How distorting are direct payments?

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**The views expressed herein are solely our own and do not represent the views of the USDA.

I. Introduction

Do direct payments distort markets?

Theory implies that decoupled payments[1] should not distort market outcomes. If non-distortionary, a government could use them in domestic policies without affecting either domestic or international markets. The United States uses direct payments,[2] a form of decoupled payment, to help subsidize farmers. A burgeoning literature has arisen exploring the extent to which decoupled payments truly can be non-distortionary.

While decoupled payments have been explored in general, little research has examined the effect that these U.S. direct payments have on production decisions. What has been done has drawbacks associated with the methods and data used. Often cross-sectional approaches were used, finding correlations between direct payments and acreage decisions, but these studies could not argue for any causal effects. Acreage changes could alter the receipt of direct payments (if base was bought or sold) while direct payments could alter acreage changes (if the payments had wealth effects, caused expectations to change, etc.). We track changes in acreage across time and use an exogenous event, a government implemented Act that allowed farmers to update base acres, to impute causation and assess the impact that an exogenously driven change in direct payments had on operators' acreage decisions.

Results suggest that average base acre changes for farms were associated with between 10 and 25 percent changes in their cropland harvested, with the farms with the largest value of production (often having the fewest base acres) appearing to decrease in size while the smaller

[1] The term "decoupled payment" has been used to refer to payments that have minimally production distorting impacts. We, however, use the term to refer to a payment that does not depend on current production decisions, outcomes, or prices.

[2] Direct payments can refer generally to payments coming from the government or specifically to particular payments known as Production Flexibility Contract payments, and previously known as Agricultural Market Transition Act payments. In this paper, when we mention direct payments, we refer to the specific payments.

size categories (tending to be comprised more of program crop farms) seemingly increased in size. On the face of it, these are substantial changes.

Why do we care?

There are several reasons why it is important to understand the effects that direct payments might have on production decisions. First, any effect that direct payments have on production might affect prices. If so, a portion of direct payment subsidies could get passed on to consumers (Westcott, 2005 and Adams, et al, 2001). Second, direct payments may provide incentives to keep marginally productive land in agriculture. This includes land that might otherwise be enrolled in environmental protection programs (Adams, et al., 2001; Anderson and Parkhurst, 2004). Third, the 2002 Farm Security and Rural Investment Act (FSRI) required that base acreage remain in agriculture, even when not being farmed. This could also distort crop production decisions. Direct payments could prevent land from leaving the agricultural sector even though efficiency may dictate its departure (Young and Westcott, 2000). While the WTO defines green-box payments as those that minimally distort trade, this raises the question of how much direct payments actually *do* distort trade. A step towards answering this question comes from better understanding the effects that direct payments have on production. In this paper, we study the extent to which direct payments might affect current or future production.

How can direct payments affect production?

Other than explicitly imposing restrictions, there are three main ways in which direct payments can affect agricultural production (Young and Westcott, 2000). First, if farmers are constrained by credit limitations, a direct payment may increase their access to borrowed capital.

With the opportunity to borrow more funds, a farm operator's profit maximizing production levels could increase. Second, direct payments that serve to increase wealth may lead to changes in the risk preferences of farm operators. These altered risk preferences may lead the farm operator to increase production. Third, expectations about future payments could alter current production. Farmers likely form these expectations, at least in part, based on current payments. If a farmer believes future payments are based on current production, they may increase the production of those crops for which they expect to receive future payments. These theories all rely on direct payments indirectly affecting production decisions. It is the presence of the direct payment, rather than their explicit expenditure on factors of production, that potentially affect production decisions. While we discuss these three theories in more detail in the literature review, we remain primarily interested in whether or not changes in direct payments actually *are* associated with changes in farmers' production decisions. We do not attempt to discover the actual reasons for *how* the payments might affect the operators' decision making processes.

II. Literature Review

History of direct payments

Under the Uruguay Round of the General Agreement on Trade and Tariffs (GATT), participating nations agreed to move away from trade distorting agricultural subsidies. Production Flexibility Contract (PFC) payments introduced in the 1996 Federal Agricultural Improvement Act (FAIR) purportedly met specific criteria set forth in the Uruguay Round Agreement on Agriculture that allow it to be classified it as a "green-box" agricultural subsidy. The green-box classification criteria include that the subsidy be based on historical production and independent of current or future production decisions, including the types and quantities of commodities farm operators choose to produce. Further, no production can be required in order to receive the subsidy. The farmer can produce any crop or none at all and still receive the payment. These criteria are intended to "decouple" the subsidy from production decisions and therefore eliminate its trade distorting effects (Burfisher and Hopkins, Feb. 2003).

