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The Forward Contract's Income Shifting Option and Implications on the Forward Basis

Previous studies have documented a cost of forward contracting grain relative to hedging in the futures markets. Our study quantifies the value of the income shifting option to forward contracting. An income shifting option refers to the fact that at harvest-time, a farmer can chose to sell uncontracted bushels of corn in the spot market or forward contract to sell after the first of the year. This option has non-trivial tax implications under a progressive tax system. By shifting income to the next tax year, a farmer can reduce the current year's income level and avoid a higher marginal income tax rate. Further, if country elevators have market power, they can capture some of the value of this income shifting option by offering a weak forward delivery January basis bid. In a sufficiently captive draw area, an elevator knows that a farmer will be willing to accept a weak January forward basis bid so long as he still receives some income tax benefits from deferring sales to the next tax year.

This option is most valuable during years when farmer income is high. Therefore, in this study we posited that during years of high farmer income we would see forward basis bids which are abnormally lower and appreciate at a slower rate than the harvest-time immediate delivery bids. We measure this effect using basis bids from elevators in seven regions in Illinois from 1980 to 2009. We find that a 1% increase in yield above trend level decreases the January delivery forward basis bids by 3 cents per bushel; we also find that the January delivery forward basis bids appreciate at 44% the rate of the immediate harvest-time delivery basis bids.

Keywords: Income tax, option value, marketing, basis, forward contract

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Surveys show that farmers prefer forward contracting over futures contracts to manage price risk; e.g., see Musser, Patrick, and Eckman (1996) and Patrick, Musser, and Eckman (1998). Further studies estimate that there exists an implicit cost of forward contracting; the cost of forward contracting which can be loosely defined as the change in the basis bid from the time the contract is signed to the delivery date. See Brorsen, Combs, and Anderson (1995), Townsend and Brorsen (2000), and Shi et al. (2005) for examples.

A farmer who has not previously contracted his grain at harvest-time has a different problem, however. The ability to sell one's grain at harvest *or* enter into a forward contract with January delivery provides the farmer with an income shifting option. Suppose crop yield is relatively good in this particular year. Delivering all of one's grain before January 1st may result in the farmer paying income taxes from a higher bracket; thus, having the option to transfer some or all of that income into the next calendar year is valuable. Presumably an elevator makes a forward bid based on:

$$\textit{forward bid}_t = \textit{Futures price}_t - T_t - \textit{Profit}_t$$

where T_t includes transportation and overhead costs and perhaps a risk premium. Elevators should be able to bid additional profit, $\textit{Profit}_t$, into the January forward bid during high income years when the later delivery period allows farmers to transfer some income to the next calendar year.

Previous research has given some attention to how tax policy effects farmer's marketing decisions. McNew and Gardner (1999) use a simulation model calibrated to the U.S. corn market to examine how farmers' storage behavior changes under progressive and flat income tax systems. They find that carryover stocks are reduced and price variability is increased under a progressive tax system relative to a flat tax system. Their insight is that under a progressive tax system, an increase in the inter tax-year price spread can induce less storage if the marginal tax-rate is high enough.

Tronstad (1991) explores after tax optimal hedging and storage behavior through the cotton marketing year using a stochastic dynamic programming model. He finds that cash sales are preferred to storage early in the marketing year, but as the end of the tax year approaches, storing cotton becomes more attractive. This is because the benefits of deferring income to the next tax year outweigh the probability of an adverse price movement.

Tronstad and Taylor (1991) use a stochastic dynamic programming model to determine the optimal dynamic marketing strategy of a Montana winter wheat producer, where the producer can store, sell in the cash market, hedge in the futures market, or use a combination of these strategies. They find that when cash prices are low and before tax income levels are low, cash grain sales are higher at the end of the tax year than at the beginning. Conversely, when before tax income levels are high, cash sales are deferred until the next tax year and the price hedged in the futures market.

This body of literature is small, but it is consistent in its prediction that (progressive) income taxes influence a farmer's optimal storage behavior. The question of whether or not this is reflected in actual farmer behavior or in equilibrium market outcomes has not been examined in actual data, however. In this article we recognize the ability to defer grain sales from one tax year to the next as a valuable income shifting option. It is highly likely that local grain elevator managers recognize the value of this option and would like to capture a portion for their own profits.

The immediate delivery basis is calculated as the difference in the harvest-time corn spot price and the December Chicago Board of Trade (CBOT) corn futures price, while the harvest-time forward basis bid for January delivery is calculated as January delivery forward corn price (quoted at harvest) minus the March CBOT corn futures price. If elevator managers are able to capture some of the income shifting option, we should find a specific pattern in spot and forward basis data. More specifically, farmer income should have a significant impact on the relationship between the spot and forward bases.

The first objective of this study is to derive the theoretical value of the income shifting option based upon the assumption that a farmer will prefer a January delivery forward contract to selling in the cash market at harvest so long as the forward spread is less in absolute value than the value of the income shifting option. The second objective is to determine if the income shifting option is recognized (and capitalized upon) by country elevator managers, and estimate how much this income shifting option weakens the January forward basis bid relative to the harvest-time basis bid. To this end we use a panel data set that contains forward and spot basis bids for harvest and January delivery at elevators in 7 regions in Illinois from the 1980 to 2009 crop years.   The dataset was generated by a weekly survey of elevators throughout Illinois by the Illinois Ag Market News.

In the next section we develop the conceptual framework of the income shifting option and show how it can affect farmer decisions and equilibrium basis levels. In the third section we describe the data we employ. The following section describes our estimation strategy and a final section concludes.

Conceptual Framework

Denote Y as the realized yield for the current marketing year. Suppose that if the harvest-time price, P_0, is such that income in the current year is greater than some threshold, $P_0 Y > \overline{I}$, then the farmer is subject to a marginally higher income tax rate of τ. In high income years his net income is $P_0 Y(1-\tau)$. By delaying the sale of some of the crop a farmer can lower his income in the current year and avoid paying the extra tax. If we assume that he has not previously forward contracted any of his crop he will choose how much to sell in the cash market at harvest, Y_0, and how much to contract for January delivery, Y_1, based on the cash and January delivery forward contract prices. Then a profit maximizing farmer will determine how much to sell in the spot market and how much to forward contract for January delivery according to the following decision problem:

(1)

$$\max_{Y_0, Y_1} P_0 Y_0 \left(1-\tau\right) + P_1 Y_1$$

$$\text{s.t. } Y_0 + Y_1 = Y \text{ and } \tau = \begin{cases} 0 & \text{if } P_0 Y_0 < \bar{I} \\ > 0 & \text{if } P_0 Y_0 \geq \bar{I} \end{cases}$$

Consider the farmer's problem if the harvest bid and the January bid were equal; i.e., $P_0 = P_1$. Then it is clear that there is a strong incentive for the farmer to delay some of his income until January to avoid paying the additional income tax when $\tau > 0$; specifically he will choose Y_0 so that $P_0Y_0 < \bar{I}$.

Now suppose that the elevator manager recognizes this. Then the elevator can capture some of the income shifting benefit by offering a January forward bid that is discounted relative to the spot bid by $0 < k < 1$ so that $P_1 = kP_0$. Then the farmer's decision problem becomes:

(2)

$$\max_{Y_0, Y_1} P_0 Y_0 \left(1-\tau\right) + kP_0 Y_1$$

$$\text{s.t. } Y_0 + Y_1 = Y \text{ and } \tau = \begin{cases} 0 & \text{if } P_0 Y_0 < \bar{I} \\ > 0 & \text{if } P_0 Y_0 \geq \bar{I} \end{cases}$$

Even when faced with a discounted price the farmer will forward contract a positive amount for January delivery, selling only as much as $Y_0 = \bar{I}/P_0$ at harvest, as long as the benefit of doing so is greater than if he sells his entire crop in the spot market. In other words, as long as the elevator manager chooses k large enough so that

(3)

$$P_0\left(\frac{\bar{I}}{P_0}\right) + kP_0 Y_1 \geq P_0 Y \left(1-\tau\right).$$

the farmer will accept the discounted forward price of $P_1 = kP_0$ and forward contract a positive amount for January delivery.

