The impact of decoupled payments on the cost of operating capital

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Abstract

Purpose – The purpose of this paper is to investigate how decoupled direct payments, paid to farm operators based on historical yields and base acreage, may lead to production distortions by altering a farmer's access to credit or enabling the farmer to receive more favorable credit terms. The authors estimate the impact of decoupled direct payments under the 2002 Farm Bill on the credit terms of farm operators, specifically the interest rate on short-term operating loans. If farm operators are able to obtain more favorable credit terms and reduce their operating cost, then this offers an additional mechanism through which decoupled payments may distort current production.

Design/methodology/approach – The authors estimate the impact of decoupled direct payments on the interest rate on short-term operating loans. In the analysis, the authors control for farm financial characteristics, farm operator characteristics, and other factors. Data from the Agricultural Resource Management Survey for the years 2005-2007, are used in the weighted regression analysis. Jackknifed standard errors are also computed.

Findings – As the proportion of base acres to total operated acres increases it is found that interest rates decline by a small but statistically significant amount. This implies that direct payments lead to lower operating costs through better credit terms.

Research limitations/implications – Lower operating costs may in turn allow some farmers to expand production or produce on land that would otherwise be unprofitable to operate and hence left idle. Ultimately, this distorts current production. However, the small magnitude of the authors' results suggests that the reduction in interest rates, though positive, may have limited distortionary impacts.

Originality/value – The paper provides evidence that decoupled payments alter a farm operator's credit terms and hence could lead to current production distortions. The paper contributes to the growing body of research investigating the mechanisms by which decoupled payments have the potential to distort current production.

Keywords United States of America, Farms, Cost of capital, Credit, Payments

Paper type Research paper

Decoupled payments, paid to farm operators based on historical plantings, yields and base acreage, were originally introduced to US agriculture in the Federal Agricultural

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Improvement and Reform (FAIR) Act of 1996 as production flexibility contract (PFC) payments. These payments replaced the old system of coupled price supports in which farmers received payments based on current prices, production or inputs. The 1996 FAIR Act came at a time of rising costs associated with maintaining existing price support programs and increased commitments to moving toward less trade-distortive and more market-oriented policies in an effort to comply with World Trade Organization (WTO) obligations. While PFC payments were to be phased out prior to the subsequent farm bill, the 2002 Farm Security and Rural Investment (FSRI) Act contained provisions for a new decoupled support system for farm operators. Under the 2002 FSRI Act direct payment program, operators receive payments based on historical base acres and yields similar to the PFC payments awarded under the FAIR Act.

When first introduced, decoupled payments were thought to have minimal impacts on current production because such payments do not alter the marginal production decision (Alston and Hurd, 1990; Blandford *et al.*, 1989; Borges and Thurman, 1994; Rucker *et al.*, 1995; Sumner and Wolf, 1996). However, several mechanisms through which decoupled payments may have the potential to influence current production have since been identified in the literature. First, decoupled payments may alter the farmer's set of risk preferences due to insurance and wealth effects (Hennessy, 1998). Second, decoupled payments may change allocations of land, labor and other inputs (Ahearn *et al.*, 2006; Kirwan, 2009). Third, decoupled payments may indirectly affect current production through uncertainty of future government payments and the farmer's expectations of those payments. Goodwin and Mishra (2006) show that uncertainty regarding future decoupled payments affects the optimal allocation of acreage amongst crops planted. Fourth, there is evidence that agricultural decoupled agricultural subsidies keep farms in production that would otherwise exit the market, leading to inflated aggregate production (Chau and de Gorter, 2005; de Gorter *et al.*, 2008). Fifth, decoupled payments may ease credit constraints by increasing the creditworthiness of the farmer via increases in total wealth or improved liquidity (Young and Westcott, 2000; Collender and Morehart, 2004; Goodwin and Mishra, 2006).

We focus on the effects of decoupled payments on the cost of operating capital and show that better credit terms may cause farmers to expand production or operate marginal land that would otherwise be left idle. Unlike other commodity programs, decoupled payments provide a risk-free stream of income that is known prior to planting. Having a stable stream of income for repayment of loans should lead to better credit terms thus reducing the cost of capital for farmers with higher shares of base acres. Therefore, we hypothesize that decoupled payments allow farmers to receive better terms on operating loans. If decoupled payments lead to more favorable credit terms on operating loans and hence reduces the cost of operating inputs, then the actual cost of production is relatively lower for farms with more land tied to decoupled payments. All else equal, lower input costs from improved credit terms can alter relative prices causing the farm to use more operating inputs such as seed or fertilizer. This in turn may increase production. Lower marginal costs require a lower marginal revenue for profit maximization, potentially allowing farms to operate marginal land that would otherwise be unprofitable and thus left idle.

