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Government Subsidies and Crop Insurance Effects on the Economics of Conservation Cropping Systems in Eastern Washington

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ABSTRACT

Government subsidies and crop insurance indemnities provide important support for many U.S. farmers. Economists often justify omitting government subsidies when comparing cropping systems because subsidies were decoupled from production in the 1996 Farm Bill. However, coupled loan deficiency payments (LDPs) were continued in the 1996 and 2002 Farm Bills for grains and were extended to several pulses and oilseeds in the 2002 Farm Bill. Furthermore, crop insurance premiums and indemnity payments have always been coupled to production. This paper calculates the impacts of including government subsidies and crop insurance on the results of two long-term cropping systems experiments in eastern Washington. Both studies compared the agronomic and economic feasibility of annual cropping no-till systems with traditional tillage-based winter wheat (*Triticum aestivum* L.)–summer fallow (WW–SF). Net returns for WW–SF exceeded those for most annual no-till systems in both experiments. No government subsidies or insurance impacts were included in previous analyses of these cropping systems. The present analysis shows that including government subsidies and crop insurance effects does not alter the profitability rankings of the annual no-till vs. WW–SF cropping systems in these experiments. However, including crop insurance indemnities did slightly alter the rankings of the three most profitable no-till systems in one experiment. The exclusion of government subsidies and crop insurance from previous research on conservation cropping systems in eastern Washington produced relatively sound economic rankings. To test the generality of this conclusion, similar comparisons would be required with other crops and in other regions.

Government subsidies and crop insurance indemnities often provide a critical source of income and risk management for farmers who grow crops supported by these programs. But frequently, these factors are excluded from economic comparisons in cropping systems experiments. Before the 1996 Farm Bill, when subsidies were coupled to current production, it was appropriate for government subsidies to be included in economic analyses of cropping systems (Dhuyvetter et al., 1996). Halvorson et al. (1994) reported that including subsidies in profitability analyses was necessary because most farmers participate in government programs and tend to consider alternative cropping systems only if the new practices comply with government program provisions.

Today, many economists omit government subsidies in comparisons of cropping systems experiments because the 1996 Farm Bill decoupled direct and supplemental payments from current production (Parsch et al., 2001; Wesley et al., 2000; Popp et al., 2002). Reasons for excluding subsidies include the arguments that fixed decoupled payments will not vary among cropping systems and that the purpose of the research is to find alternative cropping systems that do not require support payments for economic viability (Koch et al., 2004; DeVuyst and Halvorson, 2004). Another factor justifying omission of subsidies is that their level varies with each farmer's historical grain yield and production area.

The continuation of LDPs for grains in all recent Farm Bills has challenged the validity of excluding government subsidies from profitability comparisons because LDPs do vary with current crop production. The LDPs were extended to several pulse and oilseed crops in the 2002 Farm Bill. Crop insurance indemnity payments and premiums, for those who enroll, have always been coupled to production. The objective of this study was to determine the effect of including government subsidies and crop insurance on profitability rankings of cropping systems in two long-term experiments.

MATERIALS AND METHODS

Two long-term dryland cropping system experiments were conducted to determine the agronomic and economic feasibility of annual cropping using no-till compared with the traditional tillage-based WW–SF system in eastern Washington.

Ritzville Experiment

The Ritzville experiment was conducted from 1997 to 2004 on the Ronald Jirava farm located 7 km west of Ritzville, Washington. Long-term annual precipitation at the site averages 301 mm. The soil is Ritzville silt loam (coarse-silty, mixed, superactive, mesic Calcidic Haploxeroll) that is more than 2 m deep with no rocks or restrictive layers and with slopes less than 1%.

In Phase I (1997–2000) of the Ritzville experiment, four no-till annual spring-sown crops were grown. These crops were soft white spring wheat (SWS), spring barley (*Hordeum vulgare* L.) (SB), yellow mustard (*Brasica hirta* Moench) (YM), and safflower (*Carthamus tinctorious* L.) (SAF). There were three crop rotation treatments: (i) a 4-yr SAF–YM–SWS–SWS crop rotation, (ii) a 2-yr SWS–SB rotation, and (iii) continuous annual SWS. These no-till annual cropping systems offer protection from wind erosion compared with the dominant WW–SF system in the region (Papendick, 2004).

Experimental design was a randomized completed block with four replications. Each crop in all rotations occurred each year in field-scale 20- by 150-m plots, making a total of 28 plots.