Solving inequality (3) for k, we see that as long as k is larger than the amount shown in inequality (4) the farmer is willing to tolerate the price discount and still sell some of his crop in the next tax year:

(4)

$$k \geq \frac{P_0 Y \left(1-\tau\right) - \bar{I}}{P_0 Y_1}$$

Notice that this threshold is decreasing in the marginal income tax rate, τ. This means that as the marginal income tax rate increases, farmers are willing to accept a lower January forward bid in exchange for the ability to shift some income into the next tax year.

This concept implicitly assumes that country elevators which buy corn from farmers have some level of market power. Otherwise competition among elevators would ensure the forward bid was competitively set relative to the spot basis and the benefits of the income shifting options would be enjoyed fully by the farmer. The literature on market power of country elevators is sparse, but Davis and Hill (1974) find some evidence of non-competitive spatial price spreads among elevators in Illinois. A more recent case study of the Cargill and Continental merger by Hayenga and Wisner (2000) suggests that many farmers sell their grain within a captive draw area. A captive draw area is an area around an elevator for which the transportation costs to an alternative location are high enough that the elevator is effectively a monopsony buyer of grain within that area.

In the next section we describe the data set we use to determine if grain elevators can capitalize on the income shifting option in the spot-forward basis differential.

Data

The panel dataset used in this study contains the basis for pre-harvest forward delivery contracts, harvest-time spot delivery, and harvest-time January forward contracts. The pre-harvest forward and harvest-time immediate delivery basis quotes are calculated relative to the CBOT December futures contract. Harvest-time January forward basis quotes are calculated relative to the CBOT March futures contract.

Bids are recorded on Thursdays in seven regions of Illinois over 1980-2010 for corn and soybeans. The seven regions are Northern (1), Western (2), Northern Central (3), South Central (4), West Southwest (5), Wabash (6) and Little Egypt (7). The basis bids are generated as a part of a daily survey by the Illinois Ag Market News of 50-60 elevators throughout Illinois that conduct significant spot and forward transactions with crop producers. The forward bases refer to #2 grade corn bought for shipment by rail or truck for harvest or January delivery to country elevators. Illinois Ag Market News currently disseminates the forward bases through daily electronic reports, but, historical bases are published in a hard copy format only on a weekly basis. The range of bases in each of the seven regions is reported for forward bids on every Thursday. The mid-point of the reported high and low price is used to obtain a single price for each region and week.

The entire data set contains forward basis quotes for harvest delivery starting soon after the first of the year. For example, in the 1980 crop year, harvest forward basis bids are reported first on February 22, 1980 and recorded weekly until the beginning of harvest, which in that year happens to be on September 4, 1980. This is recognizable in the dataset since the pre-harvest forward bids cease and harvest-time immediate delivery bids begin starting on this date. Then near the end of harvest season Illinois Ag Market News starts to report the January forward basis bids. In a typical year this begins in mid-September to early October and runs until the first part of December. The length of this period varies from year-to-year because it depends on the beginning and duration of harvest. See table 1 for a summary of definitions and timeframes of the data in our sample.

For our analysis, it is the brief period during harvest when immediate delivery basis bids and January delivery forward basis bids are simultaneously offered that will help us answer our question of interest. Therefore, we construct our dataset using only dates when both an immediate delivery basis bid and a January delivery forward basis bid are quoted. Depending on the length of harvest this means that some crop years have more observations than others. In the next section, we explore the properties of the data set prior to specifying an econometric model to test the income shifting hypothesis.

Evidence of the Income Shifting Option in the Data

In figure 1 we present a sample of the data. This shows a scatter-plot of the forward and spot basis bids for region 4 which is South Central Illinois. Three different basis bids are pooled across time and displayed on this chart. Pre-harvest forward basis bids are represented by the blue triangles and blue trend line. The red squares denote the harvest-time immediate delivery basis bids; the trend line is in red. January forward basis bids are represented by the green triangles and green trend line.

In this chart the two time periods, pre-harvest and harvest are visible in the patterns of the data. It is instructive to focus on the trend lines for a moment, however. Figure 2 contains the same information as figure 1, but with the individual data points suppressed so that we can focus on the trends. The pre-harvest (blue line) period has been the focus of the cost of forward contracting literature. The upward slope is indicative of the cost of forward contracting. By cost of forward contracting we mean that if a farmer signs a forward contract for harvest delivery he will, in an average year, receive a weaker basis that if he had hedged in the futures market and sold his actual grain in the cash market at harvest-time.

The problem we focus on in this paper, however, pertains to the harvest-time behavior because this is the period that can shed light on the income shifting option's effect. The green line in figure 2 represents the time trend of the forward basis for January delivery as quoted during the harvest season. The red line is the time trend of the immediate delivery harvest-time basis bids.

Compare the trend line of the forward basis for January delivery to the trend line of the immediate delivery harvest-time basis. The immediate delivery basis bid is noticeably stronger on average than the forward basis bid. Since the January forward contract is deliverable just days later and since all uncertainty about the size of the harvest, typically has been resolved at this point, we suggest that the relative basis pattern in the days just before the first of the year is consistent with our theory that elevator managers can capture at least some of the income shifting option.

The slopes of the two trend lines also are informative. The harvest-time immediate delivery quotes have a steep time trend relative to the January delivery forward basis quotes. The steep upward slope of the harvest delivery bids is not surprising given the glut in the local spot market when harvest begins.

The relative slopes of the harvest-time immediate delivery trend and the January delivery forward basis trend is suggestive of the value of the income shifting option. The immediate delivery harvest-time bids see an improvement of approximately $0.30 per bushel during the harvest period, while the January forward basis bids strengthen by only about $0.15 per bushel during the same time period. This dwarfs estimates of the pre-harvest cost of forward contracting which are generally on the order of magnitude of $0.05 per bushel in the wheat, corn and soybean markets.

The discussion above has limited scope, however, because figures 1 and 2 display the data pooled over time. In any given crop year these patterns can be significantly different, and the average values may not tell the whole story. After all, the harvest-time basis pattern varies according to yield levels, carryover stocks, and any number of local supply and demand conditions. Figures 3-9 show the pre-harvest and harvest basis bids for regions 3 and 4 in five year intervals starting with 1980 through 2009. Regions 3 and 4 cover much of central Illinois, a region located in the heart of the Corn Belt. This shows that the basis does not always improve during the harvest season. Notice however, that when the time trends are positive during the harvest period, the slope of the immediate delivery harvest-time trend is always larger than the slope of the January forward delivery trend. Also, when the slopes are negative, the January forward delivery bids are stronger than the immediate delivery bids. This seems to be evidence that the degree to which elevator managers are able to capitalize on the value of the income shifting options is sensitive to the conditions of the local market.

Unit Root Testing

Before we specify and test an econometric model of the income shifting option we need to characterize the basis data. The spot (forward) basis data are constructed as the difference between the spot (forward bid) and futures price at time *t*. If the futures market is functioning well, the spot and futures prices and the forward bids and futures prices should be highly integrated. This means that movement in the futures prices should imply movement in the spot prices and forward bids. This loosely implies that we can test for a unit root in the basis data to determine if the markets were functioning well enough to conduct this kind of analysis. Stationarity in the basis indicates the spot and futures markets are well integrated. We also need to determine the stationarity of the basis variables to conduct the econometric analysis below.

We subject the panel of basis data to a typical battery of unit root tests, the results of which are reported in table 1. We use StataIC 11 to conduct the Levin-Lin-Chu, Harris-Tzavalis, Breitung, and Im-Pesaran-Shin tests as well as the Fisher-type tests from Choi (Harris and Tzavalis 1999; Breitung 2000; Choi 2001; Levin, Lin and Chu 2002; Im, Pesaran and Shin 2003; Breitung and Das 2005). These tests all investigate the null hypothesis that the panels contain unit roots against an alternative hypothesis that the panels are stationary. Where appropriate, lag lengths are selected by the AIC. Each unit root test we conduct rejects the unit root hypothesis, so we proceed assuming the basis variables are stationary.