While some researchers conclude that agricultural decoupled subsidies keep marginal farms in production thus leading to inflated aggregate production (Chau and de Gorter, 2005; de Gorter *et al.*, 2008), it is not clear that production on the land belonging to the farm would necessarily cease absent the decoupled payment. If decoupled payments are eliminated forcing farms that are profitable only with the payment to exit the market, then the land associated with these farms might be sold or leased to more efficient agricultural producers. Hence, aggregate agricultural production would remain unchanged or even increase with the removal of these decoupled subsidies. Therefore, a more appropriate question is whether agricultural decoupled subsidies cause land (not farms) to remain in production.

Agricultural land can be developed for nonagricultural uses, used to produce agricultural products, or lie fallow. However, the 2002 FSRI direct payment policy stipulates that farm operators must keep land associated with base acres in "good agricultural use" to remain eligible for direct payments. Therefore, if the land is developed for nonagricultural uses, then direct payments are forfeited. This implies that land associated with decoupled direct payments has a higher opportunity cost of development relative to land without associated base acres. But what impact, if any, do direct payments have on the decision to idle land? Direct payments are received whether or not production occurs and should have little direct impact on production decisions.

However, some studies have found that direct or other types of decoupled payments[1] might influence current planting decisions if the farm operator faces uncertainty regarding the possibility of future updating of base acreage or yields upon which benefits are calculated (Goodwin and Mishra, 2006; Bhaskar and Beghin, 2010). The implication of updating is that there is some positive probability that planting additional acres in the current period increases gross receipts in future periods.

It is also possible that decoupled payments indirectly affect the cost of production. If decoupled payments indirectly affect the costs of production, then they may alter the profit-maximizing decision to idle land. We therefore show theoretically that a decrease in the cost of operating capital can alter the decision to idle land.

Using Agricultural Resource Management Survey (ARMS) data for the years 2005 through 2007 we show farms with a higher share of base acres relative to total operated acres face lower interest rates on operating loans. This cross-sectional survey dataset contains a random, stratified sample of farms that represent US agricultural producers of various sizes, production specialties, and regions. Respondents were asked to give details about various loans obtained by the farm operation. Information given include the type of lender, interest rate, principal balance, original loan amount, type of loan (operating, long term, or short term, other), term of loan, and so forth. The ARMS dataset also contains farm financial information such as solvency, the rate of return on assets and equity, and other financial information that lenders would likely use to determine creditworthiness. The data also provide farm and farm operator characteristics that allow us to control for these factors.

We find that a higher share of base acres relative to total operated acres leads to a small but statistically significant decrease in interest rates charged by lenders for operating loans. The results suggest that some farms at the margin may increase their use of operating inputs and may operate land that would otherwise be unprofitable to operate because decoupled direct payments give them improved access to credit. Hence, the aggregate production impacts are likely positive, but small.

This paper is organized as follows. The next section presents the theory of how decoupled payments affect current production decisions through access to capital and cost of capital. The third section presents empirical evidence of an inverse relationship between the proportion of base acres to total operated acres and interest rates. The last section concludes and discusses the implications of our results.

The impact of decoupled payments on production decisions through access to credit

One way that decoupled payments have the potential to influence production is by affecting a farm's access to credit, particularly if the farm is credit constrained. Decoupled payments might replace or compliment alternative sources of funding. If a farm lacks funds and is credit constrained, then upon receipt of government decoupled payments, such as direct payments, the farm may use this cash inflow to purchase additional assets such as land. This is likely if the farm is operating on the downward sloping portion of its average cost curve and thus has not reached its optimal size. In addition, decoupled payments might also serve as a verifiable signal of a farm operator's creditworthiness (Gonzalez-Vega *et al.*, 2006). Therefore, decoupled payments might increase a farm operator's access to credit in the presence of non-price equilibrium credit rationing or allow the farmer to obtain a more favorable interest rate in the presence of price credit rationing.

Credit markets are plagued by problems of asymmetric information. At the time of loan application lenders are frequently unable to distinguish between safe borrowers who are likely to repay their loans and risky borrowers who are likely to default. Moreover, once the borrower is granted a loan there are additional moral hazard concerns surrounding the borrower's choice of project. Hence, loan markets in equilibrium tend to be characterized by persistent excess demand due to credit rationing by the lenders with loans being granted to borrowers who are indistinguishable from other borrowers who were denied loans (Stiglitz and Weiss, 1981; Jaffee and Stiglitz, 1990).

While some argue that this extreme form of non-price credit rationing is rare because the borrower can pledge collateral (Bester, 1985), price credit rationing, in which riskier borrowers are charged higher interest rates, is thought to be very common (Baltensperger, 1978). Furthermore, even when loans are fully collateralized the interest rate charged by the bank tends to exceed that of risk-less assets, such as those issued by the US Treasury (Jaffee and Stiglitz, 1990). This is due to the uncertainty of the value of the assets in the event of liquidation and transactions cost associated with liquidation.