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Abbreviations: HHH, Horse Heaven Hills; HRS, hard red spring wheat; HWS, hard white spring wheat; LDP, loan deficiency payment; NR, net returns; SAF, safflower; SB, spring barley; SWS, soft white spring wheat; SWW, soft white winter wheat; WW-SF, winter wheat–summer fallow; YM, yellow mustard.

In Phase II (2001–2004) of the Ritzville no-till experiment, safflower was dropped from the experiment due to its high soil water use and poor economic performance (Juergens et al., 2004). Hard white spring wheat (HWS) and soft white winter wheat (SWW) were added to the experiment. Existing plots were split along the long axis (i.e., went from 20 by 150 m to 10 by 150 m for a total of 56 plots) to introduce the following cropping systems: (i) a 4-yr SWW–SWW–SWS–SWS rotation, (ii) a 4-yr SWW–SB–YM–SWS rotation, (iii) a 2-yr SWS–SB rotation (retained from Phase I), (iv) a 2-yr HWS–SB rotation, (v) continuous annual SWS (retained from Phase I), and (vi) continuous annual HWS. Both phases of the Ritzville experiment were designed in consultation with an advisory group of 15 dryland wheat farmers. Although WW–SF was not present in either Phase I or Phase II of the experiment, two surveys were conducted to determine multiyear WW after SF grain yields of fields within a 7-km radius of the experiment site. These fields shared similar soils and climate as the experiment site. Descriptions of the cultural practices, budgeting methodology, and the economic results for Phases I and II of the Ritzville experiment have been reported by Juergens et al. (2004) and Nail et al. (2005), respectively.

Horse Heaven Hills Experiment

A 6-yr experiment was conducted from 1996 to 2002 on the Douglas Rowell farm in the Horse Heaven Hills (HHH) region of Benton County of south–central Washington to compare the traditional WW–SF rotation with continuous annual no-till hard red spring wheat (HRS). The experiment was designed in collaboration with an advisory committee of regional farmers. The site, selected by the farmer advisors, was located 20 km due south of Prosser, WA, in the driest portion of the HHH that receives an average of only 153-mm annual precipitation. This site is believed to receive less precipitation than any other rainfed wheat production region of the world (Schillinger and Young, 2004). The soil is a Warden silt loam (coarse-silty mixed, superactive, mesic Xeric Haplocambids). Soil depth at the experiment site was greater than 2 m, slope was less than 2%, and there were no rocks or restrictive layers.

Experimental design was a randomized complete block with six replications. Both the crop and SF phases of the WW–SF rotation were present each year. There were 18 plots with individual plot size of 18 by 90 m. Schillinger and Young (2004) provide detailed description of the materials and methods used in the HHH experiment.

Cost Accounting Methods

Market costs and returns for the the Ritzville and HHH experiments were based on the earlier work by Juergens et al. (2004), Nail et al. (2005) and Schillinger and Young (2004). Five-year average local crop prices, annual production costs, and cultural practices for all crops and rotations in the experiments are detailed in these sources. Full cost economic accounting was used to compute net returns over total costs, exclusive of policy effects, for each crop rotation in the experiments. Fixed costs included depreciation, interest, taxes, housing and insurance on machinery; land charge; and overhead. Variable costs included fuel, repairs, labor, fertilizer, pesticides, seed, custom services and other variable inputs. Opportunity costs, or returns foregone from using the farmer's own inputs, were charged for equity in machinery, equity in land, and owner–operator's labor.

Policies and Crop Insurance Background

The Ritzville and HHH experiments were analyzed separately within the context of the farm where they were conducted. To provide a perspective of how past policies have affected conservation incentives, the provisions of the contemporary 1996 and/or 2002 farm bills were applied as appropriate. This mix of past policies may provide one estimate of the effects of the unknown 2007 farm bill and other future legislation. Government subsidies under the 1996 Farm Bill included direct payments and LDPs. The 2002 Farm Bill added countercyclical payments. Direct payments and countercyclical payments are both proportional to the farm's "payment yield" and "payment area". For the purpose of this analysis the payment yield equals the multiyear average yield of the experiments. This approach provided consistency between the two experiments as the host farms had rather uniquely calculated payment yields. Payment area is 85% of a farm's base area. Base area is the historical average area of each crop on each farm. Since the historical crop rotation of both the host Jirava and Rowell farms is WW–SF [0.5 ha WW and 0.5 ha SF (rotational ha)$^{-1}$], the base wheat area for each farm is equal to one-half of the total farm area. The Jirava farm is 404 ha. The Rowell farm is 4704 ha. Therefore, the payment area for the Jirava and Rowell farms is 172 (85% of 202) ha and 2000 (85% of 2352) ha, respectively. In this analysis, each crop rotation in each experiment is assumed to be the only rotation grown on the farm, as this affects computation of LDPs.