Estimation

The conceptual framework along with the casual examination of the basis data motivates a specification for an econometric model relating the harvest-time immediate delivery basis to the January delivery forward basis. Both suggest that the harvest-time immediate delivery basis is the primary determinant of the January forward basis bid. The January delivery forward basis is distinguished, however, by conditions in the spot market. In the conceptual framework we posit that in years when there is a large crop farmer income will be higher than average which increases the value of the income shifting option. This should have a depressing effect on the January forward basis.

Using Percent Deviation from Trend Yield to Measure the Value of the Income Shifting Option

Motivated by the previous discussion we specify an econometric model relating the harvest-time immediate delivery basis to the January delivery forward basis by equation (5).

$$(5)\quad b_{it}^{Jan} = \beta_0 + \beta_1 b_{it}^{Har} + \beta_2 y_t + u_i + \varepsilon_{it}$$

where b_{it}^{Jan} is the January delivery basis bid in region *i* at time *t*, b_{it}^{Har} is the harvest-time immediate delivery spot basis bid in region *i*, u_i is a region level effect, y_t is the percent deviation from detrended mean yield for that crop year, and ε_{it} is the usual random error term. The data we examine in this specification only consists of time periods *t* where there existed a spot harvest-time bid and a January forward basis bid on the same day. Forward basis bids for January delivery rarely are offered early enough to overlap with pre-harvest forward basis bids, so we restrict our analysis to spot harvest-time bids and January forward basis bids.

The econometric model assumes the January forward basis bid in region *i* is determined by three factors. The current cash basis is the primary determinant. The constant term captures the average level of compensation for the risk of holding the contract until January. This is different from the market risk of an adverse price movement because if a risk premium for price variability existed it would already be embedded in the spread between the spot price and the March futures price, which is embedded in the two bases. The same is true of any market return to storage. Therefore β_0, if it is significantly different from zero, reflects risk each counterparty entertains by holding a contract that matures some weeks in the future. The final component of the econometric model is the realized crop yield. We postulate that the elevators are able to use this measure, which is known with reasonable accuracy even as harvest is still ongoing, as a measure of farmer's income associated with this year's harvest. In this way the elevator can predict years when the value of the income shifting option is high and consequently offer a weaker January basis bid.

This motivates two hypothesis tests. The first is a null hypothesis that $\beta_2 = 0$, which would imply that the January forward bid is not influenced by farmer income level in a particular year. The second is a null hypothesis that $\beta_1 = 1$; this would imply that the January forward basis fluctuates perfectly with the harvest-time immediate delivery basis. While $\beta_1 < 1$ indicates that the January forward basis does not appreciate as much on average as does the harvest-time immediate delivery basis during the harvest season.

We find the region specific fixed effects, u_i, are necessary in the model because the Breusch and Pagan (1980) test rejects the null hypothesis of no individual effects with a test statistic of $\chi^2 = 25155.61$ and a p-value of $p = 0.000$. We choose a fixed effects rather than a random effects model because the Hausman (1978) specification test rejects the null hypothesis that the individual effects are uncorrelated with the other regressors with a test statistic of $\chi^2 = 15.36$ and a p-value of $p = 0.0015$.

This model undoubtedly contains a high degree of autocorrelation. We could account for the autocorrelation by estimating the model as a dynamic panel, which involves instrumenting with lags of the dependent variable. However, the dynamic panel estimation procedure of Arellano (1990) and extended in Arellano and Bond (1991) was designed specifically for data sets that have a large number of panels and short number of time periods (Greene 2003). Our situation is exactly the opposite, small n and large T, with $n = 7$ and $T = 343$, since we only have 7 regions in Illinois and weekly data from the 1980 to 2009 crop years. Instead we include a lag of the harvest cash basis bid to account for the autocorrelation and use the fixed effects (LSDV) estimator.

We estimate all models in StataIC 11 using the xtreg fixed effects routine. Regression results are found in table 3. The top panel of table 3 contains the econometric model as specified in equation (5) but also including the lagged value of the harvest-time forward basis bid, b_{it-1}^{Har}, to account for the autocorrelation. We had 2,371 observations and 7 regions within Illinois, each region contained roughly 335 observations.

All variables in this model are significant at the 5% level and all but the lagged harvest bid are significant at the 1% level. The sign on the corn yield deviation is negative, which is consistent with our first hypothesis that in years of bounty elevators are able to offer a lower January forward bid than they otherwise would, capitalizing on the farmer's income shifting option in forward contracting for January delivery. Since the unit of the corn yield variable is in percent deviation from the detrended mean, we can interpret the marginal effects in the natural way. If corn yields are 1% higher than trend, the model predicts the January forward basis bid will be 3 cents less than if yields were at trend levels, all else equal. On 5,000 bushels of corn, this amounts to $150 for every 1% that yield is above trend level.

The second hypothesis concerns the estimate of β_1, which is 0.44 in this model and significantly different from 1. This reflects the scatter plot of the data in figures 1 and 2 where the slope of the January delivery forward basis trend line appears to be approximately half that of the harvest-time immediate delivery trend line. A coefficient estimate of 0.44 implies that the January forward basis will move in the same direction as the harvest-time immediate delivery basis, buy only 44% as much. This means that if the immediate delivery basis bid experiences a \$0.30 per bushel improvement over the course of the harvest season, the January delivery forward basis bid will only see a 13 cent per bushel improvement. On 5,000 bushels of corn this amounts to a \$660 cost of forward contracting relative to selling in the cash market.

In the bottom panel of table 3 we report regression results for the same analysis as reported in the top panel but without b_{it-1}^{Har} as a robustness check. The results are similar with the coefficient on y_t negative and significant and the coefficient on b_i^{Har} significantly different than 1.

Using the Value of the Harvest to Measure of the Value of the Income Shifting Option

Using yield alone as a proxy for farmer income is a concern since the natural hedge based on the negative movement of equilibrium price and yield is not negligible. To account for this we alter how we measure the value of the realized harvest. We define the variable $I_{it} = s_{it} * Y_t$. This functions as a proxy for farmer income; the spot price in region *i* at time *t* is s_{it} , and the detrended yield level for crop year *t* is Y_t. The new model is contained in equation (6).

$$(6) \quad b_{it}^{Jan} = \beta_0 + \beta_1 b_{it}^{Har} + \beta_2 I_{it} + v_i + \varepsilon_{it}$$

Again the Breusch and Pagan test rejects the null hypothesis of no individual effects and the Hausman speciation test rejects the null hypothesis that the individual effects are uncorrelated with other regressors with a test statistic of $\chi^2 = 115.43$ and p = 0.000, so we estimate this model as well as a fixed effects model.

Table 4 contains the regression results from this specification. As with the previous specification, the top panel displays the estimation results from a model which contains the lagged harvest basis, b_{it-1}^{Har} , while the bottom panel does not. The coefficient on farmer income is negative and significant at the 1% level, which is consistent with the previous model and our hypothesis. The effect of a 1% increase in farmer income translates into a 2 cent per bushel weakening of the January basis bid, all else equal. The estimate of the coefficient on β_1 is 0.45 and is significantly different from 1.

Limitations

The analysis above comes with some limitations. First, we are using basis *bids*, which do not necessarily mean that any transactions took place at these prices. This creates problems because it is not clear how well zero-transaction bids reflect the true market price at a local elevator. Further, the basis bids in our data set are only for forward contracts. Bids on other types of contracts do not appear in our data set. For example, delayed pricing contracts do not appear in our sample; therefore, they could be an important component of farmers' income tax strategy that we do not observe.

A second limitation to our analysis is that we estimate a reduced form model which has no behavioral variables in the specification. This means that we can only demonstrate that the data are consistent with our income shifting theory, but we cannot assert that these price relationships are in fact driven by the factors we propose. There are other plausible factors which could contribute to this kind of spot-forward basis relationship. For example, the end of the tax year coincides with a major holiday season, falling between Christmas and New Year's Day. It is possible that spot-forward basis patterns are influenced by a seasonal holiday slowdown of grain delivery and contracting with a subsequent increase after the first of the year. However, since we did find that farmer income was a significant factor in determining the spot-forward basis relationship we doubt the holiday is what is driving the patterns observed in the data.