Since direct payments have an associated stream of known cash inflows, lenders might view borrowers receiving such payments as less risky. The known cash inflows reduce some of the uncertainty about the future value of pledged land collateral, hence increasing the quality of the pledged collateral. In addition, decoupled payments increase the borrower's liquidity. Therefore, borrowers facing price credit rationing might receive a lower interest rate once decoupled support policies are implemented due to the increased creditworthiness of the borrower and the improved quality of the collateral. If decoupled payments lead to improved access to credit or lower the cost of capital, then the farm might increase production by purchasing additional inputs or land or by farming marginal land that might otherwise lie fallow.

The farmer's profit maximization problem

To illustrate the impact of reduced credit costs on the level of farm production, assume that farmers choose how many acres to operate, how to allocate those acres amongst the crops planted and the mix of non-land inputs used such that they maximize their expected profits. Total profit consists of profit obtained from farming, government transfers, and income earned from non-farm activities. Thus, the farmers' profit maximization problem is:

$$\underset{A_t,X_t}{Max}\, E\left[\sum_{i}^{i=n} P_{it}\Psi_{it}A_{it} - \sum_{i}^{i=n}\sum_{j}^{j=m}\omega_{ijt}X_{ijt} - \sum_{i}^{i=n} r_{it}A_{it} - C_t + DP_t + G_t + I_t\right] \tag{1}$$
$$s.t.\, F_t(X_1, X_2, \ldots, X_m, A, \varepsilon) = Y_t$$

where $_E$ is the expectation operator over the random variables, P_{it} is a random variable representing the price of the ith crop at time t, Ψ_{it} is a random variable representing the per acre yield of the ith crop at time t, A_{it} represents a choice variable, the number of acres planted of ith crop at time t, ω_{ijt} is the per unit cost of input j associated with the ith crop at time t, X_{ijt} is a choice variable representing the quantity of input j used in the production of the ith crop at time t, r_{it} is the per acre cost of the land input associated with the ith crop at time t, C_t are fixed costs at time t, DP_t is the decoupled payment at time t, G_t is all other government transfers at time t, and I_t is income generated from off-farm activities at time t. Let the technology of a multi-output, multi-input farm be represented by a transformation function $F_t(X_1, X_2, \ldots, X_m, A, \varepsilon) = Y_t$ where X_j is a vector of non-land input quantities, A is a vector of acres planted, ε is a vector of exogenous shocks, and Y is a vector of output quantities. Therefore, the production function $F_t(X_1, X_2, \ldots, X_m, A, \varepsilon) = Y_t$ maps non-land inputs and land inputs to outputs. Note that $Y_{it} = \Psi_{it}A_{it}$.

Farmers face uncertainty at the time of planting, namely, P_{it} and Ψ_{it}; yield is revealed at harvest and price is revealed at the time of marketing and sale. However, most costs are incurred at planting, and we assume that input prices are known with certainty when acreage and input decisions are made. Thus, farmers face uncertainty regarding revenues when production decisions are made but costs are known with certainty.

Note that it might be profitable for the farmer to leave land idle. Hence, idle is one crop in the set of possible crops. Let $\sum_i^{i=n} A_{it} = A_t$ represent the total acres operated by the farmer. Moreover, it is possible for A_t to be greater than, equal to, or less than A_{t-1}, since it is possible for a farmer to purchase or rent additional land or to sell or lease his land from one period to the next.

For simplicity, assume that the farm uses one operating input purchased on credit financed through an operating loan. Let that operating input be represented by the mth non-land input. Given that this input is purchased on credit, the farm considers both the purchase price of the input and the interest rate on the operating loan when choosing the optimal quantity of the operating input to employ in production. Hence, the price of the operating input is now a function of the operating loan interest rate, $\omega(R)_{mt}$ where R is the interest rate on the operating loan. Thus, after imposing the constraint we can write equation (1) as[2]:

$$\underset{\{A_{it},X_{ijt}\}}{Max}\, E\left[\sum_{i}^{i=n} P_{it}F(X_{i1t}, X_{i2t}, \ldots, X_{imt}, A_{it}, \varepsilon_{it}) - \sum_{i}^{i=n}\sum_{j}^{j=m-1}\omega_{ijt}X_{ijt} - \sum_{i}^{i=n}\omega(R)_{imt}X_{imt}\right.$$
$$\left. - \sum_{i}^{i=n} r_{it}A_{it} - C_t + DP_t + G_t + I_t\right] \tag{2}$$

The cost of credit will depend on farm financial measures such as liquidity, profitability, and solvency and farm characteristics such as size, location, land quality, types of commodities produced, and degree of government support.

We hypothesize the cost of credit decreases as the proportion of base acres to total operated acres increases. Or:

$$\frac{\partial R_t}{\partial (B_t/A_t)} < 0 \tag{3}$$

where B_t is base acreage at time t. This relationship is likely to hold since total direct payments received by the farm are a function of the number of base acres. Therefore, as base acreage increases holding the number of total acres operated fixed, the creditworthiness of the farm increases. The hypothesis that the cost of credit decreases as the percentage of base acres to total acres increases is empirically tested in the next section.