Direct payments are "decoupled" from current year crop area, crop yield, and crop price because they are based on historical values. Since the historical crop of both farms is SWW, direct payments are based on historical SWW area and grain yields. Direct payments are the same across all rotations within a year. Congress added supplemental direct payments during 1998 to 2001 when wheat prices were low, which explains the fluctuations in direct payments (Table 1). Farmwide direct payments are calculated by multiplying the farm's historical wheat grain yield × the government established annual wheat payment rate × the farm's payment area. Historical average SWW grain yields after SF were 3.6 Mg ha^{-1} for the Jirava farm and 1.61 Mg ha^{-1} for the Rowell farm. The low grain yield on the Rowell farm is due to the previously cited low precipitation at this site. Continuous HRS had not been commonly grown by farmers at either site. Considerably lower grain yield is expected for continuous annual spring wheat compared to WW–SF in these arid regions.

Countercyclical payments are decoupled from current crop yield, but not from current crop price. Payment amounts are determined by first adding the direct payment rate per megagram of grain to the 12-mo marketing year average price or the loan rate, whichever is higher. If the sum is less than the government's "target price", then the difference is the countercyclical payment. If the marketing-year average price plus direct payment rate exceeds the target price, then no countercyclical payment is awarded. The target price for wheat was \$141.70 Mg^{-1} for 2002 to 2003 and \$143.90 Mg^{-1} for 2004 (USDA-ERS, 2002). Twelve-month marketing year average

Table 1. Sum of scheduled and supplemental direct payment rates for wheat from 1996 through 2004.†

Year	Direct payments, \$ Mg^{-1}
1996	31.94
1997	23.13
1998	36.34
1999	46.99
2000	45.15
2001	37.44
2002	19.09
2003	19.09
2004	19.09

† Source: USDA-FSA (2001) and USDA-ERS (2002).

Table 2. Comparison of market net returns over total costs excluding government support payments and crop insurance by rotation and year for three no-till crop rotations (Rot) and winter wheat–summer fallow (WW–SF) in Phase I (1997–2000) of a long-term cropping systems study near Ritzville, WA. No-till rotations were: (i) safflower (SAF)–yellow mustard (YM)–soft white spring wheat (SWS)–SWS; (ii) SWS–spring barley (SB), and (iii) continuous annual SWS. Winter wheat–summer fallow data are from a survey of area farmers.†

Rotation	1997	1998	1999	2000	4-yr avg.	SD
Experiment no-till:	$ (rotational ha)$^{-1}$					
Rot 1: SAF–YM–SWS–SWS	124.22	−36.95	−83.91	−57.01	−13.41	93.74
Rot 2: SWS–SB	141.78	5.95	−55.43	−12.05	20.06	85.14
Rot 3: Continuous SWS	156.62	43.00	−36.43	13.83	44.26	81.78
Survey WW–SF	64.49	23.74	24.48	32.38	36.28	19.22

† Source: Juergens et al. (2004).

prices from National Agricultural Statistics Service (2004a, 2004b, 2004c) were utilized for our analysis. Whole-farm payments are determined by multiplying the countercyclical payment per megagram × the farm's payment area × the historical grain yield. Due to relatively higher annual average grain prices and direct payments since 2002, countercyclical payments had yet to be awarded for wheat in eastern Washington through 2004.

Loan deficiency payments are available to farmers eligible for market assistance loans, but who choose not to receive them. Farmers are eligible for market assistance loans and LDP's when the average "county posted crop price" is below the "loan rate" for the crop. The loan rate for wheat in the 1996 Farm Bill was \$78.00 Mg^{-1} (\$2.58 bushel^{-1}) (Hinman, 2002). Loan rates for wheat in the 2002 Farm Bill were wheat class specific, with the loan rate for SWW, the predominant wheat class in this study, equaling \$87.68 Mg^{-1} (\$2.90 bushel^{-1}). The low loan rates generally precluded payment of LDP's in the sample period. This result was confirmed by interviews with Adams County farmers who reported receipt of no or miniscule LDP's over the study period (D. Schafer and T. Smith, personal communications, 2006).