A grain elevator has its own risk management and income tax considerations which could affect the way spot and forward basis bids are set. It is possible that these considerations drive the results we find in the econometric model more than our income shifting hypothesis.

Conclusions

Previous studies have documented a cost of forward contracting grain relative to hedging in the futures markets. Our study quantifies the value of the income shifting option to forward contracting. An income shifting option refers to the fact that at harvest-time, a farmer can chose to sell uncontracted bushels of corn in the spot market or he can forward contract to sell them after the first of the year. This option has non-trivial tax implications under a progressive tax system. By shifting income to the next tax year, a farmer can reduce the current year's income level and avoid a higher marginal income tax rate. Further, if country elevators have market power, they can capture some of the value of this income shifting option by offering a weak forward delivery January basis bid. In a sufficiently captive draw area, an elevator knows that a farmer will be willing to accept a weak January forward basis bid so long as he still receives some income tax benefits from deferring sales to the next tax year.

This option is most valuable during years when farmer income is high. Therefore, in this study we posited that during years of high farmer income we would see forward basis bids which are abnormally lower and appreciate at a slower rate than the harvest-time immediate delivery bids. We measure this effect using Illinois Ag Market News basis bids from elevators in seven regions in Illinois from 1980 to 2009. We find that a 1% increase in yield above trend level decreases the January deliver forward basis bids by 3 cents per bushel; we also find that the January delivery forward basis bids appreciate at 44% the rate the harvest-time immediate delivery basis bids appreciate. These findings are consistent with our hypothesis that country elevators are able to capture some of the income shifting benefits of forward contracting through the relative immediate delivery harvest and January delivery forward bases.

We would like to confirm the income shifting hypothesis further. Our data set currently does not contain March delivery forward bases. However, if we could compare the pattern of immediate delivery harvest and January delivery forward bases with the pattern of immediate delivery January and March delivery forward bases we could learn a lot. It makes no difference on a farmer's income tax bill if he delivers in January or March, but it does when he decides between December and January delivery.

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Table 1: Data Definitions

Types of Basis Bids	Time Period Bids are Offered	Futures Contract Bases are Calculated Against
Pre-Harvest Forward	Jan/Feb-Beginning of Harvest	December
Harvest-Time Immediate Delivery	Beginning of Harvest-End of Harvest	December
January Forward	Beginning of Harvest-End of Harvest	March

Table 2: Panel Unit Root Tests For Basis Variables[a]

Test	Variable	Statistic		*p-value*	Lags
Levin-Lin-Chu			*adjusted t*	*p-value*	Lags
	b_{it}^{Har}		-9.89	0.00	1
	b_{it}^{Jan}		-4.39	0.00	1
Harris-Tzavalis		ρ	z	*p-value*	
	b_{it}^{Har}	0.86	-36.11	0.00	
	b_{it}^{Jan}	0.90	-27.62	0.00	
Breitung		λ		*p-value*	
	b_{it}^{Har}	-10.21		0.00	
	b_{it}^{Jan}	-3.92		0.00	
Im-Pesaran-Shin		$\tilde{Z}_{tbar}$		*p-value*	Lags
	b_{it}^{Har}	-10.22		0.00	0
	b_{it}^{Jan}	-8.52		0.00	0
Fisher-type Inverse χ^2		P		*p-value*	Lags
	b_{it}^{Har}	143.96		0.00	0
	b_{it}^{Jan}	109.05		0.00	
Inverse Normal			z	*p-value*	Lags
	b_{it}^{Har}		-10.51	0.00	0
	b_{it}^{Jan}		-8.82	0.00	
Inverse Logit		L*		*p-value*	Lags
	b_{it}^{Har}	-15.20		0.00	0
	b_{it}^{Jan}	-11.51		0.00	

[a] All tests examine a null hypothesis that the panels contain unit roots, against the alternative of stationary panels. Where applicable, lags are chosen by the AIC.

Table 3: Corn yield and the income shifting option in the January forward basis

R^2 within = 0.6639				Obs = 2371
between = 0.9128				Groups = 7
overall = 0.6327				
				Obs per group
F(3, 2361) = 1554.56				min = 332
Prob > F = 0.0000				avg = 338.7
				max = 340

	Coef.	Std. Error	t	P > |t|
b_{it}^{Har}	0.4425	0.0203	21.70	0.000
I_{it}	-0.0291	0.0110	-2.64	0.008
b_{it-1}^{Har}	0.1475	0.0204	7.22	0.000
cons	-0.0357	0.0109	-3.27	0.001
σ_u	0.044			
σ_e	0.056			
ρ	0.379	fraction of variance due to u_i		

R^2 within = 0.6567				Obs = 2372
between = 0.9294				Groups = 7
between = 0.6515				
				Obs per group
F(2, 2363) = 2259.88				min = 333
Prob > F = 0.0000				avg = 338.9
				max = 340

	Coef.	Std. Error	t	P > |t|
b_{it}^{Har}	0.5763	0.0087	66.42	0.000
I_{it}	-0.0313	0.0111	-2.81	0.005
cons	-0.0363	0.0110	3.29	0.001
σ_u	0.040			
σ_e	0.057			
ρ	0.330	fraction of variance due to u_i		

Table 4: Corn per acre income and the income shifting option in the January forward basis

R^2 within = 0.68				Obs = 2371
between = 0.92				Groups = 7
overall = 0.64				
				Obs per group
F(3, 2361) = 1656.54				min = 332
Prob > F = 0.0000				avg = 338.7
				max = 340

	Coef.	Std. Error	t	P > |t|
b_{it}^{Har}	0.4519	0.0200	22.63	0.000
I_{it}	-0.1719	0.0016	-10.49	0.000
b_{it-1}^{Har}	0.1423	0.0200	7.12	0.000
cons	-0.2309	0.0044	-5.27	0.000
σ_u	0.044			
σ_e	0.055			
ρ	0.393	fraction of variance due to u_i		

R^2 within = 0.67				Obs = 2372
between = 0.93				Groups = 7
overall = 0.66				
				Obs per group
F(2, 2363) = 2412.44				min = 333
Prob > F = 0.0000				avg = 338.9
				max = 340

	Coef.	Std. Error	t	P > |t|
b_{it}^{Har}	0.5812	0.0084	68.87	0.000
I_{it}	-0.0176	0.0017	-10.63	0.000
cons	-0.0248	0.0044	-5.61	0.000
σ_u	0.040			
σ_e	0.056			
ρ	0.344	fraction of variance due to u_i		

Figure 1: Preharvest and Harvest Forward Bases in Central Illinois, Pooled Across Years

