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The Supply Response of U.S. Rice:
How decoupled are income payments?

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Introduction

Beginning with the 1985 Farm Act, the United States farm policy began to move the crop sector toward greater market orientation and less government involvement. The 1996 FAIR Act advanced this movement by shifting the farm policy focus to decoupled payments as the primary means of income support. This Act ended deficiency payments and instead provided production flexibility contracts (PFC) payments that were independent of the production and the prices of crops, thereby, decoupled. The PFC payments were fixed annual payments to farm operators based on qualified acres historically enrolled in commodity programs and fixed program yields. However, the 1996 FAIR Act also maintained the nonrecourse marketing loan assistance and loan deficiency payments, which were clearly coupled to production. Overall, the 1996 FAIR Act was initiated in order to make agricultural production more market-oriented (Young and Westcott, 1996). This Act was also influenced, to a limited extent, by the commitment of the U.S. to reduce trade-distorting price subsidy (amber box) payments in the Uruguay Round Agreement on Agriculture (Orden, Paarlberg, and Roe). Under the 1996 FAIR Act, the United States declared that the PFC payments fell under the WTO category of green box subsidies, a category of payments that result in minimal distortions of agriculture markets (ERS, USDA,a).

The 2002 Farm Bill, known as the Farm Security and Rural Investment Act (FSRI), refined the income supports further by providing two types of payments, a fixed direct payment (DP) and a counter-cyclical payment (CCP), both based on qualified acres and program yields (Westcott, Young and Price). The CCP payment, however, is determined by the relationship between the current year price received relative to a target

price. Direct payments are similar to the PFC payments from the FAIR Act; however, the direct payments are fixed for the duration of the 2002 Farm Bill, set on a per unit basis, whereas PFC payments were fixed at total expenditure levels for each fiscal year.

It has been argued that the potential wealth and risk-reducing effects of these decoupled payments may elicit a response on the supply of commodities, counteracting the purpose of the decoupled payments. Understanding the nature of the supply response of U.S. rice is important because a relatively large share of U.S. rice production is exported. One of the primary concerns in the current negotiations of the Doha development round of the WTO is determining the extent to which income support payments under current U.S. farm programs are truly decoupled. This study provides a preliminary analysis of the effects of decoupled farm program payments on the supply response of U.S. rice using pooled cross-sectional data by state and rice type.

Background and Literature Review

Six states grow almost 99 percent of the rice in the United States. Arkansas is the largest rice producing state, responsible for 45 percent of production. Arkansas is also the only state that is a major producer of both long-grain and medium-grain rice. California is the second largest producer with 18 percent of production, nearly all medium-grain. Louisiana, Mississippi, Texas, and Missouri are the other four major rice producing states, all primarily growing long-grain varieties.

The 1996 Farm Bill was a significant shift in U.S. farm policy, with decoupled payments as the focus of income support. The Farm Bill radically changed the approach for income payments to farmers by giving a predetermined annual contract payment. The previous method of target prices and deficiency payments were replaced with payments

known as Production Flexibility Contracts (PFC) that were the heart of the change to a more market oriented agriculture sector. The PFC payments were considered to be decoupled which "effectively cuts the link between payments, production, and prices, and makes the payments a direct transfer of income to the farm household" (Markets and Trade Economics Division, ERS 2003).

The PFC payments were notified as green box payments for the World Trade Organization (WTO), meaning that they had minimal trade-distorting effects on production. This is because they were not based on current prices or production, and they were a predetermined amount. Also, farmers were given almost complete flexibility when deciding what crops to plant (with the exception of fruits and vegetables); meaning they would receive the PFC payment regardless of what crop they decided to plant or how much of it they decided to plant.

Although PFC payments were classified as non-trade distorting for WTO purposes, there have been several studies refuting the idea that they had no effect on production. Probably the most critical analysis of the PFC payments was by Hennessy (1998) in which he claimed that such payments may distort production by allowing for greater agricultural investment via wealth effects. Hennessy claimed that farmers are risk averse and they become less risk averse as they become wealthier; thus, as they receive more government payments, and become wealthier, they may be willing to produce more. Hennessy also examined the decoupled nature of CCP payments claiming that there is at least an indirect effect of such policies. He concluded that if farmers are risk averse, counter-cyclical payments will have an impact in increasing production and therefore will not be decoupled. Key, Lubowski, and Roberts (2004) agreed with the claims by

Hennessy stating that "greater wealth may allow farmers to more easily finance their operations and cope with year-to-year fluctuations in profits, effectively reducing farming costs."