Assuming constant participation, crop insurance premiums and indemnities were calculated for each rotation in both experiments for each year. Crop insurance is available for eligible crops through the Risk Management Agency of the USDA. Appropriate subsidized producer premiums for the regionally preferred optional crop insurance units were computed for all eligible crops in all rotations for each experiment in each year from 2000 to 2004 using USDA's on-line calculator (USDA-RMA, 2006; www3.rma.usda.gov/apps/premcalc/calc_login.cfm). Calculations were based on an Average Production History plan with 75% grain yield coverage and 100% price election. A 100% price election means that any indemnity (claim) for a production shortfall below the grain yield coverage level is valued at 100% of the government-established price for the ensured crop. Total ensured land area for the annual crop rotations at the Ritzville experiment was 404 ha. Total ensured land area for the WW–SF rotation at the Ritzville experiment was 202 ha since only half of the land was planted to WW each year. Similarly, premium estimates for the continuous annual HRS treatment in the HHH experiment were based on 4704 ha and the WW–SF rotation was ensured for 2352 ha. All premiums except those calculated for HRS in the HHH experiment are based on the production methods used in the experiment. There is no option for continuous annual spring wheat production in the premium calculator in the HHH, so premiums were based on the WW–SF system.

Although crop insurance premium estimates were not available for the 1997 to 1999 crop years, they were available beginning in 2000. Because the crop rotation treatments did not change over the 6 yr at the HHH experiment, the 2000 insurance premium was extended back to 1997 to 1999. Since the crop rotations treatments changed from Phase I (1997–2000) to Phase II (2001–2004) at the Ritzville experiment, the crop insurance comparisons began in Phase II.

In this study, average grain yield for crop insurance purposes equals the multiyear average yield from the experiment. In this case, 75% of the average yield is called the "trigger yield". If the actual grain yield is equal to or greater than the trigger yield, then there is no insurance indemnity in that year. If the actual grain yield is less than the trigger yield, the insurance indemnity per hectare is equal to the difference between the trigger yield and the actual grain yield × the ensured price level.

To determine the annual economic impact of crop insurance on cropping system profitability, it is necessary to calculate the advantage of crop insurance on a whole-farm basis. The benefit of an indemnity payment for one crop in a given rotation may or may not offset the cost of paying a premium and not receiving an indemnity for another crop in the rotation that year. Similarly, failing to evaluate at the whole-farm level inflates premiums and indemnities on the WW–SF system since only the WW portion of the rotation is ensured. When computing whole-farm returns, each crop in an *n*-crop rotation is assumed to occupy 1/*n* of total area. The whole-farm effect of crop insurance is calculated by subtracting the cost of all applicable crop insurance premiums from the value of all applicable insurance indemnities. The crop insurance effect per rotational hectare is then calculated by dividing the whole-farm insurance effect by the total hectares of the farm.

RESULTS AND DISCUSSION

Tables 2, 3, and 4 show the crop rotations for both experiments and list market returns over total costs, ex-

Table 3. Comparison of market net returns over total costs excluding government support payments and crop insurance by rotation and year for six no-till crop rotations (Rot) and winter wheat–summer fallow (WW–SF) in Phase II (2001–2004) of a long-term cropping system study near Ritzville, WA. No-till crop rotations contained soft white spring wheat (SWS), hard white spring wheat (HWS), spring barley (SB), soft white winter wheat (SWW), and yellow mustard (YM).†

Rotation	2001	2002	2003	2004	4-yr avg.	SD
Experiment no-till:	$ (rotational ha)$^{-1}$					
Rot 1: SWW–SWW–SWS–SWS	−175.37	−127.38	−85.12	−127.25	−128.79	36.88
Rot 2: SWW–SB–YM–SWS	−170.36	−183.08	−107.15	−139.97	−150.15	33.89
Rot 3: SWS–SB	−161.04	−113.50	−89.46	−67.01	−107.77	40.29
Rot 4: HWS–SB	−171.00	−110.48	−77.66	−68.22	−106.85	46.46
Rot 5: Continuous SWS	−141.83	−115.87	−90.65	−89.17	−109.37	24.87
Rot 6: Continuous HWS	−186.41	−104.68	−108.53	−142.22	−135.45	37.91
Survey WW–SF	−31.52	0.84	25.54	5.68	0.12	23.66

† Source: Nail et al. (2005).