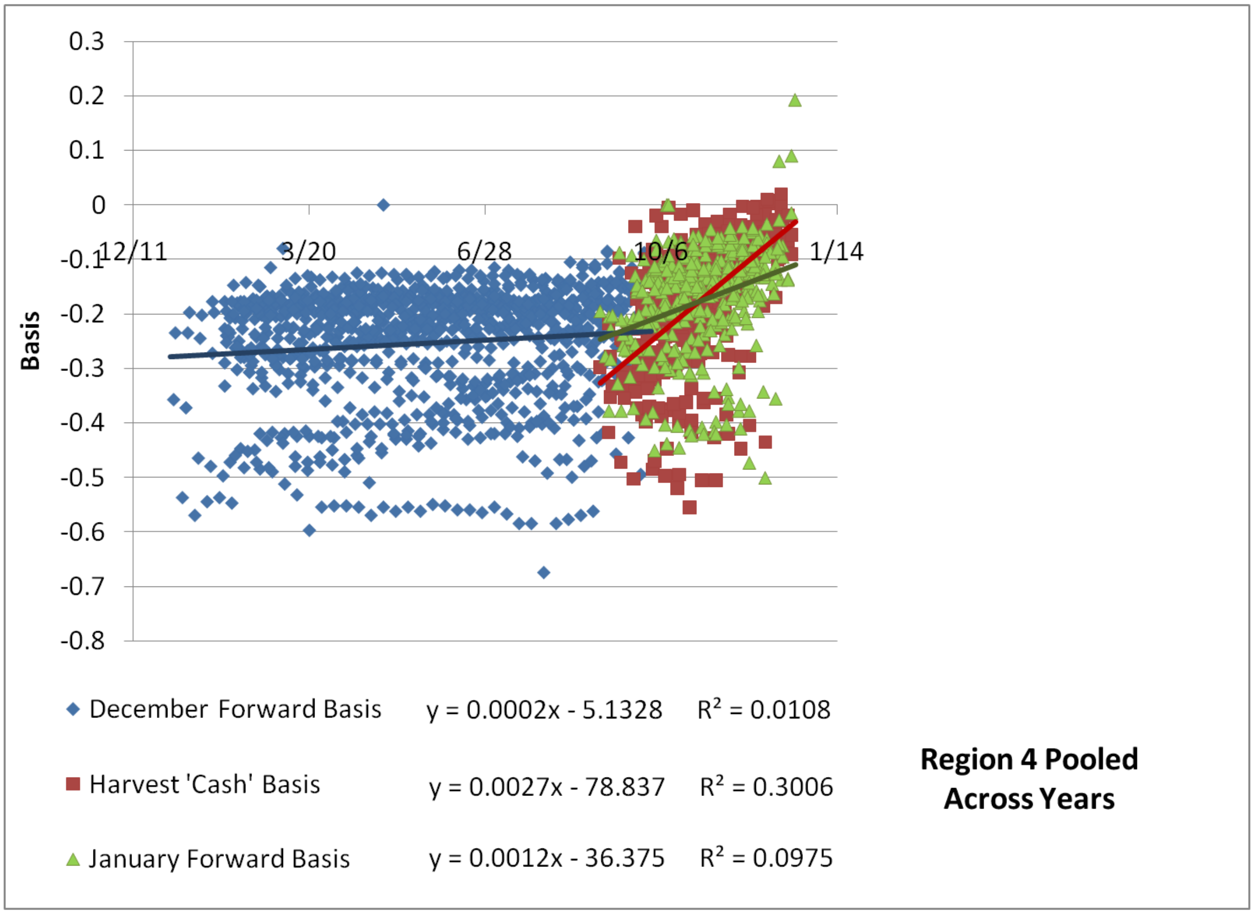


Figure 2: Trendlines of Preharvest and Harvest Forward Bases in Central Illinois, Pooled Across Years

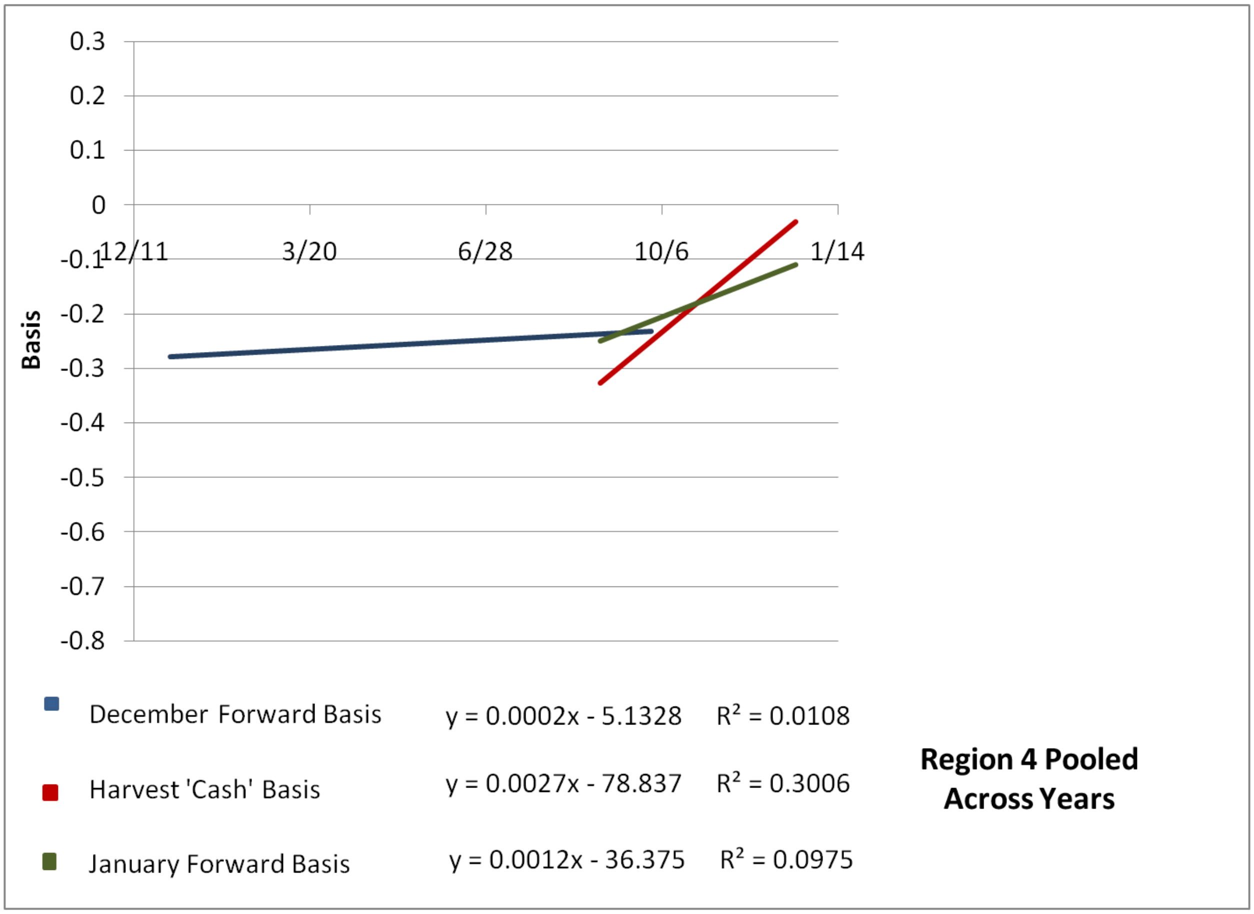
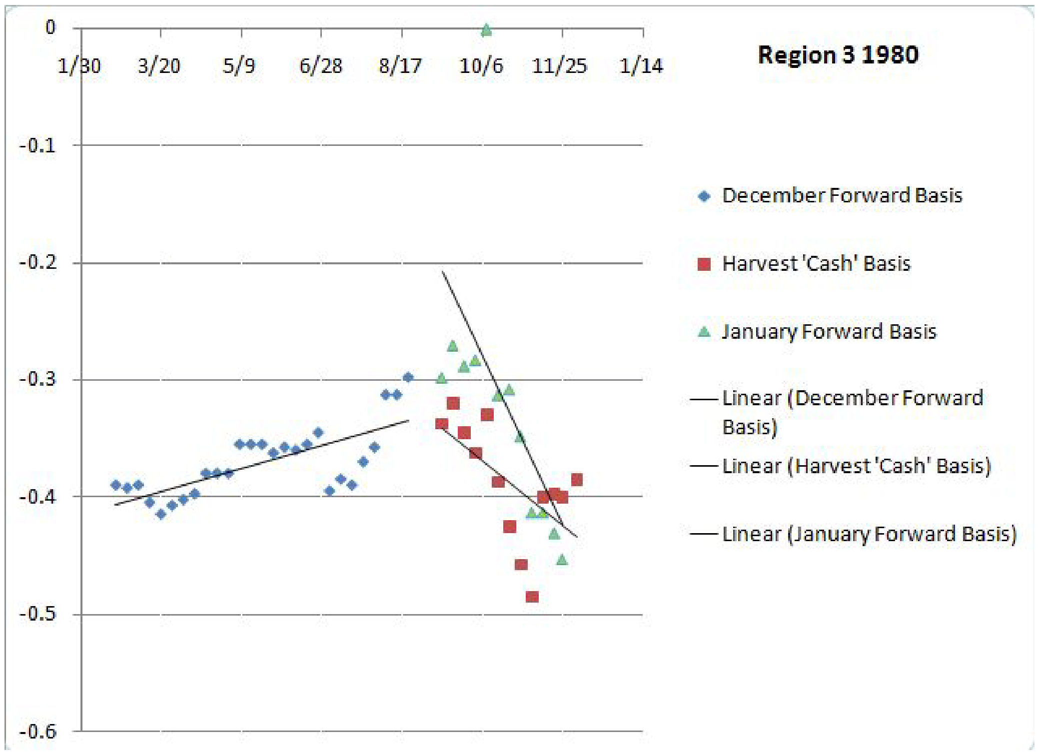