Returning to the farmer's profit maximization problem, let:

$$\Pi_t^*(P, \omega, R, r) = \sum_{i}^{i=n} P_{it} F(X_{i1t}^*, X_{i2t}^*, \ldots, X_{imt}^*, A_{it}^*, \varepsilon_{it}) - \sum_{i}^{i=n} \sum_{j}^{j=m-1} \omega_{ijt} X_{ijt}^*$$
$$- \sum_{i}^{i=n} \omega(R)_{imt} X_{imt}^* - \sum_{i}^{i=n} r_{it} A_{it}^* - C_t + DP_t + G_t \tag{4}$$

represent the farmer's profit associated with farm production where the * signifies the optimized value.

Without loss of generality, applying Hotelling's Lemma yields:

$$\frac{\partial \Pi_t^*(\cdot)}{\partial P_{it}} = Y_{it}^*(P_{it}, \omega_{ijt}, r_{it}) \tag{5}$$

which is the short-run supply function for output i:

$$-\frac{\partial \Pi_t^*(\cdot)}{\partial \omega_{ijt}} = X_{ijt}^*(P_{it}, \omega_{ijt}, r_{it}) \tag{6}$$

which is the factor demand function for input j used in the production of crop i, and:

$$-\frac{\partial \Pi_t^*(\cdot)}{\partial \omega_{ijt}} = A_{it}^*(P_{it}, \omega_{ijt}, r_{it}) \tag{7}$$

which is the factor demand function for land used in the production of crop i. Using the properties of supply and factor demand functions, we know that:

$$\frac{\partial Y_{it}^*(P_{it}, \omega_{ijt}, r_{it})}{\partial \omega_{ijt}} > 0 \quad \text{or} \quad \frac{\partial Y_{it}^*(P_{it}, \omega_{ijt}, r_{it})}{\partial \omega_{ijt}} < 0 \quad \text{and} \quad \frac{\partial X_{ijt}^*(P_{it}, \omega_{ijt}, r_{it})}{\partial \omega_{ijt}} < 0.$$

Without loss of generality, the standard first order conditions of the profit maximization problem require:

$$MRTS_{lm} = \frac{\partial F^{*}_{it}(\cdot)/\partial X_{ilt}}{\partial F^{*}_{it}(\cdot)/\partial X_{imt}} = \frac{\omega_{ilt}}{\omega(R)_{imt}}.$$

Therefore, a decline in the cost of capital changes the input price ratio and hence is likely to change the optimal allocation of inputs. If the operating input is a normal input, then lower interest rates on operating loans will increase the quantity of the operating input used. In turn, the reduction in operating costs might cause the farm to operate some acres that would otherwise be unprofitable and left idle, thus changing the optimal allocation of acres amongst the crops being produced. Hence, if decoupled payments improve access to credit, then they also have the potential to influence production decisions in the current period.

Here, we have only considered a reduction in the cost of operating capital. However, an analogous story could be told regarding a reduction in the cost of capital used to finance real estate. A reduction in the cost of real estate capital could lead to an expansion of the farm's size (use of additional land inputs).

One caveat is that direct payments might become capitalized in land values hence leading to higher land prices and higher rental rates. The degree to which capitalization occurs is debated by researchers and policymakers. Research has shown that the share of each dollar of direct payments received by farm operators that is passed through to the landlord in the form of higher rental rates can be as high as 86 percent (Lence and Mishra, 2003), while other research has shown that only 20-25 percent of decoupled payments are capitalized into land rental values (Kirwan, 2009). Therefore, the net effect of decoupled payments on total operating costs for the ith crop $\sum_{j}^{j=m} \omega_{ijt}$ is an empirical question beyond the scope of this paper. Presumably, lenders would take into consideration both the decoupled payment received and the rent paid when determining credit terms for the farm operator. However, regardless of the net effect on costs, the fact that decoupled payments influence the cost of inputs has the potential to lead to production distortions as demonstrated in the methodology shown above. Therefore, the next section empirically investigates the impact of the share of base acres to total acres operated on short term operating loan interest rates.

Empirical evidence

In this section, we provide evidence that decoupled direct payments reduce the cost of operating capital and have the potential to distort production in the current period through the mechanism discussed in the previous section. Again, it is also possible that decoupled payments influence the interest rate the farm faces on real estate loans and hence impacts the number of acres operated. Owing to lack of data on real estate loans and to avoid potential endogeneity issues associated with interrelationship between direct payments and the number of acres operated, we focus our analysis on the relationship between decoupled direct payments and the cost of operating capital.