Table 4. Comparison of market net returns over total costs excluding government payments and crop insurance for continuous annual no-till hard red spring wheat (HRS) and winter wheat–summer fallow (WW–SF) from 1997 to 2002 in the Horse Heaven Hills, Benton County, WA.†

Rotation	1997	1998	1999	2000	2001	2002	6-yr avg.	SD
	$ (rotational ha)$^{-1}$							
WW–SF	15.02	39.64	−37.54	0.40	−56.12	−44.93	−13.93	37.99
Continuous annual no-till HRS	−107.79	−60.89	−132.89	−94.48	−147.78	−111.99	−109.30	30.38

† Source: Schillinger and Young (2004).

cluding government payments and crop insurance indemnities, for each no-till annual rotation and WW–SF. With the exception of the continuous annual SWS production in Phase I of the Ritzville experiment, market returns over total costs for the no-till annual crop rotations fell short of those for WW–SF. The greatest shortfall relative to WW–SF, averaging [0.12 − (−150.15) = $150.27] (rotational ha)$^{-1}$, occurred in Phase II of the Ritzville experiment with the 4-yr SWW–SB–YM–SWS rotation (Table 3). In the HHH experiment, continuous annual no-till HRS averaged $95.37 (rotational ha)$^{-1}$ less than WW–SF (Table 4).

Table 5 lists market net returns, government direct payments, and total net returns per hectare including government subsidy payments for each rotation in each of the 8 yr of the Ritzville experiment. As noted earlier, government countercyclical payments and LDP's were not paid in this region during the study periods. Market returns are negative for some rotations in some years, indicating that crop sales were insufficient to pay for the full value of all resources including the farmer's labor and equity in owned land and machinery. Direct payments per hectare were positive and, therefore, returns per hectare increased. For example, in 1998 direct payments lifted Rotation 1 (SAF–YM–SWS–SWS) from a loss of −$36.95 (rotational ha)$^{-1}$ to a profit of $18.82 (rotational ha)$^{-1}$. Direct payment subsidies were insufficient to overcome the large economic losses incurred by all six of the no-till annual cropping systems in the four low-precipitation (Phase II) years of the experiment (Table 5). As expected, decoupled direct payments did not alter the profitability rankings of the various cropping systems during either Phase I or Phase II of the Ritzville experiment (Table 6). For example, in Phase II, survey WW–SF ranked first and the SWW–SB–YM–SWS rotation ranked last both with and without subsidies (Table 6).

Table 7 lists the effects of government subsidies and crop insurance indemnities and premiums for each crop rotation treatment for each year of Phase II of the Ritzville experiment. The magnitude of the crop insurance effect varied from rotation to rotation and from year to year. Years with high indemnity payments increased the profitability of the particular cropping system (Table 7). Years without indemnity payments decreased the profitability of cropping systems since insurance premiums still must be paid. The Phase II annual insurance effects were generally small and negative, but were quite large and positive in 2001 (Table 7). Of course, farmers averse to risk may be more interested in the fact that insurance sustains income in years of low grain yield rather than its small cost in most years. Unfortunately the 4- and 5-yr spans of the experiments in this study were considered too short to reliably measure quantitatively the risk reducing effects of crop in-

Table 5. Market net returns (NR) over total costs, government direct payments†, and total net returns for all rotations (Rot) in an 8-yr cropping system experiment near Ritzville, WA.

Year/Rot	Market NR	Direct payments	Total NR
	$ ha^{-1}		
	Phase I: 1997–2000		
1997			
Rot 1	124.22	35.49	159.71
Rot 2	141.78	35.49	177.27
Rot 3	156.62	35.49	192.11
Survey WW–SF	64.49	35.49	99.98
1998			
Rot 1	−36.95	55.77	18.82
Rot 2	5.95	55.77	61.72
Rot 3	43	55.77	98.77
Survey WW–SF	23.74	55.77	79.51
1999			
Rot 1	−83.91	72.1	−11.81
Rot 2	−55.43	72.1	16.67
Rot 3	−36.43	72.1	35.67
Survey WW–SF	23.74	72.1	95.84
2000			
Rot 1	−57.01	69.28	12.27
Rot 2	−12.05	69.28	57.23
Rot 3	13.83	69.28	83.11
Survey WW–SF	32.38	69.28	101.66
	Phase II: 2001–2004		
2001			
Rot 1	−175.37	57.45	−117.92
Rot 2	−170.36	57.45	−112.91
Rot 3	−161.04	57.45	−103.59
Rot 4	−171	57.45	−113.55
Rot 5	−141.83	57.45	−84.38
Rot 6	−186.41	57.45	−128.96
Survey WW–SF	−31.52	57.45	25.93
2002			
Rot 1	−127.38	29.29	−98.09
Rot 2	−183.08	29.29	−153.79
Rot 3	−113.5	29.29	−84.21
Rot 4	−110.48	29.29	−81.19
Rot 5	−115.87	29.29	−86.58
Rot 6	−104.68	29.29	−75.39
Survey WW–SF	0.84	29.29	30.13
2003			
Rot 1	−85.12	29.29	−55.83
Rot 2	−107.15	29.29	−77.86
Rot 3	−89.46	29.29	−60.17
Rot 4	−77.66	29.29	−48.37
Rot 5	−90.65	29.29	−61.36
Rot 6	−108.53	29.29	−79.24
Survey WW–SF	25.54	29.29	54.83
2004			
Rot 1	−127.25	29.29	−97.96
Rot 2	−139.97	29.29	−110.68
Rot 3	−67.01	29.29	−37.72
Rot 4	−68.22	29.29	−38.93
Rot 5	−89.17	29.29	−59.88
Rot 6	−142.22	29.29	−112.93
Survey WW–SF	5.68	29.29	34.97