These green-box type agricultural subsidies were continued under the 2002 FSRI Act. This Act renamed PFC payments and PFC acreage, calling them "direct" payments and "base" acreage, respectively.[3] Farm operations were given three basic options for updating their PFC acreage to base acreage (Young, et al. 2005). The first option was to simply change the PFC acreage to base acreage. PFC acreage was based on the 1991-1995 planting season, meaning base acreage updated under the first option is also based on the 1991-1995 planting season. The second option consists of option one with the additional possibility of adding oil seed acreage as base acreage.[4] Oil seed base acreage is determined by 1998-2001 plantings. The second option is the default if the farm operator made no attempt to update their PFC acreage. The third option was to determine base acreage by 1998-2001 plantings. Farm operations could maximize payments by keeping or expanding base acreage that was associated with crops that yielded higher direct payments, such as corn and cotton, and reduced base acreage that was associated with crops that yielded lower direct payments, such as wheat and oats. They could also choose to incorporate acres planted to oilseeds. Finally, they also benefited from increased payment rates to their base acres included in FSRI (Young, et al., 2005).

[3] In the economic literature, the phrase "direct payment" refers to any government payment made directly to the farm operator and may include coupled payments. The term "direct payment" in this article will refer to the 2002 Farm Bill payment that replaced the PFC payment.

[4] There are three sub-choices that farm operators can make under this option. See Young, et al., 2005.

What has been done already?

Some researchers find little evidence of decoupled payments influencing production (Burfisher and Hopkins, 2003; Goodwin and Mishra, 2005). Decoupled payments may affect farm operators' production decisions by altering their expectations of future payments, their risk preferences, or their access to capital. We briefly review the available literature on how decoupled payments affect production by altering farm operators' expectations of future payments. We then assess the literature regarding the effects of decoupled payments on the capital constraints faced by farm operators and on the risk altering, and therefore production altering, effects of direct payments. We end with a focus on the most recent papers examining how decoupled payments affect production in general.

Tileu and Roberts (1998) argue that expectations of future farm program payments may influence the current production decisions of farm operators. If an operator believes that a future act of Congress will update corn base acreage based on how much corn is produced today, she may substitute the production of another (potentially currently more profitable crop) for the production of corn.

Results from an experimental study conducted by McIntosh, Shogren, and Dohlman (2005) indicated that Counter-Cyclical Payments (CCPs) combined with price uncertainty led participants to increase the production of crops associated with the government payment relative to crops that were not associated with any payments. Participants clearly understood the ramifications of risk and adjusted their production behavior according to their expectations of future prices.

Tileu and Roberts (1998) also suggested that increases in wealth due to decoupled payments may lead to increased access to capital. Roe, et al. (2004), Kirwan (2005), Roberts, et.

al (2003), and Goodwin, et al (2003) all suggested that direct payments caused an increase in agricultural land values, which in turn would increase farm wealth and farm operators' access to capital. However, the receipt of a decoupled payment would only affect their access to capital if the farm operator faced credit constraints.

Many researchers have studied how farmers' risk preferences affect production decisions. How decoupled payments affect production decisions through changes in risk preferences makes up a portion of this body of literature. Studies by Chavas and Holt (1990), Hennessy (1998), Ridier and Jacquet (2002), and Anton and Le Mouël (2004) concluded that decoupled income transfers could affect production decisions through farmers' risk preferences. Some empirical studies, such as Burfisher, et al. (2000) and Young and Westcott (2000), found that the effects are positive but not likely to have a significant impact on overall production. Makki, et al. (2004) argued that since the marginal increase in wealth coming from decoupled payments is small, the marginal changes in risk preferences will also be small. In addition, they argued that farm operators could mitigate risk using insurance, hedging, and other management strategies rather than altering production decisions.

While many studies investigated the effects of farm subsidies in general on agricultural production (Chavas, et al 1983; Choi and Helmberger 1993; Duffy et al. 1994; Houck and Ryan 1973; Lee and Helmberger 1985; McIntosh and Shideed 1989; Morzuch and Weaver; 1980), fewer deal with how decoupled payments might directly affect production decisions. Adams, et al. (2001) found weak evidence of decoupled payments positively influencing the number of acres used in the production of major field crops for the years 1997 to 2000. Limiting their data set to eleven states that account for a large portion of U.S. field crop production, they present the decision to plant acres as a function of per acre revenues from various crops and per acre decoupled payments. Adams, et al. (2001) left out a few variables that we consider important to an acreage response analysis. In conjunction with per acre revenues, per acre costs should also affect the choice of acres used in production. Another oversight is the use of per acre decoupled payments as an explanatory variable as opposed to per base acre or total decoupled payments. If the additional acres used in production are non-base acres, or not associated with a decoupled payment, then per acre decoupled payments could be negatively correlated with the quantity of acres used in production since per acre direct payments decrease with an increase in non-base acres. Empirically, this could lead to an underestimation of the effects of decoupled payments on acreage decisions.

