28.97	78.48	-39.59	-0.4341
T-Bill	6.12	3.08	13.14	0.94	1.0000	6.12	3.08	13.14	0.94	1.0000

	Corn Price Growth Nov → Jun					Soybean Price Growth Nov → Jun				
Growth Rate (percent)	Mean	SD	Max	Min	Correlation with T-Bill	Mean	SD	Max	Min	Correlation with T-Bill
Belvidere	0.04	25.39	65.22	-50.85	-0.0441	10.40	25.89	71.69	-38.16	-0.4318
Avon	-0.73	23.97	61.74	-48.80	-0.0438	9.26	24.84	67.47	-38.42	-0.4208
Gridley	-1.74	24.48	63.83	-49.59	-0.0156	8.85	25.63	68.75	-42.35	-0.4201
Maroa	-1.27	26.04	66.59	-53.30	-0.0152	10.34	24.69	67.93	-42.05	-0.4254
Altamont	1.92	25.39	65.44	-50.67	-0.0295	10.38	25.20	69.02	-41.84	-0.4324
Mt. Vernon	0.17	24.27	65.16	-44.65	-0.0151	10.60	25.31	71.36	-39.49	-0.4087
Benton	3.31	24.44	66.61	-42.29	0.0317	11.31	25.27	72.21	-37.69	-0.3764
T-Bill	6.12	3.08	13.14	0.94	1.0000	6.12	3.08	13.14	0.94	1.0000

	Corn Price Growth Nov → Jul					Soybean Price Growth Nov → Jul				
Growth Rate (percent)	Mean	SD	Max	Min	Correlation with T-Bill	Mean	SD	Max	Min	Correlation with T-Bill
Belvidere	-4.46	29.50	67.67	-48.50	0.0877	8.29	26.94	88.85	-41.52	-0.4188
Avon	-5.56	28.33	61.43	-45.73	0.0666	7.37	25.92	83.63	-41.33	-0.4297
Gridley	-5.34	28.80	70.54	-47.28	0.0912	7.06	26.45	85.32	-43.83	-0.4255
Maroa	-4.93	30.68	69.74	-58.27	0.0895	8.44	25.56	84.85	-43.44	-0.4249
Altamont	-1.78	29.76	76.36	-45.94	0.0692	8.52	25.92	84.29	-41.10	-0.4474
Mt. Vernon	-0.41	29.24	75.09	-40.70	0.0884	8.88	26.37	86.33	-38.94	-0.4341
Benton	-0.53	29.45	69.71	-43.39	0.1276	9.11	26.53	86.37	-38.41	-0.3995
T-Bill	6.12	3.08	13.14	0.94	1.0000	6.12	3.08	13.14	0.94	1.0000

Note: Annual observations = 30. Weekly prices and three-month Treasury bill annual interest rates span from 10/30/1975 through 10/6/2005 and from 10/31/1975 through 10/6/2005, respectively, and correspond to the 1975 through 2004 marketing years.

Table 5. T-Tests of Net Corn Price Growth Rates, 1975 – 2004 Marketing Years.