† Direct payments were the only government subsidies paid for the listed rotations. Farmers in the region were not eligible for countercyclical payments or LDPs during this period.

Table 6. Four-yr average profitability rankings by cropping system with and without subsidies and insurance effect for Phase I (1997–2000) and Phase II (2001–2004) of a long-term cropping system experiment near Ritzville, WA.†

Rank	Rotation (Rot)	$ ha^{-1}	Rank	Rot	$ ha^{-1}
		1997–2000			
Without subsidy or insurance effect			**With subsidies**		
1	Rot 3: Continuous SWS	44.26	1	Rot 3: Continuous SWS	102.42
2	Survey WW–SF	36.09	2	Survey WW–SF	94.25
3	Rot 2: SWS–SB	20.06	3	Rot 2: SWS–SB	78.22
4	Rot 1: SAF–YM–SWS–SWS	−13.41	4	Rot 1: SAF–YM–SWS–SWS	44.75
		2001–2004			
Without subsidy or insurance effect			**With subsidies**		
1	Survey WW–SF	0.14	1	Survey WW–SF	36.47
2	Rot 4: HWS–SB	−106.84	2	Rot 4: HWS–SB	−70.51
3	Rot 3: SWS–SB	−107.75	3	Rot 3: SWS–SB	−71.42
4	Rot 5: Continuous SWS	−109.38	4	Rot 5: Continuous SWS	−73.05
5	Rot 1: SWW–SWW–SWS–SWS	−128.78	5	Rot 1: SWW–SWW–SWS–SWS	−92.45
6	Rot 6: Continuous HWS	−135.46	6	Rot 6: Continuous HWS	−99.13
7	Rot 2: SWW–SB–YM–SWS	−150.14	7	Rot 2: SWW–SB–YM–SWS	−113.81
		2001–2004			
Without subsidy or insurance effect			**With subsidy and insurance effect**		
1	Survey WW–SF	0.14	1	Survey WW–SF	36.38
2	Rot 4: HWS–SB	−106.84	2	Rot 3: SWS–SB	−56.95
3	Rot 3: SWS–SB	−107.75	3	Rot 5: Continuous SWS	−59.50
4	Rot 5: Continuous SWS	−109.38	4	Rot 4: HWS–SB	−68.19
5	Rot 1: SWW–SWW–SWS–SWS	−128.78	5	Rot 1: SWW–SWW–SWS–SWS	−92.18
6	Rot 6: Continuous HWS	−135.46	6	Rot 6: Continuous HWS	−99.11
7	Rot 2: SWW–SB–YM–SWS	−150.14	7	Rot 2: SWW–SB–YM–SWS	−111.88

† Crops are: hard red spring wheat (HRS), hard white spring wheat (HWS), safflower (SAF), spring barley (SB), soft white spring wheat (SWS), soft white winter wheat (SWW), winter wheat–summer fallow (WW–SF), and yellow mustard (YM).

surance. The short experiments were considered best suited to reporting simple rankings of expected incomes with and without government payments and insurance as provided in Table 6.