Figure 3: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 1980



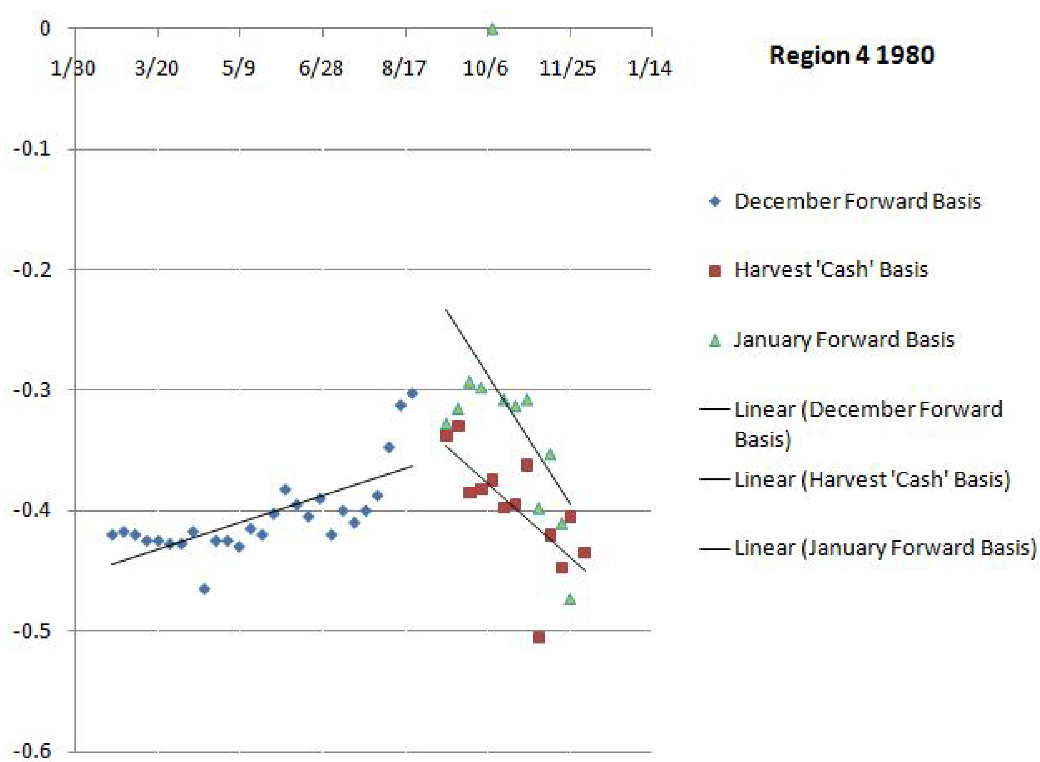


Figure 4: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 1985

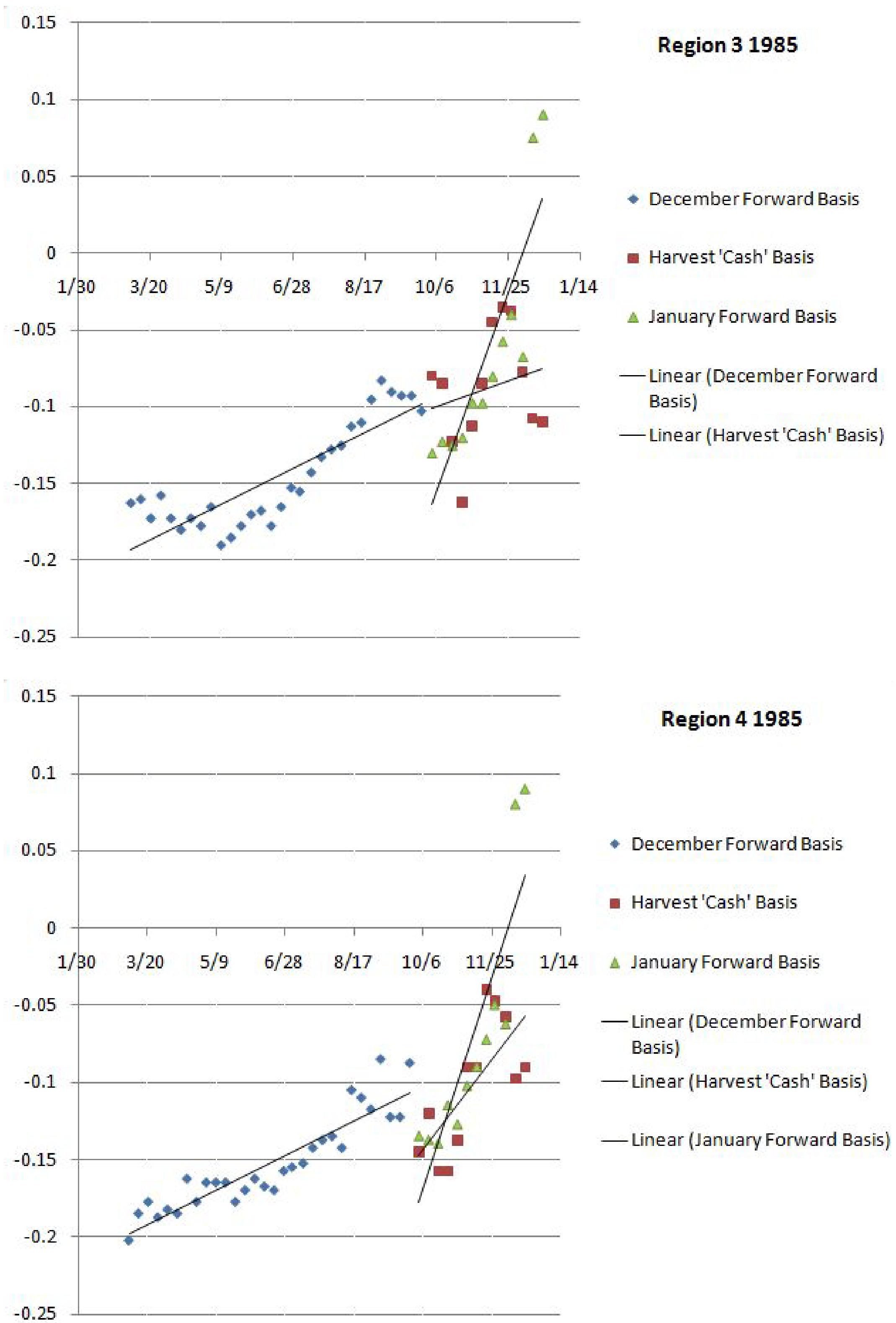