	Cumulative Storage Horizons					Consecutive Storage Horizons			
Annual Rate (percent)	Nov → Jan	Nov → Apr	Nov → Jun	Nov → Jul	Nov → Oct	Jan → Apr	Apr → Jun	Jun → Jul	Jul → Oct
Northern	-20.94	1.46	0.65	-4.43	-20.14	-0.52	-1.20	-30.45	-55.58
Belvidere	-25.05	-0.93	0.04	-4.46	-19.06	-1.90	2.66	-27.44	-52.24
Erie	-23.09	2.10	1.11	-4.26	-21.69	1.94	-1.23	-31.78	-62.08
Western	-20.02	0.35	0.12	-4.69	-21.79	-2.71	-0.36	-29.15	-61.18
Galesburg	-22.45	-0. 90	-0.97	-5.09	-21.14	-3.31	-0.94	-25.92	-58.64
Stronghurst	-23.25	1.60	1.12	-3.70	-20.93	1.29	-0.01	-28.45	-61.03
Avon	-22.18	-0.49	-0.73	-5.56	-22.21	-2.82	-1.17	-30.07	-60.09
North Central	-19.81	-0.65	-0.48	-4.76	-20.72	-4.21	0.11	-26.48	-58.19
Manteno	-22.65	-0.60	0.35	-4.12	-19.56	-2.43	2.83	-26.92	-55.97
Ashkum	-21.62	-1.02	-0.50	-4.26	-21.50	-3.64	0.98	-23.31	-61.27
Gridley	-24.23	-2.38	-1.74	-5.34	-20.82	-4.15	0.13	-23.30	-57.18
South Central	-20.49	-1.26	-0.72	-4.52	-20.66	-4.71	0.86	-23.81	-59.00
Chestnut	-26.09	-2.57	-1.84	-5.27	-21.03	-3.18	0.35	-22.47	-58.47
Maroa	-27.51	-2.69	-1.27	-4.93	-20.51	-2.46	2.58	-23.39	-57.55
Stonington	-26.01	-2.50	-1.48	-4.89	-21.02	-3.17	1.39	-22.05	-59.27
Jamaica	-18.38	1.34	0.87	-2.79	-20.45	-2.08	-0.16	-21.47	-62.10
Mason City	-19.81	-0.10	-0.67	-4.80	-19.77	-3.31	-1.91	-25.69	-54.93
Elkhart	-25.15	-2.40	-1.81	-5.26	-21.65	-3.59	0.02	-22.56	-60.48
Wabash	-5.29	4.55	4.25	1.01	-21.16	-4.78	3.21	-16.11	-73.66
Mt. Vernon	-5.80	3.19	0.17	-0.41	-21.38	-6.63	-7.20	-3.10	-71.10
West Southwest	-9.37	2.25	1.90	-1.74	-21.33	-6.28	0.96	-20.56	-67.62
Altamont	-12.39	2.81	1.92	-1.78	-21.52	-3.61	-0.32	-20.75	-67.57
Carlinville	-15.64	0.27	0.26	-3.25	-21.61	-5.61	0.36	-21.07	-64.07
Nashville	-9.33	3.99	2.94	-0.33	-21.44	-3.56	0.23	-17.44	-72.02
Little Egypt	-6.24	4.15	4.40	0.89	-21.74	-4.79	4.77	-17.62	-75.51
Benton	-7.11	3.84	3.31	-0.53	-21.47	-4.75	1.87	-20.66	-72.38

Note: Annual observations = 30. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. H_0: *Price growth* ≤ *0* and H_a: *Price growth* > *0*.

Table 6. T-Tests of Net Soybean Price Growth, 1975 – 2004 Marketing Years.

	Cumulative Storage Horizons					Consecutive Storage Horizons			
Annual Rate (percent)	Nov → Dec	Nov → Feb	Nov → Apr	Nov → Jun	Nov → Jul	Dec → Feb	Feb → Apr	Apr → Jun	Jun → Jul
Northern	14.70*	1.28	8.38*	10.48**	8.32**	-17.42	13.90*	15.78**	-6.01
Belvidere	13.87*	1.63	8.09*	10.40**	8.29*	-16.65	12.69*	16.26**	-5.71
Erie	16.88*	-0.30	8.52*	10.82**	8.41**	-20.55	16.49**	16.67**	-7.48
Western	12.64	0.52	7.57*	9.96**	7.91*	-17.55	13.07*	16.05**	-5.53
Galesburg	10.23	-1.02	6.59	9.45**	7.70*	-18.76	12.88*	16.82**	-3.95
Stronghurst	17.49*	0.08	8.32*	10.58**	8.81**	-20.23	15.51**	16.28**	-3.35
Avon	10.60	-1.01	6.71	9.26**	7.37*	-18.91	13.15*	15.79**	-4.98
North Central	8.04	-0.58	6.92	9.52**	7.57*	-17.04	13.09*	16.20**	-5.24
Manteno	6.00	-2.00	6.64	9.69**	7.20*	-182.7	14.40*	17.52**	-8.43
Ashkum	6.28	-0.97	6.74	9.80**	7.99*	-16.85	13.17*	17.69**	-3.50
Gridley	3.75	-2.75	5.83	8.85**	7.06*	-18.38	13.53*	16.65**	-4.33
South Central	3.75	-0.84	6.38	9.53**	7.69*	-16.43	12.17*	17.65**	-3.96
Chestnut	5.09	-2.24	6.21	9.23**	7.63*	-18.14	13.74*	17.01**	-2.33
Maroa	11.84	-0.32	7.26*	10.34**	8.44**	-18.15	13.54*	18.28**	-3.37
Stonington	5.76	-1.65	6.27	9.43**	7.89*	-17.54	13.07*	17.60**	-1.73
Jamaica	2.91	-2.73	6.17	8.92**	7.08*	-17.89	14.34*	15.99**	-4.85
Mason City	13.39	1.09	6.58	9.75**	8.11*	-16.97	9.92	17.92**	-3.09
Elkhart	6.97	-1.13	6.40	9.67**	7.99*	-17.40	12.62*	18.14**	-2.52
Wabash	17.23*	5.14	9.77**	11.79***	9.43**	-12.73	11.89*	16.82**	-5.77
Mt. Vernon	19.21**	4.84	8.86*	10.60**	8.88**	-13.93	10.18	14.94**	-2.90
West Southwest	15.99*	2.87	7.58*	9.99**	8.25**	-15.51	9.82	16.14**	-2.89
Altamont	15.49*	1.74	7.70*	10.38**	8.52**	-16.95	11.65	17.25**	-3.80
Carlinville	11.22	0.83	6.18	9.33**	7.84*	-16.47	9.33	17.47**	-1.53
Nashville	20.03**	4.21	8.22*	10.81**	9.02**	-15.37	9.44	17.37**	-1.81
Little Egypt	17.83*	5.37	9.80**	11.48***	8.93**	-12.74	11.61	15.65**	-7.72
Benton	20.69**	6.56	9.64**	11.31**	9.11**	-12.30	9.52	15.45**	-5.34