Including crop insurance effects altered the profitability rankings of the six cropping systems in Phase II of the Ritzville experiment (lower panel of Table 6). The SWS–SB rotation shifted rank from third to second, continuous annual SWS rose from fourth to third, and the HWS–SB rotation fell from second to fourth place. However, these crop rotations were relatively close in profitability without subsidies and insurance (Table 6). Even with the inclusion of government subsidies and crop insurance, none of the six annual no-till crop rotations in Phase II of the Ritzville experiment generated sufficient returns to cover total costs, nor did any approach the profitability of the WW–SF which averaged $36.38 (rotational ha)$^{-1}$ with subsidies and insurance despite the dry climatic conditions during Phase II. The results reflect the proverb that "a rising tide raises all ships". Subsidies and insurance boosted the highest ranked annual no-till crop rotation, SWS–SB, by $49.89 (rotational ha)$^{-1}$, increased the lowest ranked SWW–SB–YM–SWS rotation by $38.26 (rota-

Table 7. Crop insurance and government subsidy effects on net returns (NR) for all rotations (Rot) in Phase II of the long-term cropping system experiment, Ritzville, WA.

Year/Rot	NR with subsidies	Insurance effect	Total NR
	$ (rotational ha)$^{-1}$		
2001			
Rot 1	−117.92	31.59	−86.33
Rot 2	−112.91	26.53	−86.38
Rot 3	−103.59	75.66	−27.93
Rot 4	−113.55	36.78	−76.77
Rot 5	−84.38	67.09	−17.29
Rot 6	−128.96	28.01	−100.95
Survey WW–SF	25.93	6.82	32.75
2002			
Rot 1	−98.09	−9.14	−107.23
Rot 2	−153.79	−6.32	−160.11
Rot 3	−84.21	−2.57	−86.78
Rot 4	−81.19	−9.21	−90.4
Rot 5	−86.58	−2.35	−88.93
Rot 6	−75.39	−9.34	−84.73
Survey WW–SF	30.13	−2.4	27.73
2003			
Rot 1	−55.83	−12.55	−68.38
Rot 2	−77.86	−6.45	−84.31
Rot 3	−60.17	−7.78	−67.95
Rot 4	−48.37	−9.41	−57.78
Rot 5	−61.36	−2.35	−63.71
Rot 6	−79.24	−9.34	−88.58
Survey WW–SF	54.83	−2.4	52.43
2004			
Rot 1	−97.96	−8.82	−106.78
Rot 2	−110.68	−6.05	−116.73
Rot 3	−37.72	−7.41	−45.13
Rot 4	−38.93	−8.87	−47.8
Rot 5	−59.88	−8.18	−68.06
Rot 6	−112.93	−9.26	−122.19
Survey WW–SF	34.97	−2.37	32.6
2001–2004 avg.			
Rot 1	−92.45	0.27	−92.18
Rot 2	−113.81	1.93	−111.88
Rot 3	−71.42	14.48	−56.95
Rot 4	−70.51	2.32	−68.19
Rot 5	−73.05	13.55	−59.50
Rot 6	−99.13	0.02	−99.11
Survey WW–SF	36.47	−0.09	36.38

Table 8. Market returns over total costs, government direct payments, and total net returns (NR) for winter wheat–summer fallow (WW–SF) and continuous annual hard red spring wheat (HRS) rotations at the Horse Heaven Hills experiment, 1997 to 2002.

Year	Rotation	Market NR	Direct payments†	Total NR
		$ (rotational ha)$^{-1}$		
1997	WW–SF	15.02	15.88	30.90
	Continuous (Cont.) HRS	−107.79	15.88	−91.91
1998	WW–SF	39.64	24.92	64.56
	Cont. HRS	−60.89	24.92	−35.97
1999	WW–SF	−37.54	32.23	−5.31
	Cont. HRS	−132.89	32.23	−100.66
2000	WW–SF	0.4	30.97	31.37
	Cont. HRS	−94.48	30.26	−64.22
2001	WW–SF	−56.12	25.74	−30.38
	Cont. HRS	−147.78	25.74	−122.04
2002	WW–SF	−44.93	13.12	−31.81
	Cont. HRS	−111.99	13.12	−98.87
1997–2002 avg.	WW–SF	−13.92	23.81	9.89
	Cont. HRS	−109.30	23.69	−85.61

† Direct payments were the only government subsidies paid for the listed rotations. Farmers in the region were not eligible for countercyclical payments or LDPs in this period.

Table 9. Crop insurance and government subsidy effects on net returns (NR) for continuous annual hard red spring wheat (HRS) and winter wheat–summer fallow (WW–SF) in the 6-yr Horse Heaven Hills experiment, Benton County, WA, 1997 to 2002.