Goodwin and Mishra (2006) also used an acreage response model to conduct a similar investigation covering the years 1998-2001. Their found that decoupled payments had a small but statistically significant effect on the quantity of acres used in the production of corn, soybeans, and wheat. For an additional dollar of per acre decoupled payment, their estimated acreage response ranged from a one acre increase in land used for corn production to a 0.61 acre increase for soybean and 0.36 acre increase for wheat production. Similarly, Goodwin and Mishra (2005) used data from 2002 and 2003 and focused on the effects of direct payments under the 2002 FSRI Act on acreage decisions. While not statistically significant, they showed that an additional per acre dollar of direct payments leads to 1.73, 1.50, and 2.48 increases in acres for corn, soybeans, and wheat, respectively. While controlling for commodity prices, these two papers could not control for all the inputs into the production process. Additionally, the authors used per acre decoupled payments, which could introduce a bias in the results.

How does our study fit in?

We investigate the effects of direct payments on total harvested acres for all crops, not limiting our study to specific crops or groups of crops. Instead, we allowed all types of producers, including livestock producers, to harvest acres and receive government payments. We also included most states in our analysis rather than limiting our study to specific geographic locations[5] to produce a general result for the U.S. as a whole. We derived an acreage response function from a representative farm operator's profit maximization problem. Similar to previous studies, we presented acres harvested as a function of per acre revenues, per acre costs, and wealth. In contrast with earlier work, we model acres harvested as a function of the number of base acres rather than the direct payments received. One problem with earlier work was that the level of direct payments could be endogenous. By making purchasing/selling decisions concerning acres with base attached to it, the operator could alter the level of payments received. Our approach eliminates the endogeneity of the direct payments by focusing exclusively on the change in base acres due to the implementation of FSRI. In addition, rather than adopting the standard approach of studying a cross-section of farms, we incorporated methods used in labor economics to create a pseudo-panel dataset which permitted us to study changes in production decisions over time. Hence, we could establish the effects of direct payments on acreage decisions that operators made.

[5] Some states did not have sufficient observations to be included in the analysis.

III. Methodology

A. General Model

We wanted to identify how direct payments affect farmers' production decisions. We chose to examine the number of harvested acres in the operation, in part since it is the standard decision examined in earlier work and since the impacts of acreage changes are readily recognized and show, not only how the industry is changing as a whole, but how the structure of farms within the industry also change.

In 2002, the US government passed the FSRI Act, which allowed operators to update their base acres. This updating was an exogenous event and was purely voluntary. In other words, if advantageous for them, farmers could update their acres and receive higher levels of direct payments. This provided us with an exogenous shock that allowed us to properly identify the effect of a change in direct payments on production decisions.

To estimate the effect of FSRI on producers' decisions, we explored the changes in production decisions (the number of harvested acres) before and after the implementation of FSRI. For producer i (i = 1,...,N) in time period t (t = 1, 2), let Y_{it} represent the number of acres of cropland harvested. Let Y_{it} be a function of a set of factors, X_{it} that characterize the farm and the producer that influence the propensity to alter the level of cropland harvested. We used the operator's change in direct payments, *DP*, to measure the change in payments the operator experienced. We also argued that this effect may depend on the size of the operation (in terms of the level of the value of production). In particular, did different size classes of farms react differently to the FSRI Act? To test this, we created four size class dummy variables (defined by level of value of production) and interacted them with the variable *DP*. This gave us an equation to estimate that looked very similar, from a cross-sectional point of view, to earlier studies:

(1) $$Y_{it} = \alpha + \beta X_{it} + \gamma DP_{it} \cdot S_{it} + \varepsilon_{it}$$

where α, β, and γ are all coefficients to be estimated, S_{it} denotes a dummy variable reflecting the scale of the operation, and ε_{it} represents the random error term.

However, the implementation of the FSRI Act allowed us to create an event study where we can estimate the difference between period 1 (pre-FSRI Act) and period 2 (post-FSRI Act). Differencing gives us the following:

(2) $$\Delta Y_i = \alpha + \beta \Delta X_i + \gamma \Delta DP_i \cdot S_{i1} + \varepsilon_i .$$

We used the period 1 size categories for the farms (S_{i1}) to ensure that any contemporaneous decisions on altering the size of the farm do not bias the estimates of γ.