Research has also been conducted contesting the claim that PFC payments were coupled. Analysis by ERS (2003,b) indicates that the PFC payments have no effect on agricultural production in either the long run or the short run. Their study concluded that the links between decoupled payments and agricultural production are indirect and depend on the household response to the payment. They concluded that PFC cash payments increased recipients' well-being, but in ways that can be expected to have minimal links to farm production levels. In the worst case "PFC payments are no more distorting of farmers' production decisions than deficiency payments were under the pre-1996 programs" (Tweeten and Thompson, 2002).

While the decoupled stance of the 1996 Farm Bill brought about greater market orientation and less government intervention; low commodity prices from 1998-2001 exposed the lack of an adequate safety net. These low prices caused Congress to authorize supplemental payments known as marketing loss assistance (MLA) payments. For the 1998 crop, contract holders received additional payments equal to approximately 50 percent of that year's PFC payments. In 1999 and 2000, contract holders received MLA payments equal to the 1999 PFC payment rate. The amount of payments made, due to MLA payments was large; for 1997 the only direct payments made to rice farmers were $448 million. By 1999 direct payments exceeded $1.3 billion. During this same period that the MLA payments were made, the market value of production dropped to $1.23 billion from $1.76 billion, a result of much lower prices (Childs, 2001). These

MLA payments were classified as amber box support payments in the WTO raising fear that the ceiling for amber box support payments might be exceeded.

The need to provide an adequate safety net in the face of high emergency payments, combined with the need to keep income support payments below the WTO specified level; lead to the provisions of the current 2002 Farm Bill. As mentioned before, the three major provisions of the Farm Bill were direct payments, counter-cyclical payments, and the marketing assistance loans. Marketing assistance loans are price supports designed to provide eligible producers with financing; therefore, they are included in the gross margin variable of the area harvested equation used for this study, rather than being specified as a separate independent variable. Direct payments and counter-cyclical payments are income support mechanisms; therefore, they do not belong in the price component of the gross margin and must be specified as separate independent variables.

Direct payments, considered to be the most decoupled of the three payments, are similar to the production flexibility contract payments under the 1996 FAIR in that the payment rate is fixed and is not affected by current production or by current market prices. Direct payments are calculated as the direct payment rate ($2.35 per cwt.) times 85 percent of the farm's base acreage times the farm's direct payment yield. Yields are based on direct payment program yields, rather than actual yields. The main difference between the direct payment and the PFC payment is that the direct payment rates are constant through the duration of the 2002 Farm Bill, while the PFC payment rate declined over the life of the 1995 Farm Bill. The direct payment rate does not change with current production or market prices; however, farmers were allowed to update their base acreage

with the implementation of the 2002 Farm Bill, which has also lead many to question the decoupled nature of the payments.

Counter-cyclical payments were enacted in the 2002 Farm Bill to replace the ad hoc MLA payments that were made from 1998-2001. These payments are not tied to production, but they are tied to market prices in that if the market price is lower than $8.15/cwt than these payments are made. Counter-cyclical payments are made whenever the target price ($10.50) minus the direct payment rate ($2.35) is higher than the effective price[1]. The maximum counter-cyclical payment that can be paid is $1.65/cwt, with the calculation per farm computed similar to the direct payment. However, since the 2002 Farm bill allowed producers to update their counter-cyclical payment yield, the counter-cyclical payment program yield is higher than the direct payment program yield for all the rice producing states. Counter-cyclical payments for a production year are paid in three partial payments if authorized. The first partial payment is based on up to 35 percent of the projected payments rate and is made after October 1 when the crop is harvested. The second payment is based on up to 70 percent of the projected payment rate and is made after February 1st of the year after production. The final payment is made after the end of the marketing year. In the case that the projected payment rate changes and the first partial payment rate was too high; the excess is then subtracted from the second partial or the final payment. This was the case for the 2003 CCP payments.. In this case the projected payment rate was between $.65/cwt and $.90/cwt when the first

[1] The effective price is the sum of 1) the higher of the national average farm price for the marketing year or the national loan rate ($6.50) and 2) the direct payment rate.

partial payment was made. However, in January 2005, the final payment rate was just $.07/cwt, meaning that the difference must be refunded.