Year	Rotation	NR with subsidies	Insurance effect	Total NR
		$ (rotational ha)$^{-1}$		
1997	WW–SF	30.90	−3.06	27.84
	Continuous (Cont.) HRS	−91.91	−6.74	−98.65
1998	WW–SF	64.56	−3.06	61.50
	Cont. HRS	−35.97	−6.74	−42.71
1999	WW–SF	−5.31	16.4	11.09
	Cont. HRS	−100.66	10.37	−90.29
2000	WW–SF	31.37	−3.06	28.31
	Cont. HRS	−64.22	−5.98	−70.20
2001	WW–SF	−30.38	35.62	5.24
	Cont. HRS	−122.04	32.41	−89.63
2002	WW–SF	−31.81	17.39	−14.42
	Cont. HRS	−98.87	17.39	−81.48
1997–2002 avg.	WW–SF	9.89	10.04	19.93
	Cont. HRS	−85.61	6.79	−78.83

tional ha)$^{-1}$, but also lifted the traditional WW–SF system by $36.24 (rotational ha)$^{-1}$ during 2001 to 2004 (Table 6).

Table 8 lists annual market net returns, direct payments, and total net returns (including direct payments) for each crop rotation in the HHH experiment. Table 9 lists the profitability effect of crop insurance and direct payments on each rotation in each year. As expected, the inclusion of direct payments increased the returns per hectare of both continuous annual HRS and the WW–SF, but had no effect on profitability rankings given the wide gap in profitability of the two cropping systems (Table 10). Adding crop insurance did not alter the rankings, but slightly increased the profit disparity, between the WW–SF and continuous annual HRS. For the entire 6-yr HHH experiment, the average annual effect of crop insurance for WW–SF was $10.04 (rotational ha)$^{-1}$ and $6.79 (rotational ha)$^{-1}$ for continuous annual HRS. The lower indemnities for the continuous annual HRS treatment are largely due to the low experiment-based average production history yield of only 0.67 Mg ha^{-1} for the continuous annual HRS versus 1.61 Mg ha^{-1} for WW after SF.

CONCLUSIONS

Including government subsidies had no effect on the profitability rankings of several continuous annual no-till crop rotations and a tillage-based WW–SF crop rotation in two long-term experiments in eastern Washington. As expected, government subsidies increased returns to all cropping systems. Crop insurance payments altered the profitability rankings of only the three most profitable annual rotation systems in Phase II of the Ritzville experiment. These three cropping systems had similar market net returns. All other profitability rankings of all cropping systems in both experiments remained unchanged.

Similar economic comparisons with and without government subsidies and crop insurance would be required for long-term cropping systems experiments in other geographic regions before the conclusions in this paper could be generalized. Additionally, the inclusion of both government payments and crop insurance requires specific historic information about "representative farms" in the region of the experiment. Farm programs and crop insurance provisions frequently change. Including government and insurance payments for specific hypothetical farms likely reduces the range of farmers for whom cropping system economic results are applicable and possibly reduces the shelf life of economic assessments of cropping systems. Analyses that include this information nonetheless show their impact that is not trivial as shown above.

If the U.S. Congress returns to subsidies that are coupled to current production, their inclusion will be an essential part of accurate economic comparisons. However, present World Trade Organization rules discourage coupled payments. Also, where specific environmental "green payments" are available from state or federal agencies for conservation farming systems, their inclusion in economic assessments is needed for valid private profitability comparisons. However, most farm programs enacted by Congress have been tied to historic or current production of specific crops rather than to environmental practices.

Since the cost of acquiring site-specific information is high for public research institutions, analyses of these effects will likely remain with the individual. Further, longer term studies (>4 yr) to analyze insurance and government program effects on profitability rankings might better be left to simulation modeling rather than actual experiment station trials since policies change frequently and the cost of long run experiment trials is prohibitive.

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Table 10. Six-year average profitability rankings for winter wheat–summer fallow (WW–SF) and continuous hard red spring wheat (HRS) with and without subsidies and insurance effect at the 1997–2002 Horse Heaven Hills cropping systems experiment.

Without subsidies or insurance effect			With subsidies			With subsidies and insurance effect		
Rank	Rotation	$ ha^{-1}	Rank	Rotation	$ ha^{-1}	Rank	Rotation	$ ha^{-1}
1	WW–SF	−13.92	1	WW–SF	9.89	1	WW–SF	19.93
2	Continuous HRS	−109.30	2	Continuous HRS	−85.61	2	Continuous HRS	−78.83

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