While equation (2) works for a panel dataset, the data available to us does not allow us to create such a panel. We used the Agricultural Resource Management Survey (ARMS) datasets. This data gets collected every year from a different sample of farmers, giving us a series of cross-sections to work with. Following labor economists who work with similar data constraints, we constructed a pseudo-panel dataset to examine the changes across time. A pseudo-panel data set can be constructed by creating cohorts of observations within each cross-section whose characteristics are unlikely to change across time (Deaton 1985; Verbeek and Nijman 1992).

To construct a cohort, the "constituents" of a cohort should remain homogenous within each cohort and heterogeneous across cohorts over time. We used geographic location (state) and farm production specialty categories to create our cohorts. For example, we would expect a hog farm in Iowa to be similar to other hog farms in Iowa and be dissimilar to wheat farms in Kansas. Furthermore, we would expect that if we tracked the Iowa hog cohort over time, the changes the cohort experienced over time would be similar to the changes an individual Iowa hog farm would experience over the same time frame.[6] The farm production specialty categories we used, following Jinkins (1994) work on entropy, are shown in Table 1 below.

Table 1: Cohort Commodity Groupings

Group	Commodity
1	Barley, Oats, Wheat
2	Corn, Soybeans, Sorghum
3	Hay, Miscellaneous, Other crops
4	Fruits and Nuts
5	Vegetables
6	Beef Cattle
7	Sheep, Hogs, Other Livestock
8	Poultry
9	Dairy

In addition, we lumped together two years for each period (period 1 consisted of 2000 and 2001 respondents while period 2 consisted of 2002 and 2003 questionnaire respondents) to increase the number of observations and gain more precise estimates.[7] Finally, to obtain the observations used in the analysis, we grouped all firms into each period and into their respective cohorts and took the mean for each variable of concern. These means represent the average value for each variable for each cohort. Denoting a cohort average by *c*, our estimation equation then looks like the following:

(3) $$\Delta Y_c = \alpha + \beta \Delta X_c + \gamma \Delta DP_c \cdot S_{c1} + \varepsilon_c .$$

[6] Grouping the farms by these types is an assumption we make to try to ensure homogeneity and stability within groups, which allows us to make comparisons across time. If farms change their type, moving from one group to another, we couldn't make valid comparisons. We plan to check the robustness of our results by running our analysis on various groupings.

B. The Endogeneity Issue

At this point, equation (3) allows us to use a series of cross-sections to create a pseudo panel dataset and estimate how changes in direct payments are correlated with changes in harvested acres. However, the level of direct payments might not have changed *exclusively* due to the implementation of the FSRI Act. Operators might have increased (decreased) the size of their farm by buying (selling) acres of harvestable cropland. If some (or all) of these acres had base attached to them, they would have increased (decreased) their level of direct payments which might have occurred for reasons other than the FSRI Act. For example, suppose a farm found itself enjoying large economies of scale, so it bought up acres. In doing so, further suppose that those acres were all base acres. Then, in 2002, the FSRI Act was passed and it would look like the farmer received higher direct payments and subsequently bought acres, when causation ran the other way. If there is any ability for an operator to choose what type of acres (i.e. associated with base or not) he purchases (sells), then the level of direct payments he receives is, at least partially, endogenous.

The 2002 and 2003 ARMS questionnaires, however, present a solution to this problem. These surveys contained questions asking the farmers about their cropland acres. Each operator was asked to disclose the number of base acres of cropland he had under the 1996 Act and under the newly implemented 2002 FSRI Act. For example, suppose a farmer had 100 acres of cropland in 2002. He was then asked to disclose the number of these acres that were base acres under the 1996 Act (say, 25) and what he would count as base acres under the 2002 Act (say, 50). This change in base acres (of 25 acres) is due *exclusively* to the implementation of the FSRI Act. This change would also be associated with a change in the level of direct payments he

[7] Including only the years 2001 and 2002 obtains very similar results, with higher standard errors. The addition of 2000 and 2003 almost doubles the number of observations and obtains more precise estimates of the coefficients.

received. This measure of change in base is now completely exogenous since sales or purchases of acres would have no effect on this change in base.[8]

Therefore, we substitute the change in base acres due to the implementation of the FSRI Act for the change in direct payments in the equation to be estimated. This gives us the following equation:

$$\Delta Y_c = \alpha + \beta \Delta X_c + \gamma \Delta Base_c \cdot S_{c1} + \varepsilon_c . \tag{4}$$

This approach removes a large degree of the potential for biases attributable to unobservable heterogeneity and omitted variables. Important variables that we cannot measure easily or effectively (e.g. productivity of the land, location based technology, etc.) could bias the results if not included. To the extent that these types of variables remain constant through time but vary spatially, this approach eliminates any biases they might have introduced.