Figure 5: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 1990

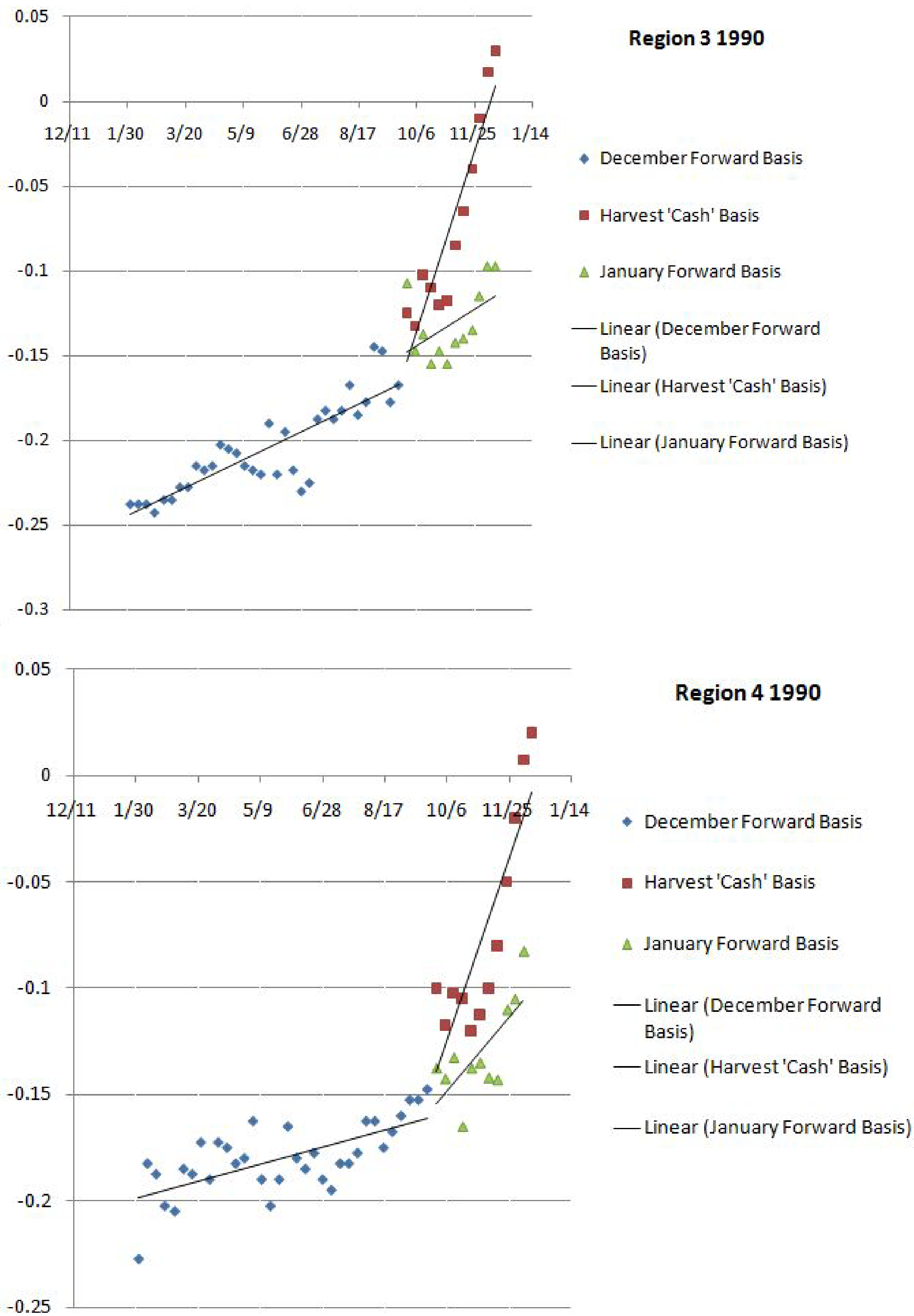


Figure 6: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 1995

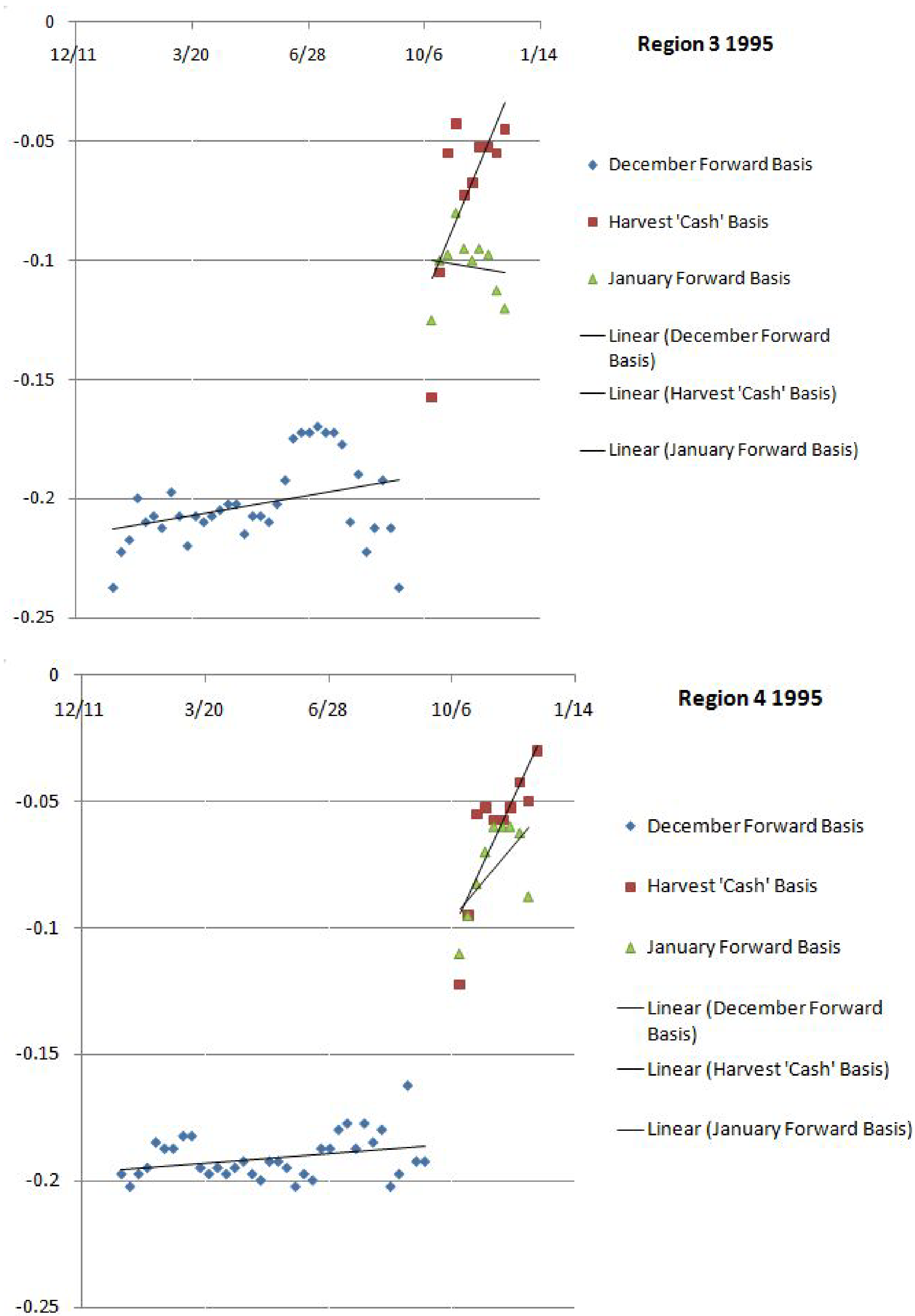
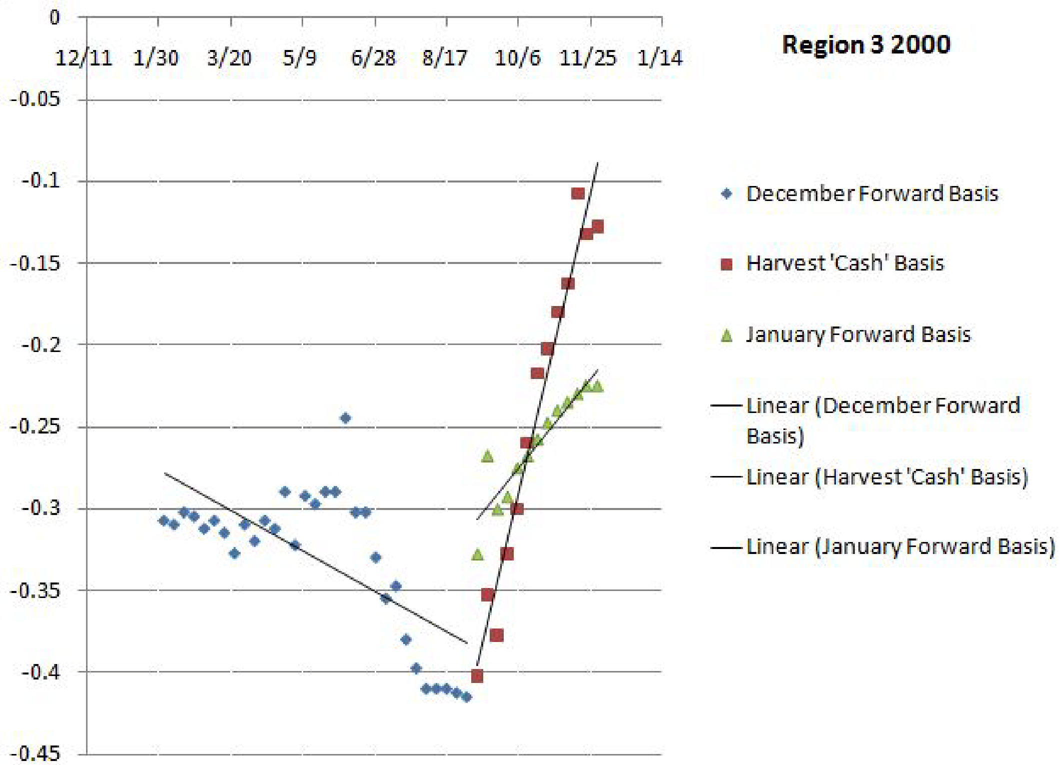