Several studies have been directed towards investigating the question of how decoupled are the income support payments of the 1996 FAIR Act and 2002 FSRI Act. Most of these studies use data obtained during the implementation period of the FAIR Act and make implications of the possibilities of the FSRI; therefore, evidence related directly to the effects of the FSRI Act is scarce.

Much of the literature that examines this topic argues that such payments are not completely decoupled. The prevailing argument is that there is at least an indirect effect in such policies. Anton and Le Mouel (2003) developed a framework to assess the risk-related incentives to produce created by the loan deficiency payments and the counter-cyclical payments (CCP) in the FSRI Act, with the conclusion from Hennessy's research as their foundation. They modeled the impacts of the CCP in the context of a risk-averse farmer maximizing expected utility. Anton and Le Mouel concluded that both CCP and loan deficiency payments create risk-inducing incentives to produce in most commodities. However, for rice, CCP's did not create risk-reducing incentives; although, there was a very large reduction in risk premiums using the loan rate from 2001. Anton and Le Mouel concluded that, although, the risk effects of CCP's were smaller than those of the loan deficiency payments for all commodities, they could be of comparable magnitude. Their research also concluded that farmers are risk averse, as stated in Hennessey's research.

Other literature has differed in the opinion that counter-cyclical payments are coupled. Westcott, et al. (2002) argue that counter-cyclical payments do not affect

marginal revenue, because they do not directly affect the farmers' current production. Rather, the expected marginal revenue of a farmers' additional output is the expected market price, so counter-cyclical payments do not affect production directly through expected returns.

Westcott and Meyer (2003) examined the supply response of cotton under the provisions of the 2002 Farm Act, specifically investigating the decoupled nature of counter-cyclical payments and direct payments. They stated "the expected marginal revenue of a farmers' additional current output is the expected market price so counter-cyclical payments do not affect production directly through expected net returns. However, because counter-cyclical payments are linked to market prices, they may influence production decisions indirectly by reducing total and per unit revenue risk associated with price variability in some situations." Westcott and Meyer also determined that direct payments are largely decoupled since these are fixed payments; however, the payments are tied to acreage, so the benefits will be capitalized into farm values, thereby increasing wealth.

A review of past literature suggests that the label of decoupled payments associated with direct payments and counter-cyclical payments is widely debated. Past studies indicate that direct payments are the more decoupled of the two; although, some claim that indirect effects from these payments have an effect on production. Counter-cyclical payments are considered by many to be decoupled in the sense that the payments are based on fixed acreage; however, they are based on current market prices, thus also affecting production at least indirectly.

Data & Methods

This study utilizes econometric methods to obtain the parameter estimates by panel data methods. The data for this study are from the period 2002-2004 and were obtained from USDA, NASS, and ERS. The cross-sectional panel data are from the six rice producing states and two types (long and medium) of rice. A pooled cross-sectional acreage supply response equation was estimated to identify the extent to which the income support payments are decoupled. Specifically a least squares dummy variable model was utilized to capture the individual heterogeneity of the cross-sections.

In this study, United States rice area harvested is analyzed through the use of an empirical supply model based on the naïve expectations model specified by Nerlove; as this was determined to be the best-fitting model. The main objective of this study is to determine if government intervention, namely direct payments and counter-cyclical payments, are empirically decoupled for the period 2002-2004.

Lin et al. state that the "theoretical underpinning of supply response assumes that producers wish to maximize expected net return. Based on the firm's implicit, multi-product production function, it can be shown that the supply of a farm commodity is a function of output and input prices for that commodity as well as output and input prices for competing crops (2000). Therefore, to characterize a supply response function, one must look at what constitutes net returns. Supply theory strongly proposes that production is directly related to prices, with profit maximization the focus of the farmer (Ferris, 1995). The key to understanding supply theory is to realize the importance the role that prices play; and to develop a logical theory for expected prices. As mentioned before, production is related to prices; however, in the case of the supply sector, prices

are sometimes difficult to determine. This is because when a farmer is deciding the amount tol plant, a certain harvest price is generally not available; rather there is only the expected price. Based on this knowledge and the objectives specified, the generic area harvested equation for United States rice used for this study is specified as follows:

$$AH^{ij}_{t} = f(AH^{ij}_{t-1}, GM^{*ij}_{t}, DP^{i}, CCP^{*i}) \quad (1)$$

Where the subscript i indicates the specific state and j indicates the rice type. AH_t stands for the area harvested in time t and is the dependent variable of interest. AH_{t-1} indicates the lag of the area harvested as indicated for the dependent variable. GM* indicates the expected gross margin for the rice farmer; which is calculated as the expected revenue minus the expected costs. DP indicates the direct payments per acre received by the farmer. Finally, CCP* is the expected counter-cyclical payment to be received. The expected gross margin and the expected counter-cyclical payment are the sources of variability that will be investigated by the hypothesized models.

Many area harvested models incorporate the price of other commodities that compete with planting decisions as an independent variable in the model. However, due to statistical reasons (lack of degrees of freedom), and because this research was not concerned with explaining the effect that other crops have on rice planting decisions; the decision to not include a variable representing other crops prices was made. It would also be difficult to specify one or even two competing crops that were grown in all six of the rice producing states.

Alternative specifications of the area harvested equation that best described the data were considered. Previous literature suggests several alternative area harvested

models that should be tested. The three specifications evaluated for this model were: a counter-cyclical lagged model, a naïve expectations model, and a futures' prices model.

The counter-cyclical lagged model suggests that farmers based their expected gross margin and their expected counter-cyclical payment on payments from last year. This model would therefore use gross margin lagged as the proxy for expected gross margin and counter-cyclical payments lagged as the proxy for expected counter-cyclical payments in equation (1). The expected gross margin is formulated based on the idea of naïve expectations, where farmers only look at one lag period when formulating planting decisions, as presented by Nerlove. Expected gross margin is formulated to be:

$$GM^{ij}* = f((RY^{ij}_{t-1} * \max(LR^{j}, MP^{ij}_{t-1} + LDP^{ij}_{t-1}) - VC^{ij}_{t-1}) \quad (2)$$

Where the subscript i indicates the state and j indicates the rice type. The independent variable RY_{t-1} is the actual yield lagged, LR is the loan rate, MP_{t-1} is the market price received in the lagged period, LDP_{t-1} is the Loan Deficiency Payment made in the lagged period, and VC_{t-1} is the variable cost from the lagged period. The maximum of LR (capped at $6.50); versus the market price lagged by state and type with the LDP by state added to the market price; is then the expected price. The expected price (in every case the MP + LDP was the greater amount) is then deflated by the CPI and multiplied by the actual lagged yields to formulate the revenue received in period t-1. The deflated variable costs (VC) by state and type are then subtracted from the revenue to equate the expected gross margin in period t for individual state and type.

The estimated counter-cyclical lagged model had several problems such as the expected gross margin was not statistically significant. Multicollinearity was present

between the direct payments and the counter-cyclical lagged payments; and both direct payments and the counter-cyclical payment lagged coefficients were statistically significant, indicating that both direct payments and counter-cyclical payments are coupled. The coefficient sign for direct payments was positive, indicating that if the government raised the direct payment rate area harvested would increase. A more significant aspect of this empirical specification was that there were only two years of counter-cyclical payments made if the time period is lagged; therefore, the marketing loss assistant payments (MLA) for the 2001 period were used as a proxy for the counter-cyclical data for 2002. These payments were $2.49/cwt; however, under the 2002 Farm Bill the maximum the current CCP payment can be is $1.65/cwt. Therefore, it seems the biggest problem with this model is missing data. This is difficult to fix; however, since the MLA payments seem to be the best proxy for the CCP lagged payment.