C. Identification Based on Differences

By using an event study, we examined the changes in base acres strictly due to the updating allowed by the FSRI Act. Since we examined changes over time in the number of harvested acres and we have the changes in base due to the FSRI Act, we should have identified clearly the effect that the FSRI Act had on the producers' decisions concerning the amount of cropland to harvest.

In addition, since some farm specialty types were more prone to having base than others (e.g. a livestock operation is less likely to produce crops on acres with base than a corn farm would), the implementation of the FSRI Act had different value for some operations than for

[8] As a first approach, we simply look at the overall change in base acres. However, this potentially could hide some changes in payments. For example, if corn base paid at a higher rate than wheat base, and a farmer changed her base from 50 acres of wheat to 50 acres of corn, she would have an overall change of zero base acres, but would

others. Some cohorts had a large change in base due to the FSRI Act while others had small changes. In effect, those with "very small" base acre changes are considered our control groups (to control for how much the harvested acres changed, holding all else constant).

By examining the data, we see clearly that estimates of the change in base across farm type categories range from an average of 1.2 acres for fruit, tree nuts, nursery, and greenhouse farms to an average of 171 acres for barley, oat, and wheat farms. This gives us confidence that we are properly identifying the change in harvested acres given a change in base acres, driven exclusively by the implementation of the FSRI Act.

D. Controls

We now have a methodology that (1) utilizes an exogenous source of variation (the introduction of the FSRI Act) of direct payments that can be measured (through the change in base acres); (2) allows us to identify the effect of the change in base acres (we posit that the FSRI Act had a different value for operators growing different crops); and (3) permits us to control for unobservable heterogeneity and omitted variables (by differencing). However, we must also control for those variables that do change over time (i.e. that do not get wiped out by differencing). If not controlled for, these factors would bias the estimates of γ in equation (4).

The matrix X contains variables to control for characteristics of the cohort's producers and operations, as well as the general environment within which the cohort functioned. In this matrix we include the cohort size (measured by sales category) and farm type of the operation. To control for the general environment, we include state fixed effects. We also include the variables that producers would look at when trying to assess whether or not to increase

experience an increase in direct payments. Future research might be able to tease out changes in base acres by crop, but for now we limit ourselves to overall changes.

(decrease) their acreage - namely the revenues and costs per acre. In addition, these variables have implicit within them the prices of inputs and outputs. Since access to capital markets might also affect how many acres a producer utilizes, we include the producers' wealth (since changes in wealth could affect the level of collateral available). We also include the change in government payments accruing to producers since these payments might also affect access to capital markets and wealth levels. The revenues and costs per acre, the wealth levels, and the government payments were all measured using lagged values. At the beginning of the current year, the previous years' values are all known and can be considered exogenous. If current values were used, endogeneity concerns would arise and we might bias our estimates of the coefficients. Hence lagged values were used.

These variables should control for most, if not all of the issues farms faced between 2001 and 2003. The controls, combined with our identification scheme, should allow us to confidently measure the effect that direct payments have on production decisions.

IV. Data

A. Construction of Dataset

The ARMS data we used gets collected by the National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture, in conjunction with Economic Research Service (ERS). NASS collects data from a cross-section consisting of thousands of farmers each year, conducted using non-random, stratified sampling techniques. With the help of ERS, NASS then constructs a set of weights for each observation to enable expansion of the sample up to national level estimates.

To create the lagged values for the years 2000 and 2001, we used 1999 and 2000 data. These datasets had 10,521 and 10,309 observations respectively. Combining the two datasets and deleting those operations with no harvested acres left us with 17,481 observations. Combining these observations into the cohorts outlined above left us with 792 observations. We then eliminated cohorts with fewer than 20 observations. This left us with 195 lagged observations for period 1. We repeated this process for period two, leaving us with a dataset of 193 lagged observations.

The same procedures were also used to create the datasets for current values of variables. We ended up with 185 observations for period one and 211 observations for period two. Finally, combining the four cohort datasets into a single, balanced pseudo-panel left us with a final dataset consisting of 173 observations.