Data and variables

Data are taken from the ARMS conducted each year by the US Department of Agriculture's National Agricultural Statistics Service (USDA-NASS). This survey samples a cross section of farms each year, gathering information on farm production practices, finances, and farm operator characteristics. In particular, respondents are asked to list any production loans they received (or other loans with a term of less than one year), the interest rates paid on those loans, the lender, and other relevant loan information. Farmers also report farm financial information that may be used to determine creditworthiness, such as farm and nonfarm assets, debts, and revenues. They also list the total number of acres operated and the number of base acres operated. Data are taken for the years 2005-2007. These years contain a consistent set of questions regarding farm operator income and loans.

ARMS data are collected from a stratified sample, and each observation in the sample is given a weight reflecting the probability of being selected. The weights are determined by USDA-NASS and are adjusted to ensure key variables in the sample data are representative of US agriculture. All results are obtained using the appropriate weights.

Observations used in the analysis are restricted to those that took out short-term operating loans in any of the sample years. It is possible that a single farm took out more than one operating loan, in which case each loan represents a single observation. Because we are interested in the link between base acres and interest rates, we restrict the data set to those observations that reported operating at least some base acres[3]. The final data set contains 2107 observations over a three-year period of farms that operated at least some base acres and took out at least one short-term operating loan.

In the analysis, we estimate the impact of the percentage share of base acres operated on the interest rates for short-term operating loans. Interest rates are reported directly on the survey. The percentage share of base acres (percent base) is calculated by dividing base acres operated by total acres operated. Since the farm's financial health also affects the interest rate the farm faces, we include several financial measures in the analysis. Typically credit scoring models include measures of solvency, profitability, liquidity, collateral, and repayment capacity.

We calculate a measure of solvency, the solvency ratio, by dividing total farm and farm household debt by total farm and farm household assets. Return on farm assets (ROA) servers as a measure of the farm's profitability and is calculated by dividing annual farm net income by average farm assets over the accounting period. We control for operator's income by combining farm production revenues, total off-farm income (both earned and unearned), and government payments, excluding direct and countercyclical payments that are derived from base acres. Income serves as another measure of profitability as well as a control for farm size. The current ratio serves as a measure of liquidity and is calculated by dividing current farm and household assets by current farm and household liabilities. Percent base serves as a measure of the quality of collateral. We use percent base rather than the dollar value of the direct payments to control for farm size. Debt exposure represents the farm's repayment capacity; this ratio is computed by dividing annual farm income (including all government payments) by total farm debt.

We also include the original value of the loan (principle) in the model. This variable is included to capture potential economies of scale in loan size that might reduce transactions costs and affect the farmer's cost of capital. Alternatively, larger loans might require a higher interest rate. Either would affect the interest rate a farm operator faces.

The model is estimated without controlling for farm and farmer characteristic and then again controlling for farm and farmer characteristics. We control for the type of farm by including dummy variables to represent the main type of commodity produced on the farm (comprising at least 50 percent of the value of production). The 18 categories of farm types are wheat, corn, soybean, sorghum, rice, tobacco, cotton, peanuts, other crops, fruits, vegetables, nursery, cattle, hog, poultry dairy, and other livestock. The number of years of farming experience and the education level of the primary farm operator are included in the analysis to control for farmer characteristics. The number of years of farming experience is a continuous variable, while education level is categorical. The four categories are did not graduate from high school, high school graduate (or GED), some college and college graduate. Furthermore, it is likely that different types of lenders charge different interest rates; hence the type of lender is also included as a control variable. Types of lenders are grouped into eight categories: Farm Credit System, government agencies (including local, state and federal agencies), commercial banks (including savings and loan institutions), supplier financing, mortgage holders (individuals from whom the farm operator has previously purchased real estate), other individuals, other lenders, and credit cards. To control for economic conditions, the year surveyed is also included in the analysis as a categorical variable.

After estimating the model controlling for farm and farmer characteristics, additional control variables for the county where the farm is located are added to the model. County level fixed effects are included to control for weather conditions, economic conditions, land and soil quality, and other unobserved characteristics that vary by county. We estimate the model using various specifications (i.e. adding controls and then county level fixed effects) to test the robustness of our model and the results.

Results

Summary statistics for the main variables are found in Table I. On average, farms face an interest rate of 7.5 percent on short-term operating loans and 68.4 percent of the acres operated by farms in the sample are base acres. However, the percent of the acres operated that are base acres varies widely across the farms in the sample. On average, farms in the sample are financially healthy with a solvency ratio of 0.3, a current ratio of 2.5 and a ROA of 7.5. Table II presents the correlations between the main variables.

