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The Western Economics Forum

A peer-reviewed publication from the Western Agricultural Economics Association

Purpose

One of the consequences of regional associations nationalizing their journals is that professional agricultural economists in each region have lost one of their best forums for exchanging ideas unique to their area of the country. The purpose of this publication is to provide a forum for western issues.

Audience

The target audience is professional agricultural economists with a Masters degree, Ph.D. or equivalent understanding of the field that are working on agricultural and resource economic, business or policy issues in the West.

Subject

This publication is specifically targeted at informing professionals in the West about issues, methods, data, or other content addressing the following objectives:

- Summarize knowledge about issues of interest to western professionals
- To convey ideas and analysis techniques to non-academic, professional economists working on agricultural or resource issues
- To demonstrate methods and applications that can be adapted across fields in economics
- To facilitate open debate on western issues

Structure and Distribution

The *Western Economics Forum* is a peer reviewed publication. It usually contains three to five articles per issue, with approximately 2,500 words each (maximum 3,000), and as much diversity as possible across the following areas:

- Farm/ranch management and production
- Marketing and agribusiness
- Natural resources and the environment
- Institutions and policy
- Regional and community development

There are two issues of the *Western Economics Forum* per year (Spring and Fall).

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Comparing Commodity Programs under the 2002 Farm Bill to the USDA Proposal for Marketing Loan, Direct Payment, and Counter-Cyclical Payment Programs

Keith H. Coble, John D. Anderson, Sarah E. Thomas, and J. Corey Miller[1]

Introduction

The current farm bill, the Farm Security and Rural Investment Act (FSRIA) of 2002, was to expire in September 2007. A number of organizations (e.g., the National Corn Growers Association, American Farm Bureau Federation, and American Farmland Trust) have developed detailed proposals to supersede FSRIA. In addition, the Secretary of Agriculture has proposed a number of significant modifications to existing programs. The Secretary (USDA) proposes fairly comprehensive changes with respect to the commodity title of FSRIA, modifying all three primary commodity support programs: direct payments, counter-cyclical payments, and marketing loan/loan deficiency payments.

A common theme in the USDA proposal and those of the National Corn Growers Association (NCGA), American Farmland Trust (AFT), and American Farm Bureau Federation (AFBF) is the development of revenue-triggered programs. The USDA and AFT proposals incorporate a national-level revenue trigger. That is, an expected level of revenue is projected in terms of national average revenue. A shortfall in the expected level of national average revenue triggers a revenue counter-cyclical payment. USDA also proposes converting the current fixed loan rates to moving average loan rates with maximum rates for most crops set below current loan rate levels. Moreover, the proposal includes adjustments to direct payment rates for some crops. While the next Farm Bill is unlikely to incorporate all of the specific details of the USDA proposal, the concept of a revenue-triggered support program continues to be discussed as a feature the Farm Bill currently being debated in Congress. Thus, a consideration of a revenue-based program taking the USDA proposal as an example is instructive.

This paper evaluates the impact of USDA's proposed farm bill changes on average farm-level revenue and addresses three specific objectives. First, we develop forecasts of average per acre program payments from 2008-2012 for all counties that produce cotton, corn, soybeans, or wheat as reported by the National Agricultural Statistics Service (NASS) of USDA. Second, we aggregate county-level payments to assess the impact of proposed changes on USDA baseline spending. Finally, we illustrate how the proposed changes result in different regional impacts by calculating average annual per acre payments from 2008-2012 for individual counties. This analysis does not attempt to quantify the effect of more stringent payment limits and/or adjusted gross income restrictions on total payments, though some modification of existing limits is a possibility in the next Farm Bill.

The model employed in this study simulates representative crop revenue from each of hundreds of counties in the U.S. The individual county models incorporate important characteristics such

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as price and yield risk and include county and other aggregate stochastic variables. The simulation, by design, maintains price-yield correlations and spatial correlations across regions.

Background and Review of Literature

Current Commodity Programs

Commodity price support currently consists primarily of three separate programs: marketing assistance loans, direct payments (DPs), and price counter-cyclical payments (PCCPs)[2]. Under the marketing assistance loan program, producers can receive a loan deficiency payment (LDP) equal to the difference between a posted county price (PCP) and the loan rate for the crop in question. For example, if the PCP for cotton in Washington County, Mississippi, is $0.49 per pound, a producer can establish an LDP rate on that day of $0.03 per pound ($0.52 loan rate − $0.49 PCP). The producer receives an LDP for all of his or her actual production. Thus, if the producer harvests 1,000 acres of cotton with a yield of 1,000 pounds per acre, the total LDP received by the producer equals $0.03 per pound × 1,000 pounds × 1,000 acres, or $30,000.

In contrast to LDPs, DPs and PCCPs are paid on historical measures known as base acres and program yields. For example, if a farm has corn base acres the farmer can receive a corn DP and—if prices fall below a specified level—a corn PCCP. The producer can receive these payments for corn and plant other crops on the base acres or idle these acres[3]. The DP is calculated as:

1) $$DP = Rate_{DP} \times 0.85 \times Base\ Acres \times Yield_{DP}$$

where $Rate_{DP}$ equals the direct payment rate (in dollars per unit) for an eligible crop and $Yield_{DP}$ equals the program yield for the crop. The 2002 farm bill establishes direct payment rates for the major program crops.

Similar to DPs, PCCPs are paid on 85 percent of base acres, but the PCCP payment rate varies with market prices. The formula for calculating the PCCP is:

2) $$PCCP = \max(0, (TP - Rate_{DP}) - \max(Rate_{LR}, MYA)) \times 0.85 \times Base\ Acres \times Yield_{CCP}$$

where TP is the target price, $Rate_{DP}$ is the direct payment rate, $Rate_{LR}$ is the loan rate, MYA is the national marketing year average price calculated by NASS, and $Yield_{CCP}$ is the program yield for the crop according to FSRIA[4]. As evident from equation 2, the PCCP reaches a maximum when the marketing year average price is less than or equal to the loan rate.

Marketing year average prices below the loan rate, therefore, do not affect the size of the PCCP the producer receives. Conversely, when marketing year average prices are greater than or equal to $TP - Rate_{DP}$, the total PCCP equals zero.

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[2] USDA generally refers to the Direct Payment and Counter-Cyclical Payment programs as a single program referenced by the abbreviation DCP. To facilitate discussion of the calculation of the payments under each of these programs, we refer to them separately.

[3] USDA rules prevent producers from receiving DPs and CCPs while planting most fruit and vegetable crops on base acres, however.

[4] Depending on the option chosen by a producer during program sign-up in 2002, $Yield_{CCP}$ may equal $Yield_{DP}$ or $Yield_{CCP}$ may be greater than $Yield_{DP}$.

USDA Proposal

The USDA proposal recommends changes to all three primary commodity support programs. For the DP and marketing loan programs, changes would consist of adjusting payment rates. Notably, for the marketing loan program, loan rates would be set at 85 percent of the five-year Olympic average of marketing year average prices, in lieu of the current fixed loan rates. Maximum rates would be established at the level proposed in the version of the 2002 farm bill initially passed by the House of Representatives.[5]

For counter-cyclical payments, USDA proposes moving from a payment triggered by declines in the marketing year average price (the PCCP) to a payment triggered by declines in national average revenue. The revenue counter-cyclical payment (RCCP) proposed by USDA would be calculated as follows:

3) $$RCCP = [\max(0, ((TP - Rate_{DP}) \times 2006\ Yield_{NP}) - (\max(Rate_{LR}, MYA) \times 2006\ Yield_{NA})))/Yield_{NCCP}] \times 0.85 \times Base\ Acres \times Yield_{CCP},$$

where $Yield_{NP}$ is the national predicted yield (i.e., Olympic average of national average yield for 2002 through 2006), $Yield_{NA}$ is the national yield in a given year, $Yield_{NCCP}$ is the national average counter-cyclical base yield, and other variables are as previously defined.

Related Policy Analysis

The PCCP program has received considerable attention since its implementation in the 2002 farm bill, as it is the newest commodity program.[6] Prior to the development of PCCPs, Miller, Barnett, and Coble (2003) conclude that the assumption that producers prefer PCCPs to fixed payments is often overstated. Significantly, their approach to analyzing farm programs differs from other methodologies in that it includes producer risk aversion and yield-price correlations. Including these correlations reveals that program changes can affect different regions of the country in different ways. These geographic differences will be an important consideration in the debate over revenue-based farm programs.

Public discourse about a potential RCCP program is ongoing as the Congress continues to debate the next farm bill. USDA's inclusion of the RCCP in its proposal focuses attention on this potential change. The current WTO commitments of the United States provide another incentive for a revenue-based program. Babcock and Hart (2005) note that such a program can "meet the proposed U.S. limits on trade-distorting subsidies with a high degree of probability." Coble and Miller (2006) note, however, that since the details of how a revenue-based support program might be implemented are unknown, the classification of such a program by WTO is also unknown.

Notably, proposals for revenue-based programs have thus far mostly emanated from the Corn Belt. Producers of crops traditionally grown in the South (specifically, cotton and rice) tend to express preferences for price-based programs. These producers observe a much lower correlation between prices and yields; thus, they logically perceive price risk and yield risk as two separate issues. Coble and Miller (2006) point out that revenue risk tends to be greatest for crops and regions where yield risk is greatest. Such a relationship may imply important

[5] A comparison of current and proposed DP rates and loan rates can be found in the USDA proposal.
[6] Previous programs based payments on price shortfalls from a target level, but the programs were linked to production, with payments actually more similar to LDPs than to current CCPs.

differences about the geographic distribution of program benefits under a revenue-based program.

Data and Methods

We use a non-parametric approach to simulate revenue for a representative acre in each county for which NASS data are available for the crops simulated (corn, soybeans, cotton, and wheat). Briefly, the model randomly draws (with replacement) from historical distributions of price and yield changes (1975-2004) to simulate 500 possible five-year time paths for yield and price outcomes.[7] For every location, yields and prices are drawn simultaneously, thus maintaining the empirical price-yield correlation for a particular location. Starting prices were defined according to December 2006 futures prices for 2007 harvest time delivery months and 2006 marketing year average prices. For yields, de-trended NASS county-level yields from 1975-2004 set the starting point for simulation. The variability of the county-level data increases by an expansion factor derived from the county crop insurance effective premium rate for 65 percent coverage[8]. This resulting yield series maintains a level of variability consistent with the farm level.

Simulated prices and yields are used to calculate revenue from crop returns, commodity programs, and crop insurance. Alternative commodity program specifications can be used to evaluate the impact on revenue for a representative acre in each county across crops and geographic regions.

Results

Table 1 reports national average revenue from different commodity programs and includes program payments under current provisions as well as those proposed by USDA for the 2007 farm bill. The model finds continuing current policy results in low per-acre LDPs and CCPs for both corn and soybeans. For cotton, counter-cyclical payments approximately equal direct payments. Crop insurance subsidy values are highest for cotton and lowest for soybeans among the crops investigated.

USDA-proposed RCCP with National-Level Trigger

The RCCP program represents a significant programmatic change, but RCCPs result in only a slightly higher payment relative to current price-triggered CCPs. The relatively small variation arises in large part because of an upward trend in expected yields, which effectively reduces the RCCP guarantee over time. Cotton direct payments increase over the current policy as the direct payment rate increases. The USDA proposal allows producers to purchase a layer of area insurance (GRP) to protect against small losses that do not reach the trigger for individual coverage. Assuming a 40 percent participation rate, the subsidized value of this program falls somewhere between $5 and $11 per acre for all three crops.

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[7] A detailed description of the model used in this analysis can be found in Coble and Dismukes (2007).
[8] Data on county premium rates are readily available from USDA's Risk Management Agency (RMA). For a detailed explanation of the process for obtaining yield expansion factors from this data, see Coble, Zuniga, and Heifner (2003).

Table 1. Projected U.S. average payments per acre per year for alternative programs: 2008-2012.

Payments/Planted Acre	Cotton	Corn	Soybeans	Wheat
Current Program				
LDP[a]	$8.17	$1.15	$3.12	$0.05
PCCP[b]	$32.65	$1.94	$1.33	$0.35
Direct Payment	$32.30	$22.51	$11.21	$15.96
MPCI[c]	$16.92	$12.04	$8.33	$10.38
Total for current programs	**$90.04**	**$37.65**	**$23.98**	**$26.75**
USDA Proposal				
Modified LDP	$2.65	$1.10	$2.78	$0.03
National RCCP[d]	$44.19	$1.12	$1.45	$0.36
Modified Direct	$53.67	$22.50	$11.97	$15.96
MPCI	$16.92	$12.04	$8.33	$10.38
GRP[e] Layer	$2.00	$1.61	$3.46	$4.29
Total for USDA Proposal	**$119.43**	**$38.37**	**$27.99**	**$31.01**
Market Revenue	$385.75	$470.91	$298.56	$252.31
Yield	647.59	124.28	39.37	41.12
Beginning Price	$0.59	$3.86	$7.20	$6.85

[a] Loan Deficiency Payment
[b] Price-based Countercyclical payment
[c] Multi-peril Crop Insurance (yield insurance)
[d] Revenue-based Countercyclical payment
[e] Group Revenue Protection (area revenue insurance)

Budget Implications

Table 2 depicts the budget implications for the alternative commodity program designs. Using the 2007 Congressional Budget Office (CBO) estimated planted acres, we compute the per acre program costs relative to the costs of the current program. The first row in table 2 reports the difference between per acre program payments under the USDA proposal and current programs. Relative to current farm policy, the USDA proposal results in a very small increase in per acre payments for corn, modest increases in per acre program payments for soybeans and wheat, and a more significant increase for cotton. Note that for cotton, the bulk of the increase is explained by the higher direct payment rate. For corn and wheat, the USDA proposal would cost less than the current programs if the GRP component were excluded. For soybeans, the exclusion of GRP would make the cost of the proposal less than a $1 per acre higher than current programs. The second row in the table reports CBO estimates of planted acres for 2007, and the third row depicts the resulting aggregate difference in total program expenditures between USDA's proposal and current programs. The three-crop total is approximately $1 billion per year.

Table 2. Summary of relative program payouts and baseline cost estimates based on 2009 projected plantings.

Farm Bill Alternative	Cotton	Corn	Soybeans	Wheat	Total
USDA Proposal - Current Per Acre	$29.39	$0.72	$4.01	$4.26	
FAPRI[a] Estimated 2009 Acres (mil.)	13.07	90.10	69.30	58.70	
Increase in baseline cost per year for USDA Proposal (mil.)	$384.13	$64.87	$277.89	$250.06	$976.95

[a] Food and Agricultural Policy Research Institute.

Regional Differences

Tables 1 and 2 report national averages and total program payouts for the USDA proposal and for current commodity programs. However, our model permits an investigation of outcomes on a county-by-county basis. We report county-level results in a series of maps showing the difference between current and proposed average payouts for various programs by county. These maps differentiate between counties where current and proposed payments would be roughly equal and those where payments would be higher under the USDA proposal over the life of a 5-year farm bill. In these figures, current and proposed payments are mapped as being equal if the payment under the USDA proposal is within $5 per acre of the current payment.

The aggregate numbers reported in tables 1 and 2 suggest that per acre payments are larger under the USDA proposal than under the current program. The county-level maps reflect the generally larger payments and provide insight into the geographic distribution of the payments.

For corn, figure 1 indicates an increase in corn payments per acre mostly in southern and western portions of the Corn Belt (specifically, southern counties in Iowa, central and southern counties in Illinois, and large portions of Missouri and Kansas). Some increase is also noted in the Mid-Atlantic States as well as the Coastal Bend region of Texas. Per acre payments for cotton (figure 2) are shown to increase in virtually every production region, with the exception of counties in Alabama. For soybeans (figure 3), the increase in per acre payments appears to be in counties is greatest in counties on the northern and southern edges of the central Corn Belt. For wheat (figure 4), increases in payments appear to be mostly in the Northern tier of states and in Kansas – principally in eastern parts of the state.

Conclusions

USDA’s farm bill proposal has attracted considerable attention from the media, from farm groups, and from members of Congress currently involved in the task of crafting the 2007 farm bill. The proposal includes a number of significant changes to commodity programs. Notable changes include a shift to a revenue trigger for counter-cyclical payments.

Analysis of USDA’s farm bill proposal indicates the proposed commodity program changes would lead to marginal increases in national average per acre payments for corn and soybeans and a more significant increase in per acre payments for cotton. From a budgetary standpoint, the USDA proposal could increase annual expenditures on commodity programs and insurance subsidies by about $1 billion.

County-level evaluation of per acre payment results suggests the geographic impact of USDA's proposal can vary from crop to crop. In general, for corn and soybeans, the proposed program changes appear to have the effect of shifting payments to the west and south. For cotton, increases are distributed fairly uniformly. For wheat, the most notable per acre payment increases occur in counties in the extreme Northern Plains and in Kansas.

Figure 1. Difference in combined payments per acre between current programs and USDA proposed programs for corn.

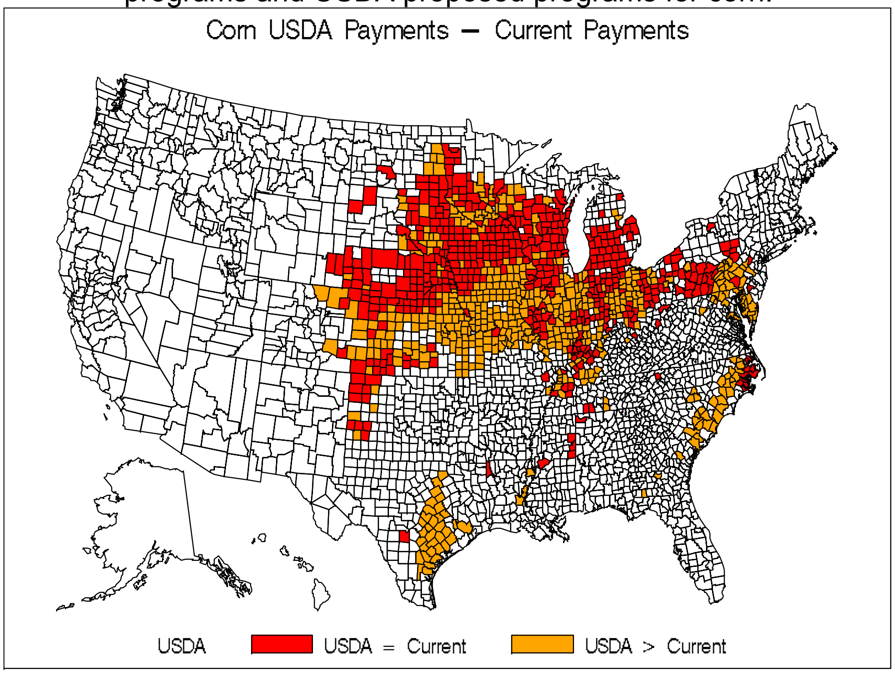


Figure 2. Difference in combined payments per acre between current programs and USDA proposed programs for cotton.

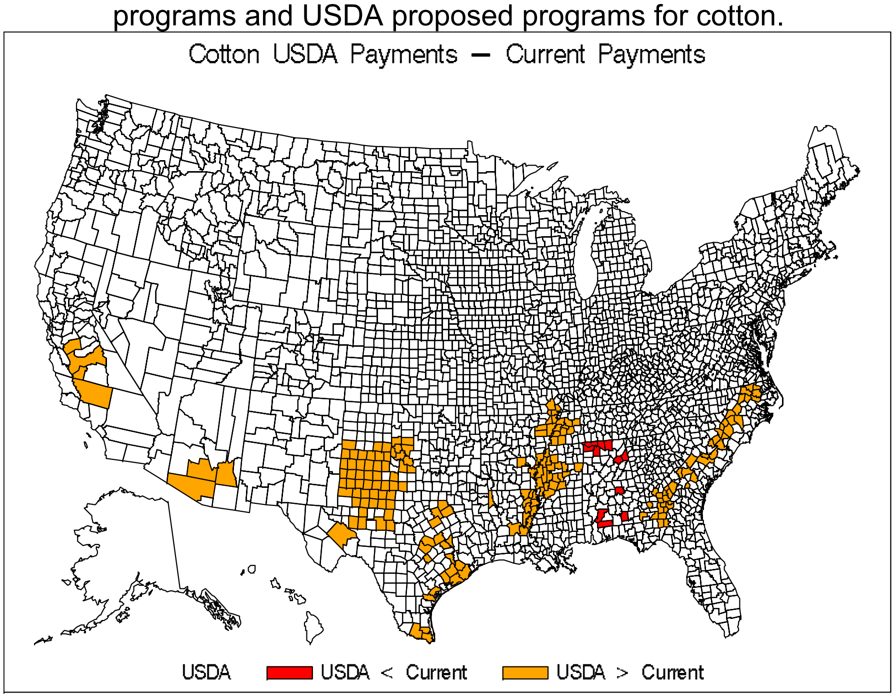


Figure 3. Difference in combined payments per acre between current programs and USDA proposed programs for soybeans.

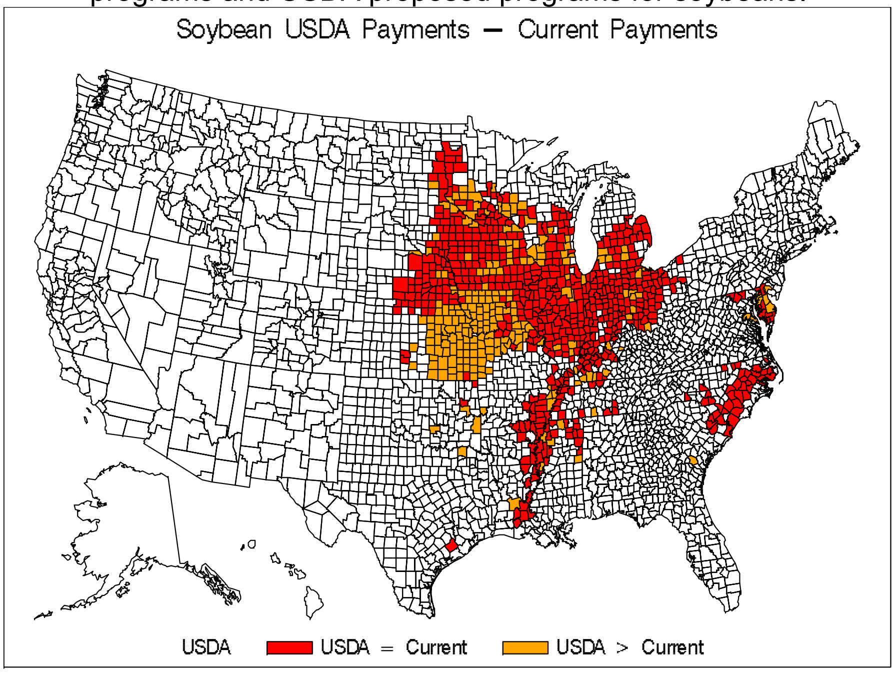
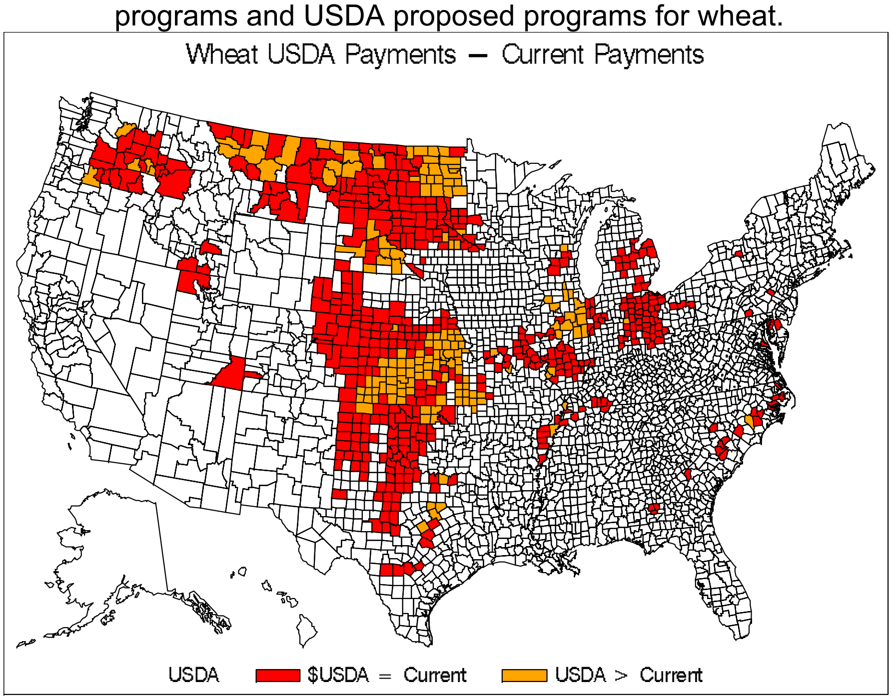


Figure 4. Difference in combined payments per acre between current programs and USDA proposed programs for wheat.



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Are High Wage Jobs Hazardous to Your Health? The Myth That Attracting Higher Paying Extractive Industry Jobs Is a Desirable Community Economic Development Strategy

John Loomis, Joe Kerkvliet, and Stephan Weiler[1]

Current Economic Development Strategies

A well known objective of local economic development specialists is to increase the number of high paying jobs in a community (Power 1988). High wage jobs are often viewed as a cure for whatever is economically ailing a community (Power 1996). High wage jobs are believed to improve the well being of the higher paid employees and their families, and ergo, the community is better off. While often this premise is simply taken on faith, some economic development specialists ground this recommendation in economic base models (Power 1988). In the rural West these high paying jobs are often in forestry, construction and mining. U.S. Bureau of Labor Statistics (BLS) data confirm that mining and construction pay well, averaging $20 an hour.

Thus, mining company officials and even federal land management agencies such as the Bureau of Land Management (BLM) often tout the higher paying jobs associated with mining as a regional economic development benefit to the communities and counties. A recent BLM supplemental environmental impact statement noted that natural gas development would “contribute to rising wage levels” in three Wyoming counties because expected earnings per job in energy development exceeds current average earnings per job (BLM 2006).

Conversely, many economic development specialists often downplay service sector jobs relative to mining and forestry jobs. Few development specialists would trade low paying tourism jobs, which depend upon preservation of natural resources and amenities, for the associated “lost” mining or forestry jobs. Indeed, BLS data confirm that workers in the “Leisure and Hospitality” industry make just $10 an hour, half what workers make in mining and construction. Thus economic development specialists may view agro-tourism primarily as a way to supplement income from production agriculture or help diversify a local economy.

So are workers in mining and construction really twice as well off as workers in the leisure and hospitality industry? Given voluntary employment contracts, worker mobility, roughly equivalent educational requirements, and a reasonably competitive job market, economic principles would suggest no such disparity in worker well being or utility. In fact, given the labor market conditions described above, at the margin, the well being or utility of workers in all employment opportunities in a community, whether mining, hospitality or value-added forestry industries are probably equal, otherwise there would be an incentive for employees to switch.

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Linking Wage Hedonic Analysis to Economic Development Strategies

A major factor in the wage disparity is that the risk of fatality in mining is more than ten times that in the hospitality and leisure industry. In particular, BLS data for 1992-1995 (Viscusi and Aldy 2003) and 2005 (BLS 2006) documents 25 deaths per 100,000 workers in mining. By comparison, deaths per 100,000 workers in the leisure and hospitality industry during 2005 was 1.8 (BLS 2006). The recent acceleration of oil and gas mining has brought increasing attention to deaths, as highlighted in a recent article entitled "Disposable Workers of the Oil and Gas Fields" (Ring 2007).

Moreover, the risk of nonfatal occupational injury is higher in extractive industries. In Montana, for example, a miner is more than 2.5 times more likely to suffer a nonfatal injury as a worker in the leisure and hospitality industry (Catlett 2007).

Many economic development specialists are apparently not aware of the economic principles underlying the "hedonic wage methodology" which has extensively analyzed the effect of workplace risk on wages. This methodology has demonstrated that in order to recruit and retain workers into high risk jobs, employers must pay these workers more. The wage hedonic method regresses the wage rate against risk of death, risk of injury as well as several control variables such as human capital (e.g., education levels), and worker characteristics (e.g., age). In addition other non-risk characteristics of the job (e.g., supervisory duties, flex time, etc.) are included as explanatory control variables as well. The regression slope coefficients on risk of death and risk of injury provide the "implicit wage compensation" or compensating wage differential for each of these risks. The wage differential is largely compensation for the added risk of death (Viscusi and Aldy 2003; Taylor 2003).

These wage differentials amounted to over $140 billion in 1990, nearly 5 percent of total wages paid (Viscusi 2007). In high wage industries the percentage of wage premium is likely much higher. It is from comparing how much additional wages must be paid to compensate for risk that the value of a statistical life is calculated (Viscusi and Aldy 2003). This value is routinely used by federal agencies to quantify the benefits of reducing not only workplace risk, but also other safety regulations.

Even some economists in their explanations of wage disparities between the tourism sector versus extractive industry have overlooked the job risk element and the explicit link with hedonic wage theory. For example, Power (1996) provides several reasons why tourism jobs report lower wages, including the frequent understatement of tip income, more flexible work hours, etc. While these are certainly part of the explanation for the wage disparity, so are differences in risk of death.

The hedonic wage theory also provides insights into other aspects of this disparity. As noted by Power (1996) flexible work hours enjoyed by many waiters and waitresses, and enjoyable work (e.g., fishing and rafting guides, ski patrollers, etc.) or work environment (e.g., ski lift operators and outdoor science school instructors) provide sufficiently high utility so employers do not need to pay a wage premium to attract job seekers. Risk of death and injury is also quite low in the leisure industry on a par with retail trade and information services (BLS 2006 and Catlett 2007).

Higher wages in mining could also be compensating workers for another type of occupational risk inherent in extractive industries, namely the risk of layoffs during bust periods. In that sense, a related hedonic rationale for high extractive industry wages could be that such workers face recurring jobless periods due to these industries' cyclical nature (e.g., Neumann and Topel

1991). In such a scenario, companies pay high wages to offset the "risk" of unemployment spells, justifying this wage premium with the assurance of longer-term local pools of labor that can be tapped for high-profit boom periods. Such a wage premium translates into high-income flows for the local economy as well.

Yet this "unemployment risk" rationale could not explain wage or jobless patterns in Appalachia, one of the most extractive-dependent and highest unemployment areas of the nation (Weiler 2000; Weiler 2001). Analyses of detailed local data in West Virginia found that unemployment risk was not systematically related to either wage patterns or jobless queues, suggesting that other factors - - such as occupational hazards - - were responsible for the noted wage premiums.

While some tourism jobs can also be cyclical, they are more **predictably** cyclical. That is, workers at ski areas or hotels know ahead of time what their periods of employment will be as compared to the unpredictability faced by miners. In fact, the seasonality of the employment is to some workers a positive attribute of the job, allowing them to pursue their own leisure activities during the "off season". For others, the closing of winter recreation season brings new seasonal jobs (e.g., river guides, mountain bike rentals) or allows for following other recreation visitors to their new recreation locations (e.g., summer park ranger).

Community Economic Development Strategies Revisited

Given hedonic wage theory, it would seem appropriate for economic development specialists and community leaders that employ them (mayors, city councils) to rethink the single minded pursuit of high wage jobs. While high wage jobs, holding everything else constant, are preferred to low wage jobs, hedonic wage models suggest that everything else will not be constant. Certainly high wage jobs that represent returns to skills and education (e.g., medical and health care field, professional and business services) would be attractive. Maintaining an attractive natural environmental and high environmental quality has been found to attract retirees (Power 1996), and therefore medical and health professionals that tend to them.

But frequently, public lands planning in the West involves trade-offs of opening new areas for mining versus preserving them for recreation, wildlife, and open-space. The increasing density of oil and gas drill rigs per unit of land leads to energy extraction becoming the sole "multiple use", as other uses and users (e.g., hikers, mountain bikers, hunters, wildlife viewers) are displaced. This displacement will likely result in direct reductions in tourism jobs and longer term reductions in other service industry jobs, as potential migrants choose locations where natural amenities have been preserved. As noted above, conventional economic development specialists might view the gain of $20 an hour mining jobs at the expense of $10 an hour tourism jobs as a net gain for community well being. However, hedonic wage methodology would suggest there has likely been no change in overall well being, as each wage is an "equilibrium wage", the amount just necessary to induce a worker into the respective occupations. For example, even if wage premiums were offered for the heightened risk of unemployment in cyclical extractive industries, firms would only pay enough of a premium to just offset the latter risk to workers to make potential workers equally well-off and willing to work at the mining job as at the local bicycle repair store. Such a situation would again leave better-paid extractive workers with the same level of well-being as lower-paid service workers, alongside the additional private and public capital planning problems inherent in local economies beset by boom/bust cycles. These high-variance economies tend to discourage longer-term investment, entrenching their narrow dependence on extractive industries and perpetuating a shallow economy based on transient labor, capital, and extractive viability (Graves, Weiler, and Bonner).

Economic development specialists and community officials concerned about the well being of workers in the community and the overall community's well being should not focus on simplistic indicators like average wages. Instead, they might give more attention to other attributes of the jobs, such as whether the worker and his/her family will reside in the community, and spend money in the community, or simply send the higher wages out of the community to their home base (Power 1996).

Of course, a town's retailers may be more concerned about their revenues rather than citizen's utility, and initially think they would prefer having a town filled with higher paid workers. However, even in this case there are a couple of drawbacks to high wage jobs. First, in isolated rural labor markets, high paying mining jobs might compete away some less risk averse workers from their current retail employment. Retailers would then have to raise wages to retain existing workers or to draw other people into the work force. These higher wages then reduce firms' profits. Second, as noted by Power (1996) not all these high wage workers reside in the community or spend their money in the community. For example, BLM asserts that 60 percent of Wyoming gas field workers are not local residents (BLM 2006). Further, as has been repeatedly reported, significant amounts of the money received in these high wage mining jobs goes into illegal drugs such as methamphetamine, at a cost of $200-$300 a day (Farrell 2005; Fuller 2007). An unofficial motto among oil and gas workers appears to be "You're wired or you're fired" (Farrell 2005). Not only does this drug money not go into legal retail outlets, but the associated assaults and crime increase a town's law enforcement costs, and drain local government budgets for expensive jail expansion, drug treatment programs, etc. County planners and federal agencies need to consider the external pecuniary costs to the community of high risk jobs. Fatal and nonfatal injuries also impact the contributions workers are able to make to their families and communities (Fuller 2007) and some of the risks in extractive industries are passed on to other sectors, especially through uninsured workers compensation funds and private medical insurance.

In conclusion, community economic development strategies need to focus on the economic well being of its citizens and residents, not solely on blind pursuit of higher wage jobs. Giving up tourism jobs for mining jobs is unlikely to improve the well being or utility of the workers. The data confirm that higher wages, if they are in mining, can be hazardous to worker health.

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Analysis of Revenue Assurance Proposals

Michael R. Dicks and Kim Anderson[1]

Introduction

Over the past 70 years, farmers have been concerned about declining real prices and have sought price support relief from the federal government. Every omnibus farm act during this time period has provided price and/or income support to eliminate financial stress partially caused by year-to-year variations (volatility) in annual revenues (income). However, the focus in agricultural policy on price support only has enabled the federal government to provide countercyclical price support, but not necessary countercyclical income support. Therefore, volatility in annual revenues remains. When yields are high and prices are low, farmers receive large market revenues and larger subsidies from the federal government to offset the decline in market prices. When yields are low and prices are high, farmers receive market revenue but little or no subsidies from the federal government because of the high prices. Therefore, farm income has fluctuated in relation to yields.

In recent years, the revenue risks have been partially covered by combining commodity programs, crop insurance, and disaster assistance. The commodity programs have provided price risk protection while crop insurance and disaster assistance have provided some degree of yield risk protection.

Currently the commodity programs offer price protection without cost to farmers and consequently, participation is universal. Disaster assistance is also offered without cost to farmers, but because it is assistance provided in reaction to a specific event (ad hoc) and rarely provides more than a small amount of yield protection, producers cannot rely on this form of assistance for yield risk protection. Indeed, the continual need for reactive disaster assistance may be seen as a sign that the current combination of commodity programs and crop insurance does not effectively provide the contingency (risk protection) markets needed in production agriculture. Crop insurance has numerous instruments that may cover price, yield, or revenue at a cost based on the level of risk protection purchased. However, adverse selection (greater participation by those with higher yield volatility) in crop insurance has led to high premiums and federal subsidies of $3- to $4-billion annually.

Various proposals for a national revenue assurance program have been presented to Congress by farm and commodity groups and agricultural policy researchers to provide adequate and effective risk management. These proposals are the result of the farmers' concerns for the lack of appropriate and effective contingency markets, which are needed by U.S. agricultural producers for risk management. The key differences in these proposals include the method of determining yield and price for estimating target revenue, the instruments used to achieve the estimated level of target revenue, and the unit area used to develop the target (for example, nation, state, or county). This analysis illustrates the impacts on total gross income for three counties in Oklahoma with varying degrees of yield volatility, of market determined versus set target prices, national versus county target yields, and the method of integrating the direct payment into revenue assurance.

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[1] Authors are professors in the Department of Agricultural Economics at Oklahoma State University. The authors thank Bruce Babcock of Iowa State University and Carl Zulauf of Ohio State for their assistance and editorial comments in developing this paper.

We selected two proposals (Babcock/Hart and Zulauf) which have distinctive key differences and compared them to the application of current policy over the last 25 years for dryland wheat production in three Oklahoma counties (Kingfisher, Tillman, and Texas). These three Oklahoma counties were chosen because they represent increasing yield risk from the eastern-most county (Kingfisher) to the western-most county (Texas). We selected wheat as the target crop because it is the primary crop of the Great Plains, and sufficient data are available for our study.

Babcock/Hart Proposal (RA-B)

The RA-B proposal attempts to provide a revenue assurance program that meets the guidelines outlined by U.S. Trade Representative (USTR) Portman to the World Trade Organization (WTO) in 2006. In that proposal, the United States noted that we were prepared to cut our Amber box policies by 60 percent from the current cap of $19.1 billion to $7.64 billion. Furthermore, we offered to cap blue box policies to 2.5% of the value of production with product-specific caps based on the 1999-2001 support levels (de minimus) also reduced to 2.5%.[2]

The sum of the 1991 to 2001 product specific caps was $16.13 billion and therefore, the proposed new amber box cap of $7.64 billion and blue box cap of $5.75 would certainly be binding under current policies, holding all other market conditions constant.

The RA-B proposal (Briefing paper 05-BP 48, November 2005) came out of the Center for Agriculture and Rural Development and is the basis for the current Revenue Countercyclical Program (RCCP) being advanced by the National Corn Growers Association. The RA-B proposal replaces the current loan deficiency payments and countercyclical payments with revenue assurance.

The RA-B proposal has the following three basic components:

1. Individual revenue will not fall below 70% of the Olympic average (average minus the highest and lowest) of the previous 5 years.
2. If revenue (national season average price times county average yield) falls below 85% of the revenue determined by the product of the effective target price (target price less direct payment) times the expected county yield, then all farmers in the county would receive the difference on all planted acres.
3. If revenue (national season average price times county average yield) falls below 95% of the revenue determined by the product of the effective target price (target price less direct payment) times the expected county yield, then all farmers in the county would receive the difference on all base acres.

To demonstrate what year-to-year revenues could be under past conditions, we calculate the gross income received from cash sales and revenue assurance payments that is determined by 100% of the difference between target revenue and actual revenue when target exceeds actual revenue. The gross revenue includes the $0.52/bushel direct payment, and we assume base

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[2] Before negotiations stalled, the plan was to update the Amber-Blue-Green Box system. Amber box spending policies that are trade-distorting and targeted for reduction (marketing loans and price supports), would be reduced and capped with product-specific caps. Blue box programs, policies that are trade distorting (direct payments and counter-cyclical payments), but exempt from reductions, would be capped at 5% of production over a period to be negotiated, with flexibility for countries with large support levels. Green box programs, policies that are non-trade distorting and are acceptable (disaster aid, conservation programs & rural development programs), would be reviewed and criteria clarified. De Minimis would be reduced by an amount to be negotiated; the current level is 5%, but the US has proposed 2.5%.

and actual acres planted to be the same. The target revenue is determined as the current effective target price (target price less direct payment) times the five-year Olympic average county yield. The Total Income received under RA-B is calculated as the actual cash income plus revenue assurance payment plus direct payment as shown below.

Actual cash income is: $USAP_i * ACY_{ij}$.

Revenue assurance payment is 95% of expected income less actual if greater than 0, or: $.95 * (OACY_{ij} * (TP - DP)) - (USAP_i * ACY_{ij})$.

Direct payment is $DP * CBY_{ij}$.

Where:

$USAP_i$ is the U.S. average wheat price in year i,
ACY_{ij} is the actual yield in year i and county j,
$OACY_{ij}$ is the Olympic average yield in year i and county j,
TP is the target price (set in legislation),
DP is the direct payment (set in legislation), and
CBY_{ij} is the base yield in year i and county j.

For example, in 2006 USAP was $4.30, ACY in Kingfisher County was 25 bushels, OACY was 32.53 bushels, CBY was 34.4 bushels, target price was $3.92/bu and the direct payment was $0.52/bu. Thus, actual cash income for Kingfisher County was $107.50 per acre and the target income was $110.61 per acre with the per acre direct payment of $17.89. Total income in Kingfisher County during 2006 would be $110.61 plus $17.89 or $128.50 per acre.

Zulauf Proposal (RA-Z)

The Zulauf proposal (U.S. Agricultural Policy at a Crossroads, Sept. 21, 2006 Testimony before the House Committee on Ag/Subcommittee on General Farm Commodities and Risk Management) is anchored in providing a government program to address continuous revenue risk and removing this risk from the current crop insurance products. Crop insurance would then handle all risk below the national systemic level. With this focus, the RA-Z proposal is often referred to as an integrated crop insurance program. A key difference between the RA-Z and RA-B proposals is the unit area used to determine the revenue target. The RA-Z proposal uses U.S. expected price and U.S. expected average yield to determine the U.S. target revenue while the RA-B proposal uses the U.S. effective target price and county average yield to establish the county target revenue. This is an important distinction in the allocation of benefits as the charts below will demonstrate.

The RA-Z proposal determines the U.S. expected price from the futures price prior to planting, and the expected yield is determined from the yield trend. The actual price received is determined from the futures price at harvest, and the actual yield is the U.S. average harvested yield as reported by USDA. The difference between expected and actual revenue, if any, is the payment farmers would receive in addition to the direct payment. The direct payment is independent of the revenue assurance payment, but it is not independent of the support payment under current policy. Again, the way that the direct payment is used is an important distinction between the RA-Z and the RA-B proposals and current policy. The RA-B proposal and current policy subtract the direct payment from the target price to obtain an effective target price. The direct payment is then added back to gross cash income plus revenue payment to obtain the total gross income. In the RA-Z proposal, the direct payment rate is not subtracted from the target price, but the direct payment is still included in the total gross income value. In this way, the RA-Z proposal provides price coverage that moves with the market while the RA-B proposal provides a preset price target. The National Corn Growers Association proposal, while based on the RA-B proposal, uses a form of market-determined price to establish the target revenue.

The Total Income received under RA-Z is calculated as:

If $AJFP_i * USTY_i > JJFP_i * USAY_i$

then

$ACY_{ij} + (DP * CBY_{ij}) + (AJFP_i * USTY_i - JJFP_i * USAY_i)$

else

$USAP_i * ACY_{ij} + (DP * CBY_{ij})$.

Where:

$AJFP_i$ is the July wheat futures price in August in year i,
$JJFP_i$ is the July wheat futures price in July in year i,
$USTY_i$ is the U.S. trend yield for wheat in year i,
$USAY_i$ is the U.S. average yield for wheat in year i,
$USAP_i$ is the U.S. average wheat price in year i,
ACY_{ij} is the actual yield in year i and county j,
$OACY_{ij}$ is the Olympic average yield in year i and county j,
DP is the direct payment (set in legislation), and
CBY_{ij} is the base yield in year i and county j.

For example, in 2006 AJFP was $3.64, JJFP was $5.03, USTY was 38.7 bushels, USAY was 38.7 bushels, USAP was $4.30, ACY in Kingfisher County was 25 bushels, OACY was 32.53 bushels, CBY was 34.4 bushels, target price was $3.92/bu and the direct payment was $0.52/bu. Thus, U.S. target revenue was $140.96 per acre and the actual income was $194.66 per acre. Because actual income exceeds target income total income for the county is cash income $107.50 plus direct payment $17.89 or $125.39

As with the RA-B proposal, we add 100% of the calculated revenue assurance payment to the total cash income plus direct payment to determine total gross income. This calculation provides for an equal comparison of the target revenue approaches and current policy. However, under current policy, only 85% of the eligible acreage receives support payments (direct and countercyclical). Percentage reductions in payments could be made to each proposal to meet budget guidelines, and the effects of these percentage reductions would vary by program and the method used to achieve the reduction.

The following three charts provide a comparison from 1983 to 2006 of the average annual gross revenues for each of the three Oklahoma counties considered, under current policy, the RA-B proposal and the RA-Z proposal. We selected this period to capture the best view of yield volatility, which is the component that the revenue assurance proposals seek to cover that is not covered by current policy. However, prior to 1996, acreage reduction programs (ARP) were used to manage supply, and these programs affected the spatial allocation of crop acreage, and did so in a way that affected yields. Locally, yields may have improved with high ARPs as the least profitable fields were placed in the program first. However, nationally and regionally, yields may have declined under the ARP as less profitable acreage was held in production as a result of program benefits. We are uncertain how potential changes in land use before and after 1996 have affected our analyses. To view these results only as they relate to the annual variation in yields within a county eliminates the need to identify any past impact of policy on land use and yields.

Figure 1. Comparison of the county average revenue that would have occurred under the RA-B, RA-Z and current commodity program for the period 1983-2006 in Kingfisher County.

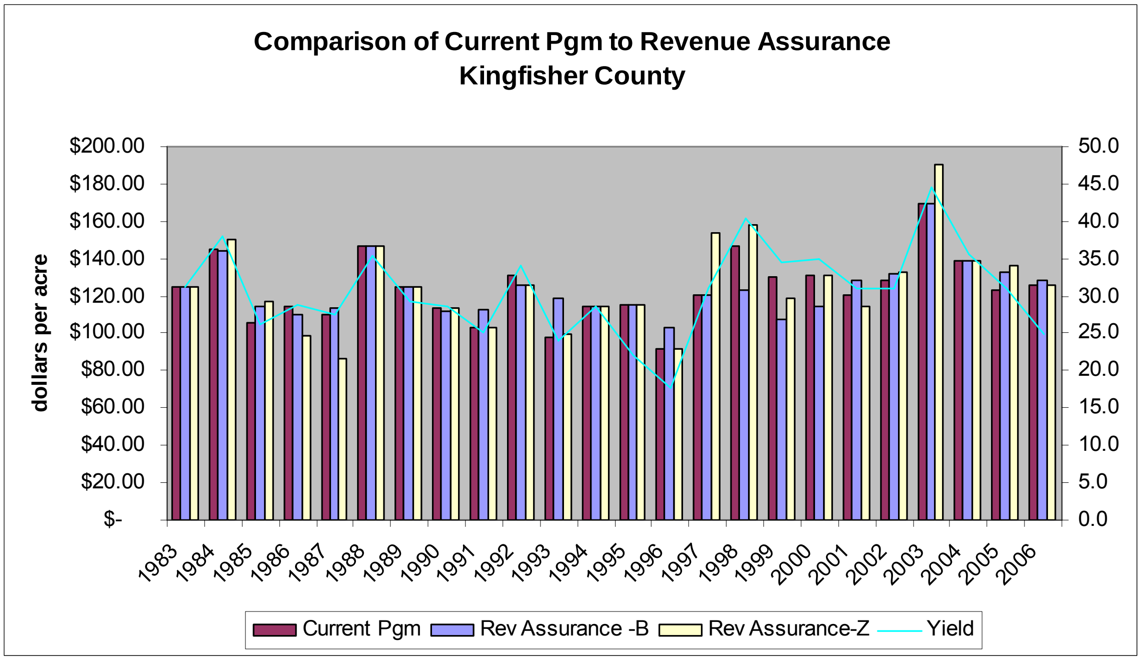


Figure 2. Comparison of the county average revenue that would have occurred under the RA-B, RA-Z and current commodity program for the period 1983-2006 in Tillman County.

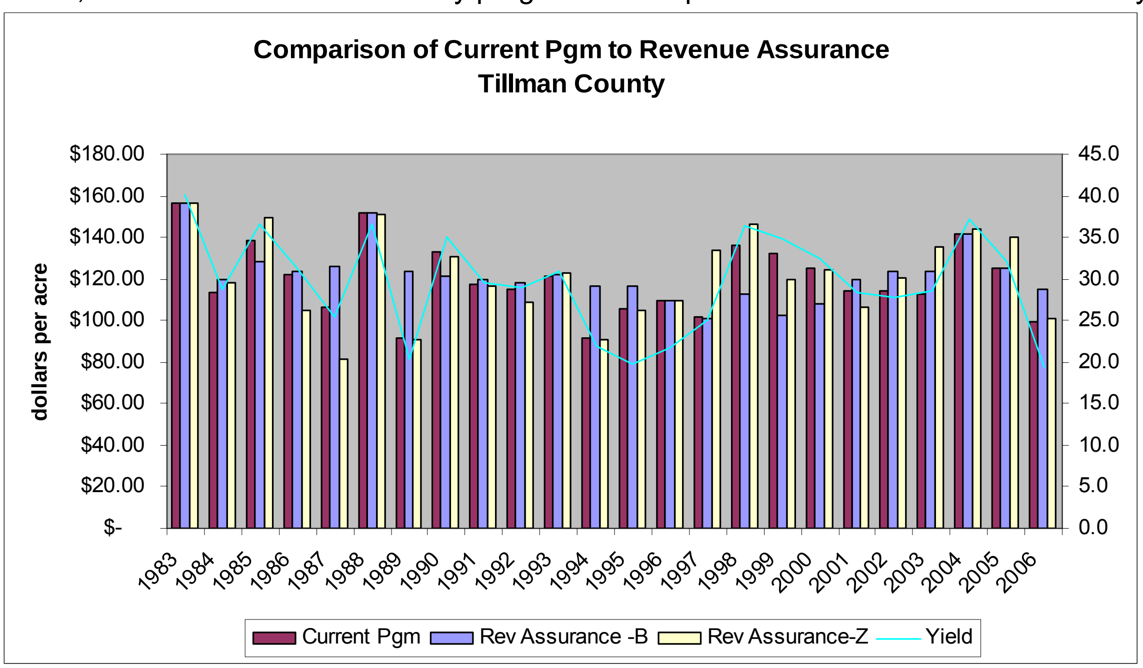
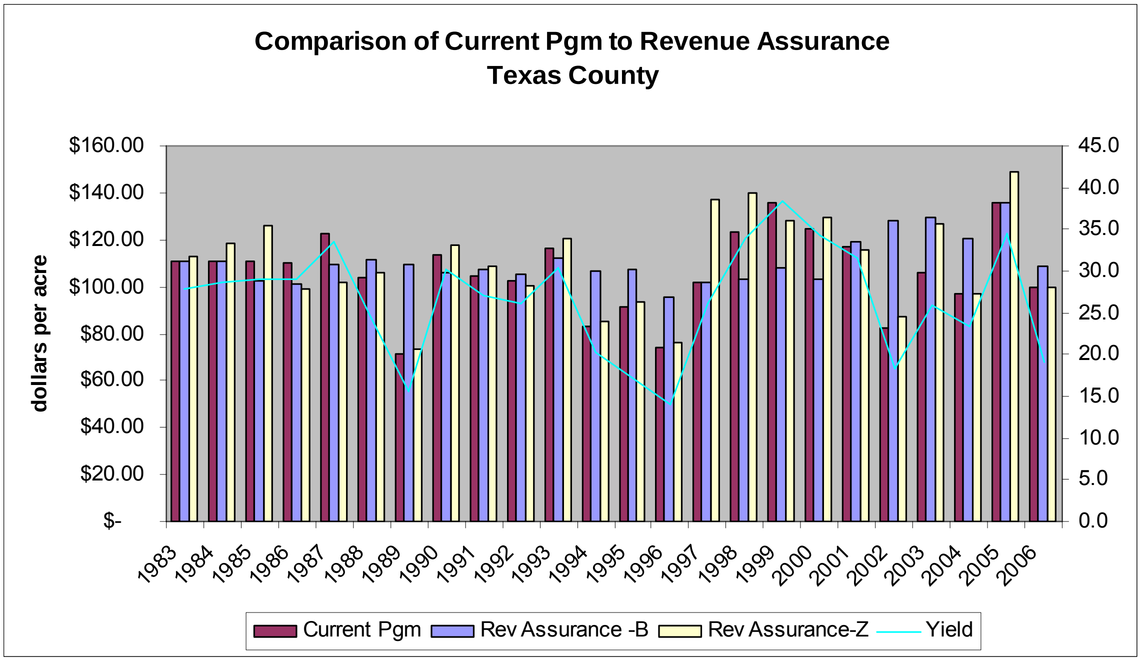


Figure 3. Comparison of the county average revenue that would have occurred under the RA-B, RA-Z and current commodity program for the period 1983-2006 in Texas County.



Figures 1, 2 and 3 above help to illustrate important elements of the revenue assurance approach to risk management. First, their effectiveness in stabilizing revenue is highly dependent on the geographical aggregation of yield. The average annual wheat yields in Oklahoma are below those of the United States. Therefore, as the comparison of the approaches of the RA-B and RA-Z proposals indicate, basing yields on the U.S. average or trend provides a higher target revenue than using the county average. Likewise, for counties whose yields exceed the national average or trend, the estimated target revenue will be less under the national average yield than the county yield.

In addition, using county average yields to determine the target revenue provides less annual variation in gross revenue and therefore better revenue risk protection. This point is important since adverse yield events are less likely to occur nationally and more likely to occur by state or by county because of adverse weather events (drought, freeze, or floods, for example). One argument against using county average yields in the target revenue calculation is that it reduces the need for crop insurance, which is a difficult empirical question to address. However, some adverse weather conditions are location specific (such as hail, fire, and wind), and crop insurance is still needed to cover these events. Also, not needing insurance payouts for county and multi-county disasters should reduce the cost of insurance and increase the number of policies. This result also occurs for the national revenue deficiency program, although the extent of the reduction in insurance rates would be smaller because county yields are more correlated with farm yields than are national yields.

The major difference between the RA-B and RA-Z proposals is related to the difference in the annual yield variation between the U.S. trend yield and the county averages, the difference in expected and target price, and the difference in the direct payment implementation method. The difference in the method for determining the target yield is amplified in Texas County where county yield variation is greatest. Using the U.S. average yield rather than trend yield in the RA-

Z proposal would have reduced the difference in gross income associated with yield variation since the U.S. yield in most years followed the yield variation in the three Oklahoma counties. However, the magnitude of variation in the U.S. yields was considerably less than that in the Oklahoma counties as shown in the chart below. Note that for the periods where yield is the lowest, the current program provides little income protection, but the revenue assurance program provides a great deal more coverage.

Figure 4. Annual average wheat yields for three Oklahoma counties and the United States from 1978 to 2006.

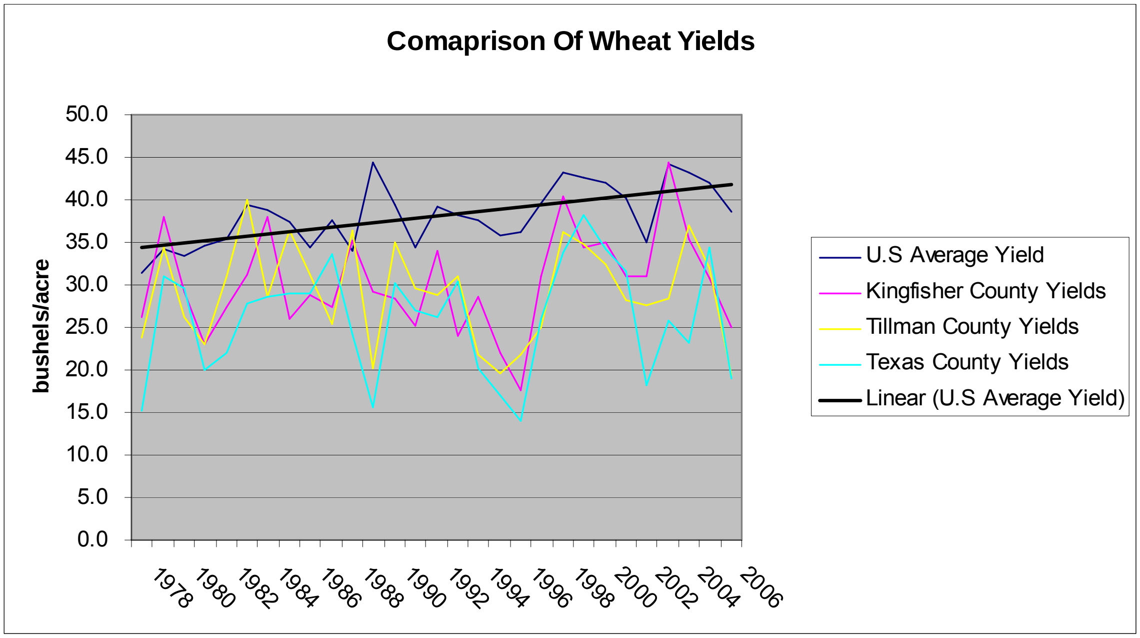


Table 1 below contains a summary of the three policy options: the RA-B and RA-Z proposals and current policy. The higher mean payout of the RA-Z proposal is directly related to the method of using the market determined price for target revenue and including the direct payment in the total gross income without adjusting the target revenue. While this method also affects the standard deviation, the effect is minor compared to the effect of the difference in yield variation between the national and county level yields. Clearly, the RA-B proposal offers much greater income stability than either current policy or the RA-Z proposal. However, the RA-Z proposal provides protection more in line with the market, which is at the root of that proposal. This distinction between the two proposals is extremely important. The RA-B proposal considers a “standard” target revenue while the RA-Z proposal considers a target revenue in line with the market and therefore seeks to offer protection at market values. This result occurs because the RA-Z proposal is based on futures prices while the RA-B is based on the current congressionally-mandated target price.

Table 1. Statistical measures of gross income for the period 1983 to 2006 under the RA-B and RA-Z revenue assurance proposals and the current commodity program.

	RA-Z	*Current*	*RA-B*
		Texas County, OK	
Mean	114.76	106.25	110.63
Median	112.29	108.07	108.65
Standard Deviation	22.27	17.14	9.68
Range	73.71	64.59	40.27
Minimum	78.52	71.36	95.61
Maximum	152.23	135.96	135.88

Discussion

This analysis of the two proposals and current policy describes the implications for total gross income of market-determined versus set target prices, national versus county target yields, and the method of integrating the direct payment into the revenue assurance. However, regardless of these factors, an important consideration for the revenue assurance program will be the incentives provided to producers in the same unit area with different levels of productivity. In using the national average yield, the incentives are regional as well as local for wheat. Almost three out of four counties in the United States produce wheat, and the variation in average annual yields between counties is large.

As an example of the impact on producers with different yields, consider farmers with yields from 30 to 50 bushels per acre in counties with average (target) yields of 30, 40 and 50 bushels per acre as shown in Figures 5, 6 and 7 below. Assuming a target price of $3.50, we map the gross income at actual prices of $2.50 to $5.00 per bushel and actual yields from 30 to 50 bushels per acre. For a county (target) yield of 30 and target price of $3.50, the target revenue would be $118.50 per acre (target yield x (greater of target or market price) plus direct payment). Any combination of actual price and yield that provides actual revenue below that target revenue would be protected, while actual revenue above that level would not be protected. Farmers with average yields of 40 bushels per acre would only receive revenue coverage up to $2.60. Beyond that price, revenue is not protected.

As the county average (target) yield is increased from 30 to 40 bushels, the level of revenue assurance is increased to $158 per acre and more of the potential actual yield and price incomes are protected by the revenue assurance. Finally, with the county average (target) yield increased from 40 to 50 bushels, revenue assurance increases to $197.50 per acre, and most of the potential actual yield and price incomes for the farm are protected.

This simple analysis indicates that while revenue is protected in all three counties with different average yields, farmers whose yields exceed the average will have less protection than farmers with yields approaching the average. Over time, this result may lead farmers to cut back on yield enhancing inputs (seed, fertilizer, chemicals) to lower yields or to purchase additional crop insurance to cover the gap in revenue protection attributable to the difference in farm and county level yields.

Targeting revenue at the county level does a good job of providing a high degree of risk management to individual farmers. What would not be covered (hail, fire, perhaps wind, and some disease) is largely poolable and could be insured through federal crop insurance at a much lower rate than today's rates.

The national revenue deficiency payment could be scaled to the individual farmer's expected gross revenue to minimize concerns about fairness within the program. Because different farmers have different gross revenues, eliminating the bias towards less productive outcomes requires scaling the national revenue deficiency payment to individual farmers' gross income at risk. This scaling is important in several comparative situations, including dryland crops and irrigated crops within the same county. A simple scaling formula could use the ratio of the farmer's expected revenue per acre to the national expected revenue per acre and then multiply this ratio by the national revenue deficiency payment. Therefore, the national revenue deficiency payment is scaled to the farmer's expected gross revenue.

Figure 5. Gross income at various levels of farm yield and price with revenue assurance using 30 bushels as target yield, $3.50 as target price and a $.45 per bushel direct payment.

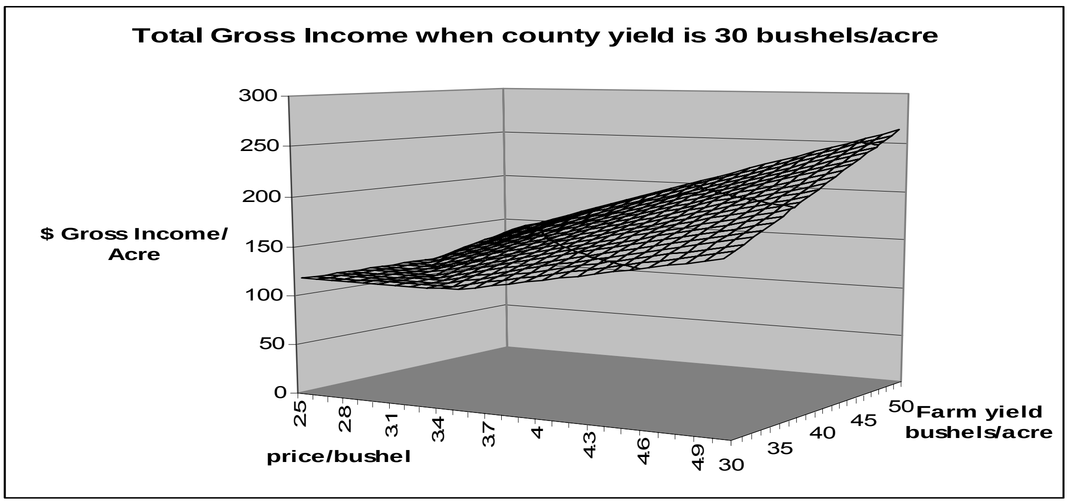


Figure 6. Gross income at various levels of farm yield and price with revenue assurance using 40 bushels as target yield, $3.50 as target price and a $.45 per bushel direct payment.

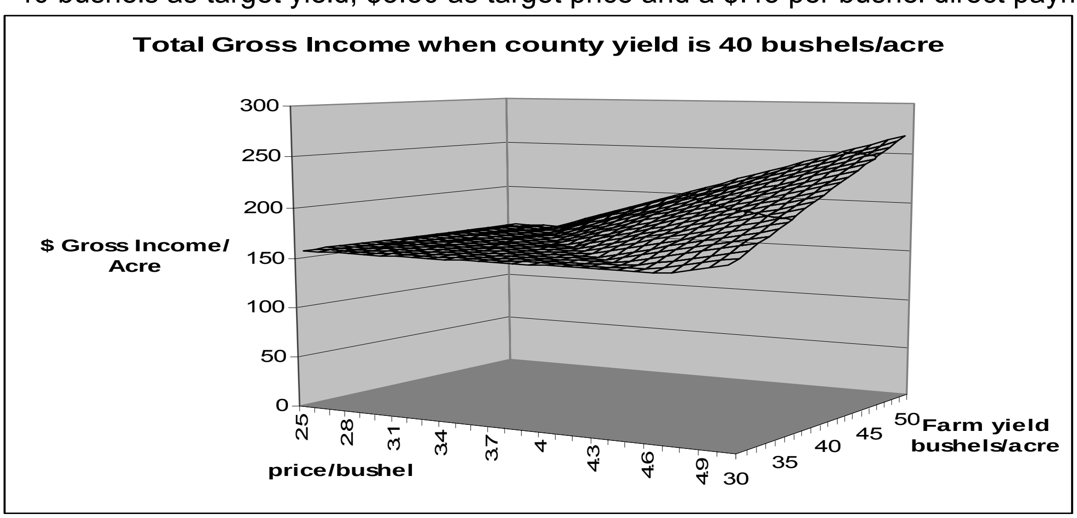
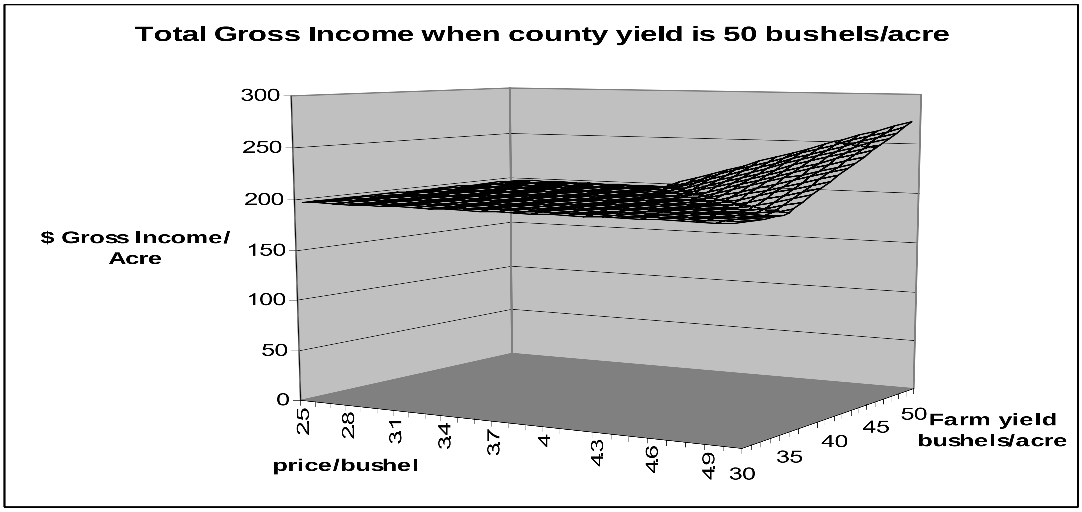


Figure 7. Gross income at various levels of farm yield and price with revenue assurance using 50 bushels as target yield, $3.50 as target price and a $.45 per bushel direct payment.



We have analyzed two proposed revenue assurance programs for Kingfisher, Tillman and Texas Counties in Oklahoma for the period from 1983 to 2006 and compared the revenue assurance proposals to the current program applied during the same period. We have illustrated examples of various methods for determining target yield and target price as well as actual price. We have also indicated different methods for including the direct payment and reducing the level of coverage to reduce budget exposure[3] and different methods of paying portions of the revenue assurance to meet WTO limits.

Regardless of the methods used to calibrate the revenue assurance program, impacts on land-use patterns will exist as they have with all other previous farm support programs. While these impacts may be minimized in the short run, unless annual adjustments are made to both expected yield and price, the impacts will be magnified over the longer run.

Finally, we have not discussed a very important component of the potential effectiveness of the revenue assurance program and that is implementation. Except for the adjustments to yields and acreage that were permitted one time under the Farm Security and Rural Investment Act of 2002, USDA has not collected yield information since the Food Security Act of 1985 was implemented. With the revenue assurance program, especially where the program attempts to include the producer's individual risk, historic yields and acreage must be collected and verified. Also, if the revenue assurance program is to be integrated with crop insurance, this requirement must be achieved for both the farm and the fields within the farm.

[3] Specifically the national revenue deficiency payment may be calculated as [(coverage rate * expected per acre revenue) - (realized revenue per acre)] or [coverage rate*(expected per acre revenue - realized revenue per acre)] As an example, [(95%*$100) - $80] = $15 while [95%* ($100-$80)] =$19.

Entrepreneurial Activity by Women in Rural South Dakota

Abbigail Meeder and Carol J. Cumber[1]

Introduction

The period since 1980 has been one of extensive, nationwide economic restructuring. This economic change has been particularly stressful in non-metropolitan areas of the United States (Bastow-Shoop et al. 1995). Rural development and rural employment growth have lagged behind that of metropolitan areas (Reed and Blair 1993). Earnings per job declined in rural areas in the 1980s. Rural development has moved from being an issue of the federal government toward being a state level issue (Leistritz and Bangsund 1998). Rural states are addressing this issue with an increased focus on rural community sustainability.

Entrepreneurial firms play an important role in economic and employment growth in the United States. Small firms produce more jobs than any other size firm, with startup firms generating twice as many jobs as existing firms that expand (Winders 2000). The United States is geographically defined as more than three quarters rural, and around one in five Americans lives and works in a rural area (Shields 2005). Small, entrepreneurial organizations add to the number of jobs available in rural communities, increasing a small community's economic viability. Economic development initiatives help to stabilize rural populations and increase the demand for housing (DeVuyst, Leistritz, and Schepp 2005). These businesses stabilize local services, enhance the local tax base, and add to local linkages, innovation, and sustainability in small communities (Winders 2000).

Even though rural firms provide almost two thirds of all rural jobs (McDaniel 2001), many rural women find it difficult to obtain employment (Shelleman and Shields 2003). The fact that rural women find it harder to find employment than non-rural women do may explain the trend that predominantly rural states have a higher proportion of women business owners than non-rural states. Rural areas often face disadvantages that urban locations do not (Robinson 2001). Business owners in rural areas may face difficulty obtaining business services such as advertising, legal consultation, accounting, and banking services (MacKenzie 1992). Physical isolation and unavailability of supplies in rural areas also pose a problem for rural firms. Rural development lags behind development in metropolitan areas (Robinson 2002). Access to technological services and electronic infrastructures are limited (MacKenzie 1992). Technology that may facilitate entrepreneurship like computer access and use is lacking in some rural areas (Shelleman and Shields 2003). Many rural areas lack information networks that will help entrepreneurs start and run their own businesses (MacKenzie 1992).

Rural areas also face problems concerning low population density, low education levels, low incomes, and high transportation costs (Shields 2005). People in rural areas are limited by location and physical difficulty in commuting to a work site (Robinson 2001). The Center for the Study of Rural America's research on Small Business in Rural America identified major challenges that hinder rural business development in rural settings as lack of infrastructure, labor, and capital (McDaniel 2001).

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Although rural settings have traditionally been thought to have a negative impact on small businesses, there are a few characteristics of a rural setting that have a positive impact. Anecdotal evidence implies that rural business owners do not feel that their location is a disadvantage (Robinson 2001). New business survival rates are comparable in rural and urban areas (Buss 1990). Shelleman and Shields (2002) studied Appalachian Women Entrepreneurs and concluded that, contrary to prior experiences, women say they do not experience adversity due to resource constraints. Rural areas may offer a more relaxed, laid-back lifestyle. The slower pace and readily available access to outdoor recreation are positive attributes of rural areas (Robinson 2001; MacKenzie 1992). The cost of living in rural areas is lower than in metropolitan areas, which may result in a reduced cost of doing business. Rural business owners also benefit from the strong social ties of a small community (Robinson 2001).

The national trend toward an increase in the number of women business owners and entrepreneurs is mirrored in rural states such as South Dakota (Shelleman and Shields 2003). According to a fact sheet compiled by The Center for Women's Business Research, in 2004 South Dakota had an estimated 37,115 privately-held, at least 50% women-owned firms, both rural and non-rural, which accounted for 54.5% of all privately-held firms in the state. These firms generated nearly $12 billion in sales and employed 79,296 people. From 1997 to 2004, the number of majority women-owned businesses (>50%) grew by 45.6% (Women-Owned Businesses in South Dakota 2004: A Fact Sheet 2004).

Although the number of women-owned firms continues to increase, very few studies exist that concentrate specifically on entrepreneurship by women in rural areas. This article reports the results of an exploratory study that focused on entrepreneurial activities by women in rural South Dakota in an attempt to assess the needs, challenges, and successes of these women.

The overall objective of this research was to evaluate how a rural setting affects South Dakota female entrepreneurial businesses, to identify business characteristics of female-owned rural businesses, to identify the factors that lead to the success of rural women entrepreneurs, and to identify the biggest business needs of rural women entrepreneurs.

Data and Methods

In May 2006, three hundred ninety-six surveys were mailed to rural businesswomen who owned at least 50% of their rural business. The census definition of a rural area, i.e, an area or city with less than 2,500 in population in either a metropolitan or non-metropolitan county, was used.

Both snowball and random sampling techniques were used. Extension educators from around the state of South Dakota were asked to review a list of business owners in their area and recommend participants from the pre-constructed mailing list of 1,624 rural women business owners (acquired from InfoUSA) or business owners they knew from their area whose names were not on the list. Extension educators recommended 225 business owners (57% of the total). An additional one hundred seventy-one rural women business owners were randomly sampled (43% of the total). A total of 110 business owners (28% response rate) completed and returned the survey.

Results

The most common industry (nearly 34%) represented was retail trade, followed by professional, scientific, and technical services (23%), and health care and social assistance (8%). Over 27% of survey participants had gross annual sales in excess of $90,000. Almost 68% of these businesses targeted a local market, and nearly 23% targeted a regional market. Only 9% targeted a national or international market. All but five of the 110 survey respondents defined themselves as successful.

Rural Setting's Effect on Female Entrepreneurial Businesses

Survey participants were asked to rate aspects of a rural area that may affect a business. Table 1 indicates the results.

Table 1. Impact of a rural setting on a business.

Rural setting's impact on:	Highly Positive 1 %	Moderately Positive 2 %	No Impact 3 %	Moderately Negative 4 %	Highly Negative 5 %	Index Average
Availability of customers (n = 105)	56.2	18.1	8.6	11.4	5.7	1.92
Availability of financing (n = 101)	30.7	33.7	23.8	9.9	2.0	2.19
Availability of technological resources (n = 97)	31.9	32.9	24.7	4.1	6.2	2.20
Availability of suppliers (n = 100)	27.0	26.0	37.0	7.0	3.0	2.33
Availability of support systems (n = 95)	22.1	33.7	31.6	10.5	2.1	2.37
Social networks (n = 97)	16.5	29.9	37.1	15.5	1.0	2.55
Workforce availability (n = 100)	23.0	27.0	25.0	22.0	3.0	2.55
Availability of training programs (n = 96)	16.7	29.2	34.4	19.8	0.0	2.57
Availability of organizational resources (n = 98)	10.2	35.7	35.7	17.4	1.0	2.63
Overall impact of rural setting on business (n = 98)	24.5	29.6	24.5	19.4	2.0	2.45

Fifty-six percent of respondents reported that a rural setting had a highly positive impact on the availability of customers. The index average was 1.92; the highest index average for all the factors. Although one might think that a rural area would limit the availability of customers because of a limited population, one explanation for this finding is that people in rural areas are more familiar with the people and businesses in this area than more populated areas. Customers of rural businesses could be friends of the business owner and may be more willing to support local businesses. The highest proportion of respondents found that a rural setting had a moderately positive impact in relation to financing, the availability of technological resources, the availability of support systems, and work force availability. Financing may be easier to acquire in rural areas because the people are more familiar with each other, and a banker may take into account not only financial stability, but also characteristics like work ethic and drive when considering loan applicants. Workforce availability may also be better in rural areas because rural residents may find it harder to attain other jobs in an area with limited businesses. In regards to availability of resources, the results were equal for moderately positive and no impact. The highest proportion of respondents indicated that a rural setting did not impact the availability of suppliers, social networks, or training programs. On the whole, a majority of respondents felt that the overall impact of rural setting on a business was either moderately or highly positive.

The Impact of Female Ownership on a Business

Survey participants were asked to rate aspects of running a business that might be impacted because they were female. Table 2 indicates the results.

Table 2. Impact of female ownership on a business.

Impact of being female on:	Highly Positive 1 %	Moderately Positive 2 %	No Impact 3 %	Moderately Negative 4 %	Highly Negative 5 %	Index Average
Customers' view of your business (n = 103)	40.8	26.2	26.2	6.8	0.0	1.99
How women are treated as business persons (n = 101)	27.7	22.8	30.7	15.8	3.0	2.00
Business sales (n = 99)	32.3	24.2	34.3	8.1	1.0	2.21
Acquiring financing (n = 102)	26.5	19.6	31.4	18.6	3.9	2.54
Overall impact of female ownership on business (n = 102)	30.4	23.5	37.3	5.9	2.9	2.27

Almost 41% of respondents believed that female ownership had a highly positive impact on customers' views of their business. The index average was 1.99; the highest index average for all the factors. The most frequently chosen response for how women are treated as business persons, the impact on business sales and acquiring financing, was no impact.

Overall, the majority of respondents felt that female ownership had either a moderately positive or highly positive impact on their business. The last factor supports this finding. This shows that, contrary to the belief that female ownership has a negative impact on a business, in this study, participants felt that female ownership had either no impact or a positive impact on their business.

Factors Leading to the Success of Rural Women-Owned Businesses

For the purposes of this study, success was defined not only by the sales of a business, but also by self-disclosure of participants as to what they believed defined success. Survey participants were asked to choose the top three factors they felt led to the success of rural women-owned businesses. Table 3 indicates the results.

Table 3. Factors leading to the success of rural women-owned businesses.

Factors Leading to Success:	# of responses*	% of total responses
Hard work	85	27.7
Drive/Passion	48	15.7
Owner's prior experience in that area of business	32	10.5
Strong support systems (family, friends, social groups, community, etc.)	28	9.2
Efficient financial management	28	9.1
Participation in community events (networking)	14	4.6
Organization and planning	14	4.6
Efficient time management	11	3.6
Supportive community with an entrepreneurial spirit	11	3.6
Well-trained employees	10	3.3
Adequate financing	10	3.3
Efficient marketing	6	2.0
Efficient advertising	5	1.6
Utilizing e-commerce	1	0.3
Luck	1	0.3
Other	2	0.7
Total responses	306	100.00

* Participants were allowed to choose up to three factors.

The three most important factors leading to the success of rural women-owned businesses were hard work (28%), having drive or passion for what the business person is doing (16%), and the owner's prior experience in that area of business (10%). The other factors were each less than 10% of the responses.

Characteristics of Successful Business Women

Survey participants were asked to choose the top three factors they believed made a businesswoman feel successful. Table 4 indicates the results.

Table 4. Characteristics of successful business women.

What do you believe makes a female business person feel successful?	# of responses*	% of total responses
Helping others	64	20.9
Contributing to the family income	57	18.6
Making a profit	48	15.7
Feeling a sense of accomplishment	37	12.1
Working for oneself	27	8.8
Being in control	25	8.2
Having more flexibility in a job	18	5.9
Fulfilling a need in the community	17	5.6
Other	13	4.3
Total responses	306	100.0

*Participants were allowed to choose up to three options.

The most frequently chosen factor that makes a female business person feel successful was identified as helping others (21%), followed by contributing to the family income (19%), making a profit (16%), and feeling a sense of accomplishment (12%). The remaining characteristics of successful business women each accounted for less than 10% of survey responses. When participants were asked if they felt their business was successful, very few stated that their business was unsuccessful. Only five of the 105 respondents to this question felt that they were unsuccessful. The results of these questions show that the female business owners do not define success entirely in monetary terms.

Comparison of Prior Experience of Women Business Owners and Sales

Survey participants were asked to report whether they had prior experience before starting their business. Table 5 indicates the results.

Table 5. Comparison of prior experience of women business owners and sales.

Did you have prior work experience in the area of business you now operate?	Yes %	No %	N=
Overall average of all women business owners surveyed	63.3	36.7	109
<$1,000 in Annual Sales	100.0	0.0	1
$1,001-$10,000 in Annual Sales	45.4	54.5	11
$10,001-$20,000 in Annual Sales	46.1	53.8	13
$20,001-$30,000 in Annual Sales	50.0	50.0	10
$30,001-$40,000 in Annual Sales	60.0	40.0	5
$40,001-$50,000 in Annual Sales	75.0	25.0	4
$50,001-$60,000 in Annual Sales	57.1	42.9	7
$60,001-$70,000 in Annual Sales	100.0	0.0	1
$70,001-$80,000 in Annual Sales	87.5	12.5	8
$80,001-$90,000 in Annual Sales	50.0	50.0	4
$90,001-$100,000 in Annual Sales	100.0	0.0	10
>$100,000 in Annual Sales	64.7	35.3	17

More than 63% of participants had prior work experience in the area of business they now operate. In all but one sales category (above $50,000 in annual sales) there was prior work experience in the area of business they now operate. Four of the six ranges less than $50,000 in sales had lower levels of prior experience. The business owners in the categories with higher sales have more experience than the women in the categories with lower sales. The higher the sales, the more likely business owners are to have prior experience. This trend can lead one to believe that if a business person has experience in the area of business she operates, she may be more likely to have higher sales and be more successful monetarily.

Needs of Rural Women Business Owners

Survey participants were asked to identify needs of rural women business owners. Table 6 presents the results. Survey respondents most frequently indicated a very high need for personal support systems, a willingness to take a risk, qualified workers, and sources of financing. An equal percentage (29%) of respondents indicated either a very high or a moderate need for mentors. A moderately high need was most frequently expressed for local services and supportive public policies. Regarding training programs, there was only a three percent difference between those who believed there was a moderate need versus a very high need.

A moderate need was most frequently identified in the areas of building/rental space, governmental support systems, institutional support systems, contact list/directory, youth and adult entrepreneurial programs, and institutional resources.

Conclusions

The overall objective of this research was to evaluate how a rural setting affects South Dakota female entrepreneurial businesses, to identify business characteristics of female-owned rural businesses, to identify the factors that lead to the success of rural women entrepreneurs, and to identify the biggest business needs of rural women entrepreneurs.

Although some previous studies suggested that a rural setting would negatively affect businesses, our findings were the opposite in that less than one-fourth of the respondents felt that was the case. Most survey participants stated that being a female rural business owner either had no impact on their business or was positive. As expected, operating in the retail industry was most common, as was the finding that the majority of businesses had under $100,000 in gross annual sales, and targeted a local market. The three factors considered most important to the success of these businesses were hard work, drive/passion, and prior experience. They dismissed the concept that luck played a role.

Interestingly, all but five of the women surveyed indicated that they were successful, even though they may have low gross annual sales. This can be explained by how they defined success, for the most frequently chosen indicator was that they were helping others. This was followed by contributing to family income, making a profit, and having a sense of accomplishment.

This research also sought to identify the needs of rural female entrepreneurs in South Dakota. There are many, including a need for training programs, personal support systems, qualified workers, sources of financing, mentors, and a willingness to take a risk.

The results of this research may be beneficial to rural women business owners and rural women who are considering starting a business. Rural women entrepreneurs can use the information from this study to better understand business success and forecast and manage challenges they may face. If female entrepreneurs have a family, this study may also be useful. Having more information, female entrepreneurs will be better equipped to run a successful business. The increase in family income from the business will be beneficial to all members of the family. By increasing the family income, the female entrepreneur is increasing her family's quality of life.

Small business associations, training programs, and information and support resource providers may also find the results of this study useful. The information from this study can assist small business associations and training program leaders in planning seminars and helping entrepreneurs in the areas where help is most needed.

Policy makers may also be interested in the results. With the number of rural female entrepreneurs increasing in South Dakota, the state is experiencing an increase in rural economic development. Because South Dakota is a rural state, policy makers are very interested in economic development and rural sustainability. Policy and government action may take place to better support women in rural areas to start and succeed in business.

Table 6. Needs of rural women business owners.

Need for:	Very High 1 %	Moderately High 2 %	Moderate 3 %	Moderately Low 4 %	No Need 5 %	N =	Index Average
Personal support systems	65	21	10	2	2	104	1.54
Willingness to take a risk	67	15	13	3	1	104	1.55
Qualified workers	49	25	18	1	6	99	1.89
Sources of financing	43	31	19	3	3	99	1.91
Training Programs	34	22	37	5	2	95	2.20
Building/rental space	27	31	29	7	7	101	2.28
Local services	19	38	32	7	4	95	2.40
Supportive public policies	22	32	31	10	4	96	2.42
Mentors	29	23	29	11	8	98	2.47
Governmental support systems	26	26	31	11	7	98	2.49
Institutional support systems	18	25	34	17	6	96	2.69
A contact list or directory	11	32	36	12	8	97	2.74
Youth and adult entrepreneurial education programs	11	27	34	21	6	96	2.83
Access to institutional resources	12	20	45	16	6	93	2.85

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Genotyping: What Applied Economists Should Know

Eric A. DeVuyst, David K. Lambert, and Marc L. Bauer[1]

Introduction

Information drives markets. Buyers and sellers conduct transactions based largely on the attributes of goods or services being exchanged. In some cases, these attributes are easily observed, and goods or services are traded at prices reflecting both buyers' and sellers' valuation of the attributes. In many cases, however, information about the attributes of a product cannot be completely known at the time of transfer, or one party may have greater knowledge of a product's attributes than the other participant in an exchange. A rich literature addresses market characteristics when uncertainty about a product is equally shared or when knowledge about the good or service being exchanged is asymmetric (Stigler 1962; Akerlof 1970; Stiglitz 2000).

Imperfect information affects most markets. Agricultural markets may be especially rife with imperfect information. Markets for wheat (Lambert and Wilson 2003), wine (Fraser 2005), livestock (Ladd and Gibson 1978; Chvosta, Rucker, and Watts 2001), and farm and range land (Miranoski and Hammes 1984; Xu et al. 1993; Elad et al. 1994; Torell et al. 2005), among others, reflect attribute uncertainties for intermediate or final agricultural goods. Uncertainty about the attributes of intermediate goods introduces uncertainties about the quality traits of final products. Various instruments exist to reduce product attribute uncertainties. For example, wheat variety can affect the levels of end use traits desired by processors (Lambert and Wilson 2003). Production contracts are designed so growers produce a specific variety best suited for the end user's needs. Wheat markets also offer premiums and discounts based on various product characteristics. Quality price differentials are found in numerous other markets, such as hogs, beef, milk, corn, oilseeds, and most fruit and vegetable markets.

Cattle genetics are receiving increasing recognition for signaling multiple aspects of animal profitability (Lambert and DeVuyst 2006; DeVuyst et al. 2007; Lusk 2007). Scientific advances are increasing the role of genetic information in determining performance and quality of crop and livestock products. Although tools have long been available to determine the value of information in decision making (e.g., Babcock 1990), few studies have attempted to value information embedded in genetic structure. Valuing genotypic information is only recently becoming possible as research evolves that relates animal genetics to performance or animal quality. The objectives of this paper are to describe recent research relating animal genetics to cattle performance and carcass quality and, ultimately, profitability. We suggest directions for future research relating genetic research to production decisions, discuss current and future data collection and analysis activities, and close with a discussion of how increasing knowledge of genetic structure may affect markets.

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The Economics of Genotypic Information

Most economists are not well-trained in genetics, including a subset of the authors. Therefore, a short course in genetics will set the stage for current research on beef cattle genetics and economic research. A gene is a strand of deoxyribonucleic acid (DNA) that encodes a specific protein. Each gene is a chain of nucleotides. The four nucleotides comprising all DNA are adenine (A), cytosine (C), guanine (G) and thymine (T). The specific order of the chain of nucleotides (A, C, G, and T) instructs cells how to function, including what proteins to produce. The order of a set of three nucleotides dictates which amino acid to place in the protein being made. A mutation, or polymorphism, occurs when one nucleotide occurring within a gene is replaced by another, thus altering the amino acid placed in the newly made protein. When mutations occur, the size, shape and/or efficacy of the protein being produced can be altered. In many cases these changes are minor and have little or no effect on an organism. In other cases, the changes may be significant and alter the organism's biology. In beef cattle, mutations may affect coat color, horned vs. polled, growth, fat deposition, muscling and post-mortem tenderness. In the most extreme cases, proteins essential to life are so severely altered through mutation of the genetic instructions that the animal cannot survive.

Genotype describes the order of nucleotides at a specific location on a gene. Because animals are diploid, they have two copies of each gene or alleles. For example, a "CT" genotype indicates cytosine lies on one gene and thymine on the other, hence it is heterozygous. A homozygous animal would have the same nucleotide on both alleles, such as a "CC" or "TT" genotype. A location on a gene that differs is called a single nucleotide polymorphism (SNP) or a mutation. SNPs are often called genetic markers.

Because genes are formed by nucleotides chained together, multiple mutations are possible at different locations on the same gene. A haplotype is a set of SNPs within a gene. Since protein function can be determined by the influence of multiple amino acids, haplotyping is thought to provide more information than SNPs for complex cell functions.

Biology is determined by genotype, environment and the interaction of genotype with environment, so knowledge of genotype may indicate potential animal performance and, consequently, livestock profits. Genetic information may have value if awareness of animal genetic structure affects management, costs, and revenues. Producers and their organizations have utilized other less specific information, such as expected progeny differences (EPDs)[2] in registered bull markets (Chvosta, Rucker, and Watts 2001), to signal information regarding the genetic potential of individual animals. The need for improved information in beef cattle production and markets was stressed by Hennessy, Miranowski, and Babcock (2004), who noted that efforts to improve beef quality may not succeed until better information is available about individual animal genetic traits. Scientific advances are only now shedding light on the role of specific genes in animal performance and quality. Incorporation of desirable genetic traits can perhaps best be distributed through a cattle herd through selective breeding. Although breeding programs to improve herd genetics may be lengthy due to the biological reproduction process in beef cattle, selective breeding programs using artificial insemination and embryo transfer may decrease the time necessary to achieve desirable genetic structures. Although the effects of genotype on animal performance and quality is still uncertain, several

[2]Expected progeny differences, or EPDs, are indices to reflect relative differences in progenies' traits, such as marbling, rate of gain, etc.

breed organizations are currently considering adding genetic markers as part of their databases (Shafer 2007).

Most phenotypic traits result from a complex interaction of several genes. For example, EPDs are an aggregate measure of the expression of several genes (Thallman and Hruska 2004), and have been shown to affect breeding stock prices (Chvosta, Rucker, and Watts 2001). Animal scientists suspect that additional genotype information will be used to augment rather than replace EPD measures (Thallman and Hruska 2004). Since it is currently cost prohibitive to identify the genetic structure of all breeding animals, EPDs will probably continue to be used in selecting replacement stock. However, augmenting EPD scores with genetic information would provide greater information to the buyer regarding performance of the breeding stock.

Collecting and analyzing DNA information is costly. DNA testing costs vary with the number of SNPs evaluated, but $35 per head for a single SNP is common. Producers or technicians can collect required tissue, semen, hair or blood samples. However, data collection for statistical testing of hypotheses relating genotype to animal characteristics requires large-scale data collection and tracking of specific animal performance and quality. The genetic and animal performance and quality data for DeVuyst et al.'s (2007) research on fed cattle were collected over a two-year period. Data collection involved tracking cattle from placement in a feedlot over the approximately 180-day feeding period through post-slaughter carcass evaluation. At placement, blood samples were taken via venous puncture and analyzed for genotype using laboratory facilities at North Dakota State University. Various animal measurements were taken during the feeding phase, at slaughter, and 24 hours after slaughter. The research team, including the faculty, spent several January and February days in a South Dakota feedlot in sub-zero temperatures collecting data. Individual animals were marked using a temporary carcass tag at slaughter and followed through the grading process 24 hours after slaughter. A permanent carcass tag was pinned to each carcass as they were weighed and sent to the cooler. Complete data for each animal from placement through grading required the researchers to be present at each major step in this process.

Economic Analysis of the Leptin Gene

The leptin gene has been associated with animal metabolism, fat deposition, feed conversion, and milk production (Bierman et al.[3] 2004; Buchanan et al. 2002, 2003; Kononoff et al. 2004; Larson et al. 2005, 2006). Table 1 summarizes the current state of knowledge concerning leptin genotype, cattle performance and traits, and profitability. Lambert and DeVuyst (2006), DeVuyst et al. (2007), and Lusk (2007) demonstrate that leptin genotype has the potential to affect the value of beef carcasses, feedlot profitability, and ultimately feeder animal markets. Value derives from the grid (or formula) pricing of beef carcasses, where prices are based on weight and discounts or premiums for carcass quality and yield. Mutations in the leptin gene have been shown to affect carcass yield grade (Schenkel et al. 2005; Larson et al. 2005, 2006) and carcass quality grade (Larson et al. 2005, 2006). Consequently, leptin genotypes and haplotypes have the potential to affect feedlot profitability by decreasing lean yields leading to smaller premiums or larger discounts, increasing marbling scores leading to larger premiums or smaller discounts, and possibly affecting time on feed and feed costs.

[3]The notation in Bierman et al. (2004) is somewhat confusing relative to current genetics notation. Their "CC" genotype refers to the "TT" genotype discussed here and "RR" is equivalent to the "CC" genotyped discussed here.

Knowledge of the function of specific genes may lead to better predictions of final outcomes, and management strategies can be optimized given likely biological outcomes. For example, if genetic information indicates that a steer is likely to produce less external carcass fat (i.e., a high-yielding carcass[4]), rations might differ from rations for a steer with a genetic disposition towards deposition of more external carcass fat. Optimal feeding periods may differ among genotypes based on optimal times on feed and likely final weight, yield, and quality grade outcomes. Marketing strategies may also differ for animals of different genotype. For example, specific animals may be marketed using lean rather than quality grids.

Three studies analyze beef animal feedlot performance based on the leptin gene (Lambert and DeVuyst 2006; DeVuyst et al. 2007; Lusk 2007). Based on placement and carcass information, Lambert and DeVuyst's research suggested optimal selection of feeder cattle based on genotype. Optimal number of days on feed did not change when genotype was known. However, lean (CC genotype) steers under identical feeding schedules returned between $13 and $30 per head more than TT (fat genotype) animals. Net return measures under both models were significantly higher for CC (lean) than CT (mixed or heterozygous) and for CC (and CT) over TT (fat) animals. The difference in returns was not, however, large enough to cover individual animal genotype testing costs.

In contrast, DeVuyst et al. (2007), studying the same SNP as Lambert and DeVuyst (2006), reported an economic advantage from feeding TT (fat) genotype cattle, both steers and heifers. Their results show that optimal days-on-feed varied little by genotype, but advantages from feeding TT cattle vs. CC cattle was over $20 per head and as large as $37. Both heifers and steers were considered in their study. As was expected, TT cattle were more likely to grade Choice and Prime but also more likely to yield grade 3 and higher. Given genotype testing costs of around $35 per sample, DeVuyst et al. (2007) conclude that genotyping is close to breaking even depending on market prices and other factors.

Lusk (2007) analyzed the economic impact of two SNPs on the leptin gene. He analyzed feedlot performance data for 1,668 commercial cattle. He found use of genetic information potentially adds $23/head for steers and $28/head for heifers if producers optimally select and feed cattle based on genotype. Upper limits of $60/head were realized if animals were optimally marketed based on genetic traits. Lusk (2007) concluded that the ultimate gainers from increasing information content of leptin gene characteristics will be owners of fixed assets, such as animal genetic stock, owners of genotyping technology, and perhaps consumers who are able to obtain meat products better matching tastes and preferences.

While the three available economic studies on leptin genotyping show positive returns to genotyping, there are still many unanswered questions. Optimal days on feed varied little when the producer possessed or did not possess genotypic information. Also, unaddressed is how these differences are affected by recent high feed prices. In fact, all three studies ignore potential differences in feed intake and feed efficiency by genotype. The testing of the relevant biological and economic hypotheses would require a feeding trial through the finishing period and collection of relevant carcass traits post-slaughter. These data have not yet been collected.

[4]Some confusion is possible regarding yield. USDA uses yield grades 1 through 5 to indicate leanness. High-yielding carcasses are given low USDA yield grade scores, where the fattest carcasses are given a USDA yield grade 5.

Table 1. Summary of Leptin Genetics Research.

Author(s) / SNP location	Result (Significance)
Bierman et al. 2004 Exon 2 SNP 305	T allele decreases cutability (p < 0.10), marbling (p < 0.05) and increases % Choice (p < 0.10)
Buchanan et al. 2002 Exon 2 SNP 305	T allele increases fat deposition (p ≤ 0.023) T allele more frequent in Angus than in Charolais and Simmental (p < 0.05)
Buchanan et al. 2003 Exon 2 SNP 305	TT Holstein cows milk 1.5 kg/d more than CC cows (p = 0.04)
DeVuyst et al. 2007 Exon 2 SNP 305	T allele in fed cattle reduces ribeye area (p < 0.05) TT cattle fatter than CC (p < 0.05), heavier than CC (p < 0.10) and $14-$48/hd more profitable than CT and CC cattle (NA*)
Kononoff et al. 2005 Exon 2 SNP 305	T allele associated with higher yield grade scores (p ≤ 0.06) and not associated with carcass weights (p = 0.03) TT cattle have higher quality grades than CT (NA) No difference between TT and CC quality grade and yield grade (NA)
Lambert & DeVuyst 2006 Exon 2 SNP 305	CC cattle $6-$8 more profitable than CT (NA) CC cattle $13-$31 more profitable than TT (NA)
Larson et al. 2005 Exon 2 SNP 305	TT cattle have thicker backfat than CT or CC (p = 0.04) TT cattle have smaller ribeye than CT or CC (p = 0.02) TT cattle have higher yield grade scores than CC (p = 0.03) No differences in average daily gain by genotype (NA)
Larson et al. 2006 Exon 2 SNP 305	CC cattle have larger ribeye than CT or TT (p < 0.001) TT cattle have higher yield grade scores than CT or CC (p < 0.001) TT cattle have higher marbling scores than CC or CT (p = 0.01)
Lusk 2007 Exon 2 SNP 305 + USASMS2	Difference cattle value varies by genotype by as much as $60/hd (NA)
Nkrumah et al. 2005 USASMS2	T allele increases backfat thickness (p = 0.001), marbling score (p = 0.01), dry matter intake (p = 0.001), final live weight (p = 0.1), dry matter intake (p = 0.001) T allele does not affect feed efficiency (p =0.81), ribeye area (p = 0.40)
Nkrumah et al. 2005 USASMS3	G allele increases final live weight (p = 0.04), backfat thickness (p = 0.04) G allele does not affect feed efficiency (p = 0.29), marbling score (p = 0.36), or ribeye area (p = 0.64)

*Not available or reported.

Markets and Genetic Information

The three studies quantified the relationship of genotype with feedlot performance and carcass quality and value. All three found an economic value to the genetic information. While management strategies did not always differ by genotype,[5] genotype did affect the value of the finished animals. Consequently, if genetic information could be collected at low cost, producers may pay more for feeder cattle with preferred genetics. As DeVuyst et al. (2007) demonstrate, the benefits of individual animal testing are, at best, about equal to the costs. Can the benefits be realized by reducing testing costs? One possible solution may be to reduce the fixed cost of genetic testing through selective breeding programs. Thallman and Hruska (2004) thus argue for using DNA markers to assist breeding stock selection. Selection and mating criteria may include phenotype, EPDs, and known DNA markers. Mating of cattle with known genotype would result in a predictable distribution of calf genotypes from a cow-calf producer. Further, if both dam and sire are homozygous (CC or TT, for example), the genotype of offspring is predetermined. As each cow is expected to wean multiple calves over her life and each bull may sire hundreds or even thousands of calves, the fixed costs of genotyping just the breeding stock would be spread over numerous calves. If calves from these matings are retained for breeding purposes, the costs of genotyping could be spread over generations of cattle.

Utilizing genetic information throughout the supply-demand chain and across generations of cattle requires that mechanisms be developed to reliably collect, store, and transmit information. For breeding stock, breed registries have been established to relay information. Pedigree, EPDs and progeny data are usually maintained in these registries. Adding relevant genotypic information should be low cost (after the cost of collecting the DNA data), though occasional verification of genetic data will be necessary given common mating practices (e.g., multiple bulls in a pasture or lot) and errors. Transmission of data beyond the cow-calf operation becomes more difficult. Consider data that may be relayed to consumers, such as a genetic index measuring tenderness. These data must be maintained and relayed for individual animals from cow-calf producer to the supermarket shelf or restaurant menu. Current data collection and maintenance methods are not established, at least on an industry level, to allow for that level of identity preservation. Read-write identification tags could aid in these