Note: Annual observations = 30. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. H_0: *Price growth* ≤ *0* and H_a: *Price growth* > *0*.

Table 7. Pairwise T-Tests of Spatial Difference in Net Corn Price Growth, 1975 – 2004 Marketing Years.

	Cumulative Storage Horizons			Consecutive Storage Horizons		
	Nov → April	Nov → June	Nov → July	Jan → April	April → June	June → July
Northern						
Belvidere - Erie	-3.03**	-1.07	-0.20	-3.83***	3.89**	4.34
Northern - Western	1.11	0.53	0.26	2.19**	-0.85	-1.30
Belvidere - Galesburg	-0.003	1.01	0.63	1.42	3.60*	-1.53
Belvidere - Stronghurst	-2.53**	-1.08	-0.76	-3.18***	2.67	1.01
Belvidere - Avon	-0.45	0.77	-5.56	0.92	3.83*	2.63
Northern - North Central	2.11***	1.13	0.30	3.68***	-1.32	-3.97*
Belvidere - Manteno	-0.34	-0.31	-0.34	0.53	-0.16	-0.52
Belvidere - Ashkum	0.09	0.54	-0.2	1.74	1.68	-4.13
Belvidere - Gridley	1.45	1.78**	0.88	2.25*	2.53*	-4.14
Northern - South Central	2.72***	1.36	0.09	4.19***	-2.06	-6.64***
Belvidere - Chestnut	1.64	1.88*	0.81	1.28	2.31	-4.97*
Belvidere - Maroa	1.76	1.31	0.47	0.56	0.08	-4.05
Belvidere - Stonington	1.57	1.52	0.43	1.28	1.27	-5.39
Belvidere - Jamaica	-2.27	-0.83	-1.67	0.18	2.82	-5.97
Belvidere - Mason City	-0.84	0.71	0.34	1.41	4.57***	-1.75
Belvidere - Elkhart	1.46	1.85*	0.80	1.70	2.64	-4.88
Northern - Wabash	-3.09**	-3.60***	-5.44***	4.26**	-4.42	-14.34***
Belvidere - Mt. Vernon	-4.12***	-0.13	-4.05***	4.74**	9.86	-24.34*
Northern - West Southwest	-0.80	-1.25	-2.69***	5.76***	-2.16	-9.89***
Belvidere - Altamont	-3.74***	-1.88*	-2.68***	1.71	2.99	-6.69**
Belvidere - Carlinville	-1.20	-0.22	-1.21	3.71***	2.31	-6.37***
Belvidere - Nashville	-4.92***	-2.89**	-4.13***	1.67	2.44	-10.00**
Northern - Little Egypt	-2.69**	-3.75***	-5.32***	4.27**	-5.97**	-12.82***
Belvidere - Benton	-4.77***	-3.27**	-3.93***	2.85	0.79	-6.78**

Annual observations = 30. ***, **, * denote statistical significance at the 1%, 5%, 10% level, respectively. H_0: *The mean difference* = *0* and H_a: *The mean difference ≠ 0*.