B. Construction of Variables

The dependent variable in equation (4) represents the change over time in the number of acres used in production. We focus on crop production and use mean total acres harvested for each cohort as our measure of acres used in production for the current period. We used lagged per acre revenues to control for prices and expected revenues per acre, calculated by dividing a cohort's lagged mean value of crop production by its lagged mean acres harvested.

We used lagged per acre costs to control for input costs, calculated by dividing the total costs of the operation by the number of acres in production. We calculated the level of government payments accruing to the operation as the total government payments received minus the level of direct payments and level of Conservation Reserve Payments and Wetland

Reserve Payments received in the previous period. Finally, we used the lagged mean net worth of each operation to calculate each cohort's expected wealth for each period.

Size categories were calculated using the period one average value of production for each cohort. We created four categories. A cohort fell in the first category if it produced an average of less than $50,000 worth of agricultural products. If it produced an average between $50,000 and $100,000 worth of goods, it fell in the second size category. The third category consisted of those cohorts averaging between $100,000 and $250,000 of production while the remaining cohorts comprised the largest farm size category.

Finally, in 2002 (and 2003), each operation was asked, of the amount they owned in 2002 (2003), how many base acres they operated under the 1996 Act and under the 2002 Act. We differenced these two values to produce a change in base acres due exclusively to the implementation of the FSRI Act.

The fixed effects we include in the model are for regions and general farm type specialties. In particular, the regions include the North East (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, and VT), the Lake States (MI, MN, and WI), the Corn Belt (IL, IN, IA, OH, and MO), the Northern Plains (KS, NE, ND, and SD), Appalachia (KY, NC, TN, VA, and WV), the South East (AL, FL, GA, and SC), the Delta (AR, LA, and MS), the Southern Plains (OK and TX), the Mountain states (AZ, CO, ID, MT, NV, NM, VT, and WY) and the Pacific states (CA, OR, and WA). In addition, farm types were grouped into three main categories: livestock, program crops, and non-program crops. Livestock cohorts are those cohorts where the majority of production comes from livestock. Program crop cohorts are those cohorts where the majority of production comes from corn, soybeans, wheat, rice, sorghum, barley, oats, upland cotton, peanuts, or other oilseeds. Non-program crop cohorts make up the remainder.

Table 2 contains descriptive statistics for the cohorts we produced. The average change in revenue per acre was $298 over this time frame. This was offset by an average of $260 in costs per acre. Government payments increased by an average of $1.67 per acre while net worth changed by an average of over $50,000. Overall, the number of harvested acres decreased during this time period examined by close to an average of 30 acres. In the meantime, due to the implementation of the FSRI Act, the number of base acres increased by an average of over 51 acres.

To get a better idea of how the independent variable, *Dbase*, differs across cohorts, we looked at different size categories and different farm production specialties. Table 3 contains these descriptive statistics. For the cohorts containing the smallest farms, with an average value of production of just under $25,000 in period one, the base acres increased an average of just over five acres. For the next size category, farms averaged just under $74,000 worth of production in period one and experienced an average growth of over 64 acres of base acres. Farms in the third size category averaged just over $156,000 worth of agricultural production and experienced a gain of over 92 acres of base acres. The largest size category contained farms with an average of just under $702,000 of production, gaining just under 30 acres of base. Interestingly, the average number of harvested acres in this category was smaller than the average in the next largest size category. This probably indicates that farms in the largest categories spent a larger portion of their activities on livestock or high value crop operations such as nursery or fruit and vegetable operations, therefore requiring less harvestable cropland than farms in the next largest size category.

These trends are increasingly evident by examining the same sets of variables by farm specialty type. As expected, farms producing primarily program crops had much higher average changes in base acres (95.1) versus farms producing primarily livestock (19.5) or non-program crops (6.7). Farms producing primarily program crops also had the highest levels of harvested acres in each year.

V. Results

Results for the analyses lie in Table 4. We used three different specifications to check for robustness. The first set of results contains only the change in harvested acres regressed on the change in base acres and the lagged control measures of revenues per acre, costs per acre, government payments, and net wealth, without including any of the fixed effects. The change in base acres for the three largest size categories and the change in net wealth showed up statistically significant, as well as the third largest size category. Farms producing between \$100,000 and \$250,000 worth of goods appear to have fewer harvested acres than do the largest farms. As net wealth increases, so do the level of harvested acres. For each additional acre of base that can be updated, the operators of the largest farms decrease their harvested acres by almost 2.5 acres while operators of the next two largest size categories increase their acres harvested by one half an acre and just over one acre respectively.