The results for the weighted regression estimation of the model without controlling farm and farmer characteristics are summarized in Table III. The percent of base acres operated has a negative and statistically significant impact on the interest rate of

	Description	Mean	SD
Interest	Annual interest rate on short-term operating loan (%)	7.473	1.632
Percent base	Percentage of total acres operated that are base acres (%)	68.44	30.24
Principal (in millions $)	Original principal value of the loan	0.313	0.152
Solvency	Total farm household debt divided by total farm household assets	0.310	0.781
ROA	Annual rate of return on farm assets = net income divided by farm assets	7.512	87.037
Current ratio	Current assets divided by current liabilities	2.513	5.598
Debt exposure	Farm household income divided by farm household debt	3.501	7.619
Income (in millions $)	Annual farm household income	1.174	3.125

Notes: Data are taken from the ARMS administered by the USDA-NASS for the years 2005 through 2007; only observations that had at least one short-term operating loan and operated at least some base acreage are included; there are a total of 2,107 observations for the three-year period

Table I. Descriptive statistics of main variables

Table II.
Pearson correlation coefficients for main explanatory variables

	Percent base	Solvency	Income	Net income	Principal	ROA	Currrent ratio	Debt exposure
Percent base	1.0000	0.0632	−0.0729	−0.0123	−0.0618	0.0243	−0.0274	−0.0888
Solvency		1.0000	0.0380	0.0013	0.0586	0.7292	−0.0796	−0.0591
Income			1.0000	0.6440	0.7420	0.0408	0.0122	0.0768
Net income				1.0000	0.6076	0.1449	0.0376	0.0094
Principal					1.0000	0.0176	−0.0363	−0.0316
ROA						1.0000	0.0082	0.0707
Currrent ratio							1.0000	0.6624
Debt exposure								1.0000

Notes: Data are taken from the ARMS administered by the USDA-NASS for the years 2005 through 2007; only observations that had at least one short-term operating loan and operated at least some base acreage are included; there are a total of 2,107 observations for the three-year period

Variable	Expected sign	Coefficient	SE
Constant	+	8.0265*	0.1031
Percent base	–	−0.0070*	0.0014
Principal	?	5.0×10^{-8}	9.2×10^{-8}
Solvency ratio	+	0.5349*	0.1248
Income	–	-9.4×10^{-8}**	4.0×10^{-8}
ROA	–	−0.0039*	0.0011
Current ratio	–	−0.0285*	0.0097
Debt exposure	–	0.0260*	0.0075
R^2		0.0297	
Adjusted R^2		0.0262	
No. of observations		1,979	

Notes: Significant at: *1 percent level; only observations that had at least one short-term operating loan and operated at least some base acreage are included in the analysis

Table III. Weighted regression results for Model 1

short-term operating loans. For every 1 percent increase in the share of base acres operated, the interest rate decreases by about 0.007 percent. This implies that those who operate larger shares of base acres receive better terms on their operating loans. Our measure of solvency, or the debt to assets ratio, exhibits a positive significant relationship with interest rates. As debt increases relative to assets, interest rates on operating loans also increase. Similarly, farms with higher levels of debt exposure face higher interest rates on short-term operating loans. Higher revenues from farm, nonfarm, or government sources lead to lower interest rates, as expected[4]. ROA, another measure of profitability, also has a significant negative relationship with the interest rate. Furthermore, higher levels of liquidity, measured by the current ratio, are negatively related to the interest rate. The loan amount (principle) is the only non-significant variable. The effects of all other variables are significant and have the expected sign[5].

Farms that operate significantly higher shares of base acres appear to receive better terms on their operating loans. If farm operators are able to reduce their costs of production, they may find it profitable to remain in production when they would otherwise exit. However, our results suggest that a high share of base acres would not result in significant savings. For example, if 90 percent of a farmer's acres are base, they would receive a 0.63 percent discount on the annual operating cost of capital compared to a farmer with no base acres. On a one year loan of $100,000 that is a savings of only $630. Such a small savings relative to the size of the loan may not be sufficient to cause a farmer that would otherwise leave the market or idle land to remain in production.

To test the robustness of these results, we run several alternative specifications of the model. In Table IV, the second column lists results when additional loan, farm, and farm operator characteristics are included in the analysis. Controlling for the type of lender, the primary types of commodities grown on the farm, operator education and experience, and the year surveyed, we show that coefficients of the explanatory variables included in the previous model change very little. However, the explanatory power of the model, or R^2-value, increases by 0.17.

Table IV also summarizes the results of the weighted regressions allowing for county level fixed effects. Adding county level fixed effects causes the effects of the