Figure 7: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 2000



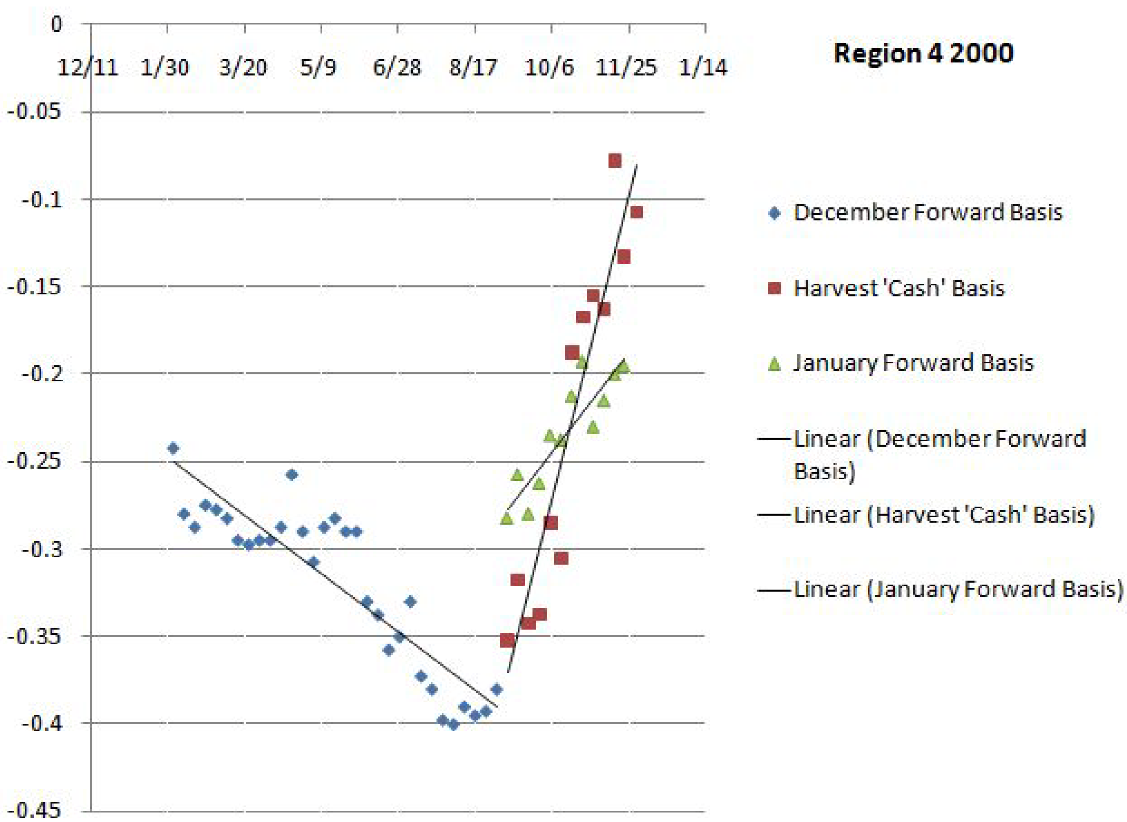


Figure 8: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 2005

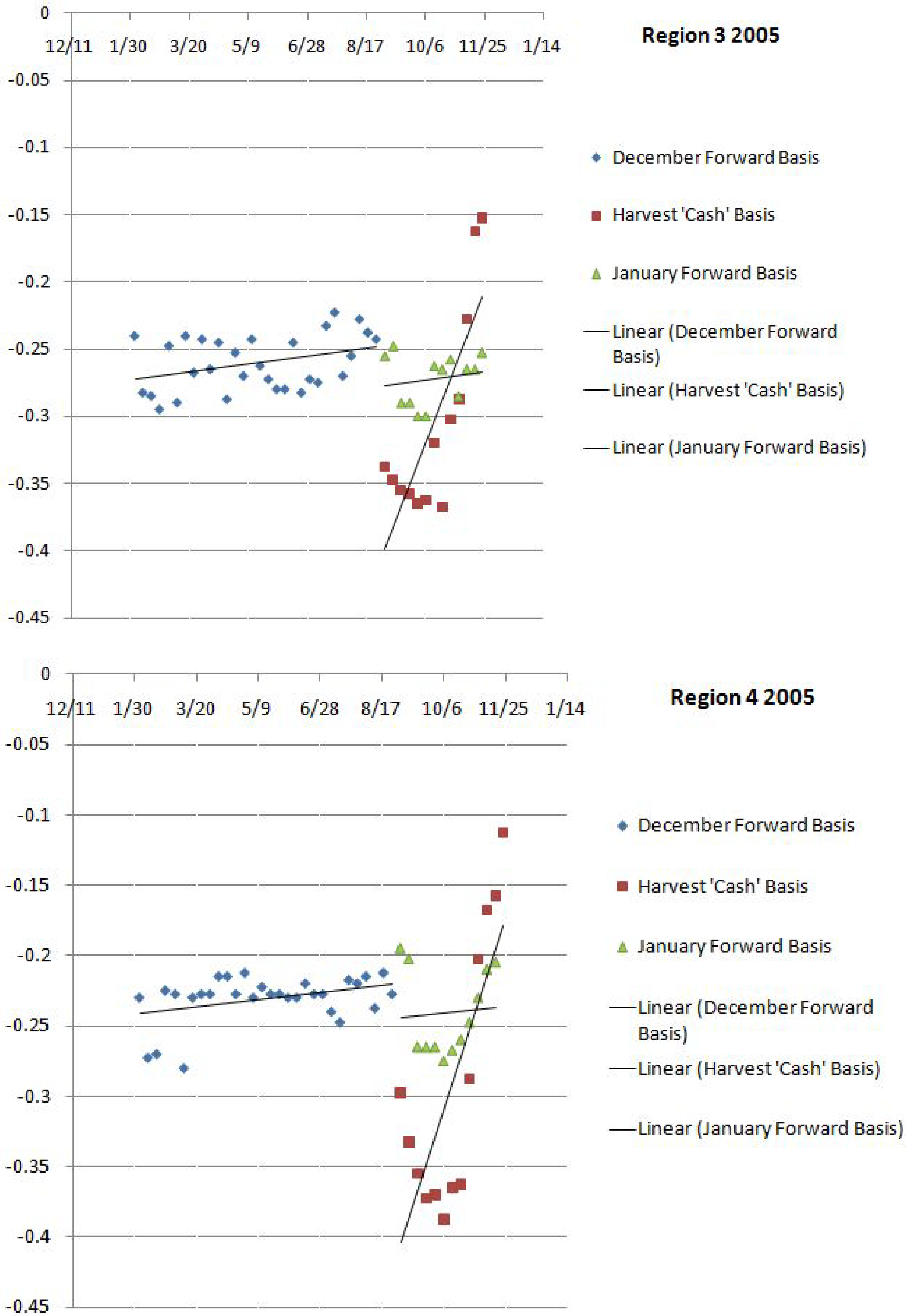


Figure 9: Preharvest, Harvest, and Post Harvest Forward Bases in Central Illinois, 2009