Specification two includes fixed effects for the farm specialty and for the region. Results again show that the change in lagged net worth is positively correlated with the change in harvested acres for the middle two farm size categories while the largest farm size category again has a close to two acre decrease. Only the smallest farm size category shows no statistically significant change in the number of harvested acres adopted due to the change in base acres due to the FSRI Act. Results seem to suggest that the acres are being redistributed from the largest farms (in terms of value of production) to the smaller farms. This could be due to the fact that the largest farm category seems to be comprised mainly of those farms with little use for base acres (such as nursery or livestock operations). Larger crop operations might lie in the second and third size category and could be the ones most able to take advantage of the base acre updating. This would suggest that, rather than being redistributed from larger farming operations in general, the redistribution comes from farms without a primary focus on program crops to farms with a focus on the program crops.

The last specification includes all the two way interactions between the fixed effects and size categories. Results for the change in base acres retain their sign and significance for all but the smallest farm category (which, once again, becomes insignificant), and are only slightly lower than previous results across all four size categories. This robustness gives us some confidence in our results.

Our results appear to show that direct payments do matter to the decisions that operators make on the farm. Using the results from the last specification, it appears that for an additional acre of base, the operator chooses to increase the total number of harvested acres by 1.37 acres on farms producing between $50,000 and $100,000 worth of goods. With an average change in base acres of 51.5 acres, this translates into a change of harvested acres of almost 71 acres. This is close to a 25 percent increase in the cropland harvested for the average sized farm in this size category. For farms producing between $100,000 and $250,000 worth of agricultural goods, a one acre change in updated base led to a 0.84 acre increase in total cropland harvested. This translated into an average change of just over 43 acres, or close to a ten percent change in the size of cropland harvested for the average sized farm in this category. Finally, for the largest farms, a one acre increase in updated base led to a decrease of 1.27 acres of cropland harvested. This translated into a drop of over 65 acres, or a decrease of somewhere in the vicinity of 20 percent of cropland harvested. These effects seem to be relatively large and could have serious effects on the total agricultural industry.[9]

VI. Conclusions

How decoupled are decoupled payments? This paper tries to shed some light on how changes in direct payments are associated with changes in operators' production decisions.

We examined the direct payments that farmers received and found that, even though not directly tied to production, the payments appeared to be associated with changes in farmers' production decisions. Current results show that a one acre change in base was linked with a decrease of just over one and a quarter acres of total harvested acres in the largest farms. A similar one acre change in base was also associated with an increase of under one acre of total harvested acres in farms producing between $100,000 and $250,000 worth of goods and to an increase of just over one harvested acre in farms producing between $50,000 and $100,000 worth of agricultural goods. The smallest farms appeared to remain unaffected by changes in base. This suggests that the largest farms decreased their total cropland harvested by approximately 20 percent. It also suggests that the second largest set of farms increased their total cropland harvested by nearly ten percent, while the third largest set of farms increased their total cropland harvested by almost 25 percent on average. These appear to be substantial changes.

Farms might be redistributing the acres from non-program crop and livestock specialties to program crop farms. Due to the updating, farms that focused on producing program crops might be better situated to buy up more cropland, while farms that focused on producing non-

[9] These results seem to imply a redistribution of acreage from farms with higher values of production to farms with lower values of production. However, we are only examining the effects of direct payments, so the overall effects of any redistribution remains unknown. Other effects could be causing the largest farms to increase in size and the effect of the direct payments that we found might be dampening the extent to which the largest farms are growing.

program crops and livestock might be selling their cropland off. In addition, it could be the case that, amongst program crop farms, different farm sizes are redistributing acres amongst themselves. While we tried to control for these possibilities using various fixed effects, the nature of our data and the use of cohorts leaves room for future research to better answer these questions.[10]

[10] Again, as in footnote 8, it makes some sense to clarify that we do not mean to suggest that the largest farms (in terms of value of production) are necessarily decreasing in size and that the smaller farms are increasing in size. Our results suggest that the direct payments have such an effect on the industry, but this is not likely to be the only influence on farm size. Recent studies on economies of scale and risk considerations, among other influences, have opposite effects on the size of farms - where the larger farms increase in size while the smaller farms get smaller or exit. The overall effect of farm size needs to weigh all these factors. We just want to note that in this paper, we are only examining the effect that direct payments have on production decisions.