Variable	Controls Coefficient	SE	County controls Coefficient	SE
Contestant	7.1733***	0.2565	8.5495***	1.4882
Percent base	−0.0067***	0.0015	−0.0044*	0.0025
Solvency	0.6486***	0.1202	0.1099	0.1737
Income	-1.1×10^{-8}***	3.8×10^{-8}	-6.6×10^{-8}*	3.0×10^{-8}
Principal	9.2×10^{-8}	8.5×10^{-8}	5.8×10^{-8}	7.0×10^{-8}
ROA	−0.0049***	0.0010	0.0001	0.0015
Current ratio	−0.0461***	0.0092	−0.0344**	0.0142
Debt exposure	0.0371***	0.0072	0.0123	0.0090
Years experience	0.0112***	0.0028	0.0047	0.0042
Government agency	−1.3357***	0.1993	−2.2980***	0.4201
Commercial lender	0.3995***	0.0999	0.3522**	0.1563
Supplier financing	1.9715***	0.2146	−0.2275	0.4445
Mortgage holder	−0.6736	1.2038	−2.5097	1.7481
Other individuals	−0.9484*	0.5225	−0.4902	0.6701
Other lenders	−0.4455	0.4918	−0.5231	0.8460
Credit cards	−1.9137***	0.5642	0.0000	0.0000
Wheat farm	0.2495	0.1679	0.0746	0.2470
Com farm	0.2741**	0.1360	−0.0523	0.1926
Soybean farm	−0.3939**	0.1915	−0.8956***	0.3158
Sorghum farm	0.2624	0.7995	−1.8725	2.0316
Rice farm	0.5254*	0.2780	0.0168	0.6230
Tobacco farm	0.9050	0.6661	2.7006	6.2855
Cotton farm	0.0069	0.2435	0.0636	0.4014
Peanut farm	1.1345	1.1545	0.4583	1.1161
Other crop farm	0.6584***	0.1680	−0.2074	0.2651
Fruit farm	0.5758	0.4022	−0.5892	0.6178
Vegetable farm	−0.2720	0.2950	−0.0208	0.4976
Nursery	−1.5036*	0.8312	0.7750	1.1071
Cattle farm	−0.0683	0.1337	−0.0906	0.2218
Hog farm	0.2183	0.2873	−0.1899	0.4124
Poultry farm	−0.3344	0.4370	−0.1077	0.8456
Dairy farm	0.0879	0.2015	−0.1353	0.3318
Other livestock farm	0.0887	0.3072	0.7369*	0.4410
High school	−0.1841	0.1668	−0.0149	0.3122
Some college	0.0431	0.1709	−0.0763	0.3191
Graduated college	−0.3035*	0.1837	−0.6357*	0.3365
2006	0.7042***	0.0969	0.3371**	0.1464
2007	−0.0090	0.1036	−0.0436	0.1460
No. of observations	1,979		1,315	
R^2	0.2024		0.9072	
Adjusted R^2	0.1872		0.7438	

Note: Significance at: *10, **5 and ***1 percent levels

Table IV.
Weighted regression results with controls

percent of base acres on interest rates to decline slightly relative to the effect without county controls, but remain statistically significant. In addition, the effects of solvency, ROA and debt exposure are no longer significant.

Given that ARMS data are a stratified sample, the computation of jackknifed standard errors is generally preformed when working with this dataset. The jackknife procedure involves splitting the data into a fixed number of subsamples and repeating the estimation with each subsample omitted. We follow the estimation procedure recommended by the USDA's Economic Research Service (Dubman, 2000) and use 15 subsamples. The jackknifed standard errors are presented in Table V. Note, the jackknife procedure leads to larger standard errors than the weighted regression analysis yet the coefficients are the same. Thus, several coefficients are no longer

	Controls		County controls	
Variable	Coefficient	SE	Coefficient	SE
Contestant	7.1733^{***}	0.7781	8.5495^{***}	1.4182
Percent base	-0.0067^{*}	0.0045	-0.0044	0.0074
Solvency	0.6486^{*}	0.4951	0.1099	0.9087
Income	-1.2×10^{-8}	1.4×10^{-8}	-6.6×10^{-8}	7.1×10^{-8}
Principal	9.2×10^{-8}	4.6×10^{-8}	5.8×10^{-8}	3.3×10^{-7}
ROA	-0.0049	0.0041	0.0001	0.0067
Current ratio	-0.0461	0.0512	-0.0344	0.0389
Debt exposure	0.0371^{**}	0.0204	0.0123	0.0195
Years experience	0.0112^{*}	0.0074	0.0047	0.0157
Government agency	-1.3357^{***}	0.5238	-2.2980^{**}	1.3023
Commercial lender	0.3995^{**}	0.1857	0.3522	0.4327
Supplier financing	1.9715	2.0527	-0.2275	0.7861
Mortgage holder	-0.6736	1.4280	-2.5097	2.7431
Other individuals	-0.9484	0.7893	-0.4902	5.2502
Other lenders	-0.4455	0.4133	-0.5231	2.1837
Credit cards	-1.9137	4.0431	–	–
Wheat farm	0.2495	0.3896	0.0746	0.5302
Com farm	0.2741	0.2847	-0.0523	0.3866
Soybean farm	-0.3939	0.6075	-0.8956	1.4340
Sorghum farm	0.2624	1.1160	-1.8725	2.3153
Rice farm	0.5254	0.4742	0.0168	0.6607
Tobacco farm	0.9050^{*}	0.5860	2.7006^{*}	1.8360
Cotton farm	0.0069	0.2292	0.0636	0.6476
Peanut farm	1.1345^{*}	0.7367	0.4583	0.8777
Other crop farm	0.6584	0.7347	-0.2074	0.4391
Fruit farm	0.5758	0.5589	-0.5892	0.8532
Vegetable farm	-0.2720	1.0383	-0.0208	0.7612
Nursery	-1.5036	1.8869	0.7750	0.9575
Cattle farm	-0.0683	0.2746	-0.0906	0.4562
Hog farm	0.2183	0.5056	-0.1899	0.6230
Poultry farm	-0.3344	0.4445	-0.1077	0.7594
Dairy farm	0.0879	0.3869	-0.1353	0.5601
Other livestock farm	0.0887	0.6367	0.7369	1.1557
High school	-0.1841	0.5461	-0.0149	0.6454
Some college	0.0431	0.5608	-0.0763	0.7384
Graduated college	-0.3035	0.5998	-0.6357	0.7045
2006	0.7042^{***}	0.2525	0.3371	0.3921
2007	-0.0090	0.2559	-0.0436	0.3812
No.of observations	1,979		1,315	