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Table 8. Pairwise T-Tests of Spatial Difference in Net Soybean Price Growth, 1975 – 2004.

	Cumulative Storage Horizons			Consecutive Storage Horizons		
	Nov → April	Nov → June	Nov → July	Feb → April	April → June	June → July
Northern						
Belvidere - Erie	-0.43	-0.42	-0.12	-3.80***	-0.41	1.77
Northern - Western	0.81**	0.52*	0.41	0.84	-0.27	-0.48
Belvidere - Galesburg	1.50***	0.95***	0.59*	-0.19	-0.56	-1.76
Belvidere - Stronghurst	-0.24	-0.18	-0.52	-2.82**	-0.02	-2.36
Belvidere - Avon	1.37**	1.14***	0.93**	-0.47	0.46	-0.73
Northern - North Central	1.45***	0.95*	0.75*	0.081	-0.41	-0.77
Belvidere - Manteno	1.45**	0.71	1.10*	-1.71*	-1.27	2.72
Belvidere - Ashkum	1.35**	0.60	0.31	-0.48	-1.44	-2.21
Belvidere - Gridley	2.25***	1.55***	1.23***	-0.84	-0.39	-1.38
Northern - South Central	1.99***	0.95*	0.63	1.73*	-1.87*	-2.05
Belvidere - Chestnut	1.88***	1.17**	0.66	-1.06	-0.75	-3.38
Belvidere - Maroa	0.83	0.06	-0.15	-0.85	-2.03	-2.34
Belvidere - Stonington	1.82***	0.97**	0.41	-0.39	-1.34	-3.98*
Belvidere - Jamaica	1.91***	1.48**	1.21**	-1.66	0. 27	-0.86
Belvidere - Mason City	1.51**	0.65*	0.18	2.77***	-1.67	-2.62
Belvidere - Elkhart	1.69***	0.73*	0.30	0.07	-1.88	-3.19*
Northern - Wabash	-1.40***	-1.31**	-1.11*	2.01	-1.04	-0.24
Belvidere - Mt. Vernon	-0.78	-0.20	-0.59	2.51**	1.31	-2.81
Northern - West Southwest	0.80*	0.49	0.07	4.09***	-0.36	-3.12*
Belvidere - Altamont	0.39	0.02	-0.22	1.03	-0.99	-1.91
Belvidere - Carlinville	1.91***	1.07**	0.45	3.36***	-1.22	-4.18**
Belvidere - Nashville	-0.13	-0.41	-0.73	3.25***	-1.11	-3.90
Northern - Little Egypt	-1.42***	-1.00**	-0.61	2.29**	0.14	1.72
Belvidere - Benton	-1.55**	-0.91	-0.81	3.17**	0.81	-0.37

Annual observations = 30. ***, **, * denote statistical significance at the 1%, 5%, 10% level, respectively.
H_0: *The mean difference* = *0* and H_a: *The mean difference ≠ 0*. The analysis was performed for the 1975 through 2004 marketing years.

Table 9. Pairwise T-Tests between Net Corn Price Growth and Interest Rates, 1975 – 2004.