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Table 2: Variable Definitions and Summary Statistics for Sample

Variable Name	Definition	Mean	Std. Dev.
Harv_acres	Change in harvested acres	-29.3	172.1
Rev_Acre	Lagged change in revenue per acre	297.2	4515.4
Cost_Acre	Lagged change in cost per acre	260.2	3248.6
Gov_Acre	Government payments per acre (excluding direct, CRP, and WRP payments)	1.7	29.4
Net_W	Lagged change in net wealth	50009.8	275834.4
D_Base	Change in base acres due to implementation of FSRI	51.5	87.1
VOP<50	Cohorts with farms averaging less than $50,000 value of production	0.25	--
VOP50-100	Cohorts with farms averaging between $50,000 and $100,000 value of production	0.23	--
VOP100-250	Cohorts with farms averaging between $100,000 and $250,000 value of production	0.32	--
VOP>250	Cohorts with farms averaging more than $250,000 value of production	0.20	--
Spec1	Livestock farms	0.47	--
Spec2	Non-program crop farms	0.09	--
Spec3	Program crop farms	0.44	--
Reg1	North east region	0.07	--
Reg2	Lake state region	0.12	--
Reg3	Corn belt region	0.17	--
Reg4	Northern plains region	0.10	--
Reg5	Appalachia region	0.12	--
Reg6	South east region	0.08	--
Reg7	Delta region	0.08	--
Reg8	Southern plains region	0.07	--
Reg9	Mountain region	0.10	--
Reg10	Pacific region	0.09	--
N	Number of observations	173	

Source: 2000-2003 Agricultural Resource Management Survey

Table 3: How do D_Base and Harv_Acres change with Farm Size and Type?

Category	Definition	Mean	Std. Dev.
	Size		
VOP<50	(N = 43)		
D_Base	Change in base due to implementation of FSRI	5.1	7.5
Harv_Acre1	Average number of harvested acres in period 1	81.1	49.3
Harv_Acre2	Average number of harvested acres in period 2	70.2	41.7
VOP50-100	(N = 40)		
D_Base		64.3	78.0
Harv_Acre1		281.8	189.0
Harv_Acre2		296.7	248.4
VOP100-250	(N = 55)		
D_Base		92.5	118.0
Harv_Acre1		487.4	369.7
Harv_Acre2		443.7	373.1
VOP>250	(N = 35)		
D_Base		29.6	55.4
Harv_Acre1		362.6	495.5
Harv_Acre2		282.9	315.0
	Farm Specialty		
Program Crops	(N = 76)		
D_Base		95.1	104.8
Harv_Acre1		485.8	399.3
Harv_Acre2		436.7	365.8
VOP1	Value of production, period 1	114,802.4	94669.4
VOP2	Value of production, period 2	105,668.1	76,834.6
Livestock	(N = 81)		
D_Base		19.5	52.4
Harv_Acre1		170.3	132.5
Harv_Acre2		157.2	146.2
VOP1		269,449.7	410400.1
VOP2		233,445.3	344,402.9
Non-program Crops	(N = 16)		
D_Base		6.7	13.4
Harv_Acre1		221.1	511.2
Harv_Acre2		204.6	348.5
VOP1		412,794.7	514,902.7
VOP2		508,831.9	646,441.1

Source: 2000-2003 Agricultural Resource Management Survey

Table 4. Regression Results - various specifications

Parameter	(1) Estimate	(1) Std. Err.	(2) Estimate	(2) Std. Err.	(3) Estimate	(3) Std. Err.
Intercept	-29.33	29.52	-28.24	52.04	211.15***	63.98
D_Base*lag VOP<50	2.19	3.01	5.44*	3.22	2.98	3.43
D_Base*lag VOP 50-100	1.09***	0.30	1.46***	0.32	1.37***	0.35
D_Base*lag VOP 100-250	0.51***	0.17	0.66***	0.19	0.84***	0.21
D_Base*lag VOP>250	-2.44***	0.45	-2.03***	0.46	-1.27*	0.71
lag VOP<50	4.19	39.62	21.25	41.47	149.97	182.93
lag VOP 50-100	-24.63	42.86	8.19	45.53	76.53	277.13
lag VOP 100-250	-69.07*	38.84	-32.28	40.93	-199.45	123.89
lag Rev_Acre	0.01	0.01	0.01	0.01	0.004	0.01
lag Cost_Acre	-0.01	0.01	-0.01	0.01	-0.02	0.02
lag Gov_Acre	0.71*	0.40	0.43	0.41	-0.23	0.43
lag Net_W	0.0001***	0.00004	0.0001***	0.00004	0.0001***	0.00004
Specialty Fixed Effects	No		Yes		Yes	
Region Fixed Effects	No		Yes		Yes	
Fixed Effect Interactions	No		No		Yes	
R^2	0.08		0.33		0.70	
N	173		173		173	

*** denotes significance at the 1% level
** denotes significance at the 5% level
* denotes significance at the 10% level