Notes: Significance at: *10, **5 and ***1 percent levels; jackknifed standard errors are calculated using the process recommended by the USDA's Economic Research Service (Dubman, 2000)

Table V. Regression results with controls and jackknifed standard errors significant, including the coefficients on percent base for the specification with county level fixed effects[6].

Land quality: a complicating factor

There are also other possible explanations for our findings. For example, differences in interest rates might also reflect differences in borrowing capacity or differences in land quality. However, we attempted to control for differences in borrowing capacity by including independent variables that capture borrowing capacity such as the solvency ratio and repayment capacity.

Because base acres are determined by historical production, regions in the USA with a history of production are both the most fertile regions and have relatively higher shares of base acres. Any correlation between base acres and land quality may affect our results. The impact that the share of base acres has on interest rates may be capturing discounts due to superior land quality rather than from a stream of direct government payments. If base acres are of a higher productive quality, then a larger share of base may lead to better terms on operating loans not because of direct government payments, but through its potential association with better quality land and hence higher productivity. Although, inclusion of geographic control variables decreased the magnitude of the impact of the share of base acres, the coefficient remained statistically significant. Furthermore, because the total value of production is included in the independent variable income, we are likely accounting for yields, a reflection of land quality. This logic, combined with the theoretical model presented, leads us to favor the hypothesis that it is the stream of direct payments that is driving the better credit terms. We also find similar results when we replace the explanatory variable percent base with the dollar value of the direct payments received by the operation.

Conclusions

The use of agricultural decoupled payments has been increasing as WTO member nations try to bring their policies into compliance with the agreement on agriculture. However, the true production effects of these policies are still unclear. Many studies have found varying degrees of distortion associated with decoupled payments citing various mechanisms driving the effects. These mechanisms included impacting risk attitudes through wealth and insurance effects, influencing access to credit, influencing farmers' expectations regarding future government support policies, and influencing the farm's decision to exit the market. The analysis presented here contributes to the emerging literature on the production effects of decoupled programs by exploring the effects of decoupled support on the cost of operating capital. If decoupled payments reduce the cost of capital, then these payments have the potential to alter relative input prices and hence impact production.

The results suggest that some farms at the margin may employ more inputs or operate land that would otherwise be unprofitable and left idle because direct payments reduce the cost of capital. These results are robust to a number of different specifications. Therefore, the aggregate production impacts are likely positive, but small; only agricultural land that would suddenly become profitable to operate with small decreases in the interest rates of operating loans would be affected. Nevertheless, the results indicate that decoupled payments have the potential to distort current production. These findings have implications for future WTO negotiations and policy formation.

Further, it is possible that differences in land quality may be driving some of these results. If base acres are consistently of a higher productive quality, then farms with more base acres may get better terms on operating loans independent of associated direct payments. Our results therefore represent an upper bound on the impact of direct payments on interest rates.

Notes

1. Decoupled payments refer to a type of payment intended to be production neutral. By using the word "decoupled" we are not implying the payment is actually decoupled, but are investigating the claim. Direct payments refer to the specific decoupled payment legislated in the 2002 Farm Act.
2. The price received for idled land is likely to be zero. However, in some cases the farmer might receive payments from the government to idle land (i.e. if the farmer is a participant of the Conservation Reserve Program). If this is the case, then these types of payments should not be included in G_t to avoid double counting them.
3. Including farm operations with no base acres in the analysis yields nearly identical estimated results. However, when all farm operations are included in the analysis the coefficient on the share of base acres becomes insignificant due to the large number of farms (45 percent) in the sample without any base acres, but who face positive interest rates on operating loans.
4. Using the net income had no impact on the signs or significance of the other independent variables.
5. Using the log of the dependent variable had no impact on the signs or significance of the independent variables.
6. We also run an alternative specification that focuses on farm financial information such as total assets, total debt, total current assets, total current liabilities, and farm income. The effects of the share of base acres on the interest rate of short-term operating loans are similar to those found in Table IV.

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