	Cumulative Storage Horizons			Consecutive Storage Horizons		
Difference (percent)	Nov → Apr	Nov → Jun	Nov → Jul	Jan → Apr	Apr → Jun	Jun → Jul
Northern	-4.66	-5.47	-10.54*	-6.59	-7.43	-36.49
Belvidere	-7.05	-6.07	-10.58*	-7.97	-3.56	-33.48
Erie	-4.02	-5.01	-10.37*	-4.14	-7.45	-37.82
Western	-5.77	-6.00	-10.80*	-8.78	-6.58	-35.19
Galesburg	-7.02	-7.08	-11.20**	-9.38	-7.16	-31.96
Stronghurst	-4.52	-5.00	-9.81*	-4.79	-6.23	-34.49
Avon	-6.60	-6.85	-11.68**	-8.89	-7.39	-36.11
North Central	-6.77	-6.60	-10.88*	-10.28	-6.11	-32.52
Manteno	-6.71	-5.76	-10.23*	-8.50	-3.40	-32.97
Ashkum	-7.13	-6.61	-10.37*	-9.71	-5.24	-29.36
Gridley	-8.50	-7.85*	-11.45**	-10.22	-6.09	-29.35
South Central	-7.38	-6.83	-10.64*	-10.79	-5.37	-29.85
Chestnut	-8.69	-7.95	-11.39**	-9.25	-5.88	-28.51
Maroa	-8.81	-7.38	-11.04*	-8.53	-3.65	-29.43
Stonington	-8.62	-7.59	-11.01*	-9.24	-4.84	-28.09
Jamaica	-4.78	-5.24	-8.90	-8.15	-6.39	-27.51
Mason City	-6.21	-6.79	-10.91**	-9.38	-8.13	-31.73
Elkhart	-8.51	-7.93	-11.38*	-9.66	-6.21	-28.60
Wabash	-1.57	-1.87	-5.11	-10.85	-3.01	-22.15
Mt. Vernon	-2.93	-5.94	-6.53	-12.71	-13.43	-9.14
West Southwest	-3.86	-4.22	-7.86	-12.35	-5.27	-26.60
Altamont	-3.30	-4.20	-7.89	-9.68	-6.55	-26.80
Carlinville	-5.85	-5.85	-9.36*	-11.68	-5.87	-27.12
Nashville	-2.13	-5.85	-6.44	-9.64	-6.00	-23.48
Little Egypt	-1.97	-1.72	-5.23	-10.86	-1.46	-23.67
Benton	-2.28	-2.80	-6.64	-10.82	-4.35	-26.70

Annual observations = 30. ***, **, * denote statistical significance at the 1%, 5%, 10% level, respectively.
H_0: *The mean difference* = *0* and H_a: *The mean difference ≠ 0*. The analysis was performed for the 1975 through 2004 marketing years.

Table 10. Pairwise T-Tests between Net Soybean Price Growth and Interest Rates, 1975 – 2004.

	Cumulative Storage Horizons			Consecutive Storage Horizons		
Difference (percent)	Nov → Apr	Nov → Jun	Nov → Jul	Feb → Apr	Apr → Jun	Jun → Jul
Northern	2.26	4.36	2.21	7.79	9.56	-12.05
Belvidere	1.97	4.28	2.18	6.57	10.03	-11.75
Erie	2.40	4.71	2.29	10.37	10.44	-13.53
Western	1.45	3.85	1.79	6.95	9.82	-11.57
Galesburg	0.47	3.33	1.58	6.76	10.59	-9.99
Stronghurst	2.21	4.46	2.70	9.39	10.05	-9.39
Avon	0.60	3.15	1.25	7.03	9.57	-11.02
North Central	0.80	3.41	1.45	6.97	9.97	-11.28
Manteno	0.53	3.57	1.08	8.28	11.30	-14.48
Ashkum	0.62	3.68	1.87	7.05	11.47	-9.54
Gridley	-0.28	2.73	0.95	7.41	10.42	-10.38
South Central	0.27	3.41	1.57	6.05	11.43	-10.00
Chestnut	0.09	3.11	1.51	7.63	10.78	-8.37
Maroa	1.14	4.23	2.32	7.42	12.06	-9.41
Stonington	0.15	3.32	1.77	6.95	11.37	-7.77
Jamaica	0.06	2.80	0.96	8.22	9.76	-10.90
Mason City	0.46	3.63	2.00	3.80	11.70	-9.13
Elkhart	0.28	3.56	1.87	6.50	11.91	-8.57
Wabash	3.66	5.67	3.32	5.77	10.60	-11.82
Mt. Vernon	2.75	4.49	2.77	4.06	8.72	-8.94
West Southwest	1.46	3.88	2.14	3.70	9.91	-8.93
Altamont	1.58	4.27	2.40	5.54	11.03	-9.85
Carlinville	0.06	3.22	1/73	3.21	11.25	-7.58
Nashville	2.11	4.69	2.91	3.32	11.14	-7.85
Little Egypt	3.68	5.37	2.82	5.49	9.42	-13.77
Benton	3.53	5.20	2.99	3.40	9.22	-11.38

Annual observations = 30. ***, **, * denote statistical significance at the 1%, 5%, 10% level, respectively.
H_0: *The mean difference* **=** *0* and H_a: *The mean difference ≠ 0*. The analysis was performed for the 1975 through 2004 marketing years.