The futures' prices model suggests that farmers are not naïve; rather they are forward looking and base their price expectations on futures' prices. The area harvested equation using this model can then be specified as:

$$AH^{ij}_{t} = f(AH^{ij}_{t-1}, GM^{*ij}_{t}, DP^{i}, CCP^{*i}) \quad (3)$$

$$GM^{*ij}_{t} = (\underbrace{\max(FP^{i},LR)}_{EP^{*}_{t}}*RY^{ijt}_{-1}) - VC^{ij}_{t-1}$$

$$CCP^{*i} = \min(1.65,(TP-DP-EP^{*}_{t})))*PY^{i}$$

Where EP is the expected price for period t, RY_{t-1} is the yield lagged one period, and PY^{i} is the program yield for counter-cyclical payments specified by state. Difficulties arise

when employing the idea that farmers project revenues based on futures prices. First, there is only a futures price for long grain and not medium grain rice. As stated by Ferris, "to presume that decision makers can integrate supply and demand information and accurately forecast prices is unrealistic. Even the best of econometricians have difficulty accomplishing that" (1998). Another problem that arises when calculating the expected GM is the amount of loan deficiency payments (LDP). Since these payments are paid on current daily market prices and production; no judgment could be made on the forecasted payments for a period. That coupled with the fact that all of the projected CCP amounts were $1.65; essentially bases the projections on false information for gross margin. This is because realistically both LDP payments are made, and the CCP payment rate has been $1.65 for only one period and less than that for the other two years. Statistical problems associated with this model were that neither expected gross margin, nor direct payments, nor expected counter-cyclical payments were statistically significant. Also multicollinearity was present and could not be remedied without changing the model specification.

The naïve expectations model was determined to be the best in estimating the area harvested model for the data utilized. The rational expectations model treats expected gross margin the same way as the counter-cyclical lagged model for equation (2); however, the specification for the expected counter-cyclical payment is different. This model is based on the idea that farmers are both naïve and forward looking in their decision making. The rational expectations model has several benefits with the most important being that the actual counter-cyclical payments paid are used in the model, except in the case of 2003. For this year the announced CCP at the time of the first

payment was $.65 announced in October; however, the final CCP calculated January of the next year was changed to $.07. Since the first announcements are considered to be a projection of what farmers expected the final payment to be, this was the amount used for this model. This model can be considered to be credible since farmers have a good idea of what the farm price and the counter-cyclical payment will be for that year, based on projections from USDA.

The data used for this study are considered to be panel data since there are observations on the same units (cross-sections) in several different periods (time series). The data is estimated using pooled Ordinary Least Squares (OLS), while allowing for cross-sectional effects by specifying different intercepts for state and type. The type of model specified is the least squares dummy variable model which is where a dummy variable is used for each individual and the intercept is omitted. Doing this allows each individual to have a different intercept, and so OLS, including all these dummy variables, should guard against the omitted variable bias (Kennedy, 2003).

Results and Analysis

The results for the original naïve expectations model are presented in Table 1. The Durbin *h* statistic, used to calculate serial correlation in the presence of the lagged dependent variable, indicates that there is negative serial correlation present. For the original model, CCP payments are the only regressor with a parameter estimate statistically different than zero. Therefore, the model indicates that gross margin; lagged area harvested, and direct payments are not statistically different than zero. The short-run elasticities were also calculated and presented in Table 1. The estimated elasticity for lagged_GM seems to be very low, while that for DP is negative and relatively high. This

would indicate that farmers are more responsive to direct payments than the expected gross margin; however, expected gross margin makes up a larger proportion of farmers' income than direct payments, indicating that farmers should be more responsive to the expected gross margin. The variance inflation factor[2] indicates that multicollinearity might be present, especially in the sense that the direct payments might be correlated with lagged GM or CCP payments. The F-value and the adjusted-R^2 both indicate that the model is statistically significant. Overall, the need to include the gross margin in the final model combined with the statistical problems encountered, indicate that some variables should be excluded and a new model should be estimated.

[2] Statistical measure of multicollinearity. A measure less than 10 indicates no problems; however, higher than 10 indicates that multicollinearity might be a problem.

Table 1. Original model (standard errors are in parantheses), LSDV (2002-2004)

Variable	Parameter Estimate	P-value	Variance Inflation	Short-Run Elasticity
Intercept	2643139	0.04	-	
	(1096975)			
Lag_AH	-0.1141	0.54	171.47	
	(0.1805)			
Lag_GM	70.78	0.79	17.67	0.01464
	(253.83)			
Medium	-1332045	0.01	207.16	
	(226317)			
CA	-311091	0.65	1810.68	
	(669083)			
LA	-1032830	0.01	101.54	
	(158445)			
MS	-1316092	0.01	140.99	
	(186705)			
MO	-1263096	0.01	208.83	
	(227227)			
TX	-1157979	0.01	301.37	
	(272965)			
DP	-13932	0.31	1551.16	-2.88140
	(12899)			
CCP	1496.15	0.03	4.94	0.30943
	(576.77)			
Adj. R^2	0.9961			
F Value	506.71			
Durbin *h*	-2.1758			

The final model utilized for this research is presented in Table 2. The final model is specified as area harvested is a function of the state and type of rice; the gross margin; and counter-cyclical payment. The parameter estimate for the gross margin lagged is 343.43, indicating that as the gross margin from last year increases by one dollar, area harvested increases 343.43 thousand acres. The parameter estimate for counter-cyclical payment is 956.29, indicating that as counter-cyclical payment increases a dollar for the year, area harvested increases 956.29 thousand acres. For the final model, multicollinearity is not problematic and there is no serial correlation present.

Table 2. Final model (standard errors are in parantheses), LSDV (2002-2004)

Variable	Parameter Estimate	P-value	Variance Inflation	Short-Run Elasticity
Intercept	1222949	0.01		
	(39550)			
Lag_GM	343.43	0.01	2.97	0.07103
	(106.05)			
Medium	-1217933	0.01	2.17	
	(23615)			
CA	-853666	0.01	2.60	
	(25858)			
LA	-801849	0.01	2.16	
	(23572)			
MS	-1110565	0.01	1.75	
	(21196)			
MO	-1159722	0.01	1.72	
	(20991)			
TX	-1142174	0.01	1.71	
	(20987)			
CCP	956.29	0.02	1.92	0.19778
	(366.82)			
Adj. R^2	0.9959			
F Value	609.35			
Durbin	0.7803			

The statistical models estimated indicate that the area harvested from last year does not have a statistical effect on the area harvested this year, although past literature claims it is important. A possible reason that this variable was deemed statistically insignificant was that there were only three years of data and the area harvested for these three years differed greatly.

This analysis examined the nature of the income support payments to rice farmers, specifically direct payments and counter-cyclical payments. The final statistical model indicates that direct payments do not have an effect on area harvested since the estimate is not statistically different than zero. However, the parameter estimate for counter-cyclical payments is statistically different from zero, suggesting that counter-

cyclical payments are not decoupled and that they have an effect on the area harvested of rice.

The results of this analysis indicate that direct payments are decoupled and do not induce a supply response; while, the hypothesis that counter-cyclical payments have no effect on the supply response was rejected. These results confirm the ideas of Hennessy that counter-cyclical payments elicit a supply response that can be attributable to risk-reducing or wealth effects. However, unlike Hennessy's results, direct payments were determined to be decoupled.

Summary and Conclusion

The Uruguay Round Agreement on Agriculture (URAA) brought about changes in domestic support for the agriculture sector. Domestic support is classified according to its trade-distorting impacts, with amber box support the focus of reduction. The changes in the URAA have had an impact of the provisions in the 1996 Farm Bill and the 2002 Farm Bill.

The United States farm sector has gradually moved to more market orientation and less government involvement, with the ushering in of the URAA provisions. The 1996 Farm Bill drastically shifted such policy to decoupled payments. However, when a strong decline in prices exposed the lack of an adequate safety net; counter-cyclical provisions were included in the 2002 Farm Bill to address this issue. U.S. Farm Bills have moved towards decoupled payments in accordance with the world-wide movement towards freer trade. The 2002 Farm Bill allocated income support payments to farmers in the form of direct payments and counter-cyclical payments; both of which have been debated on whether they are truly decoupled.

This analysis examined the decoupled nature of direct payments and counter-cyclical payments to determine if they have an impact on U.S. rice area harvested. A naïve expectations model was specified, with the results indicating that direct payments are decoupled; however, counter-cyclical are not. Overall, the results indicate that a change in the expected gross margin or counter-cyclical payments would stimulate a supply response in rice production. The lack of a significant amount of time-series data renders results of this analysis as preliminary and tentative; as such more data would allow for better inferences.

The results of this study concur with past literature that counter-cyclical payments elicit a supply response. However, direct payments were deemed to be decoupled, which differs from the same literature. Westcott's study involving cotton indicated that counter-cyclical payments are mostly decoupled and direct payments are decoupled. The results from this study agree with those results in that direct payments are considered to be decoupled and counter-cyclical payments are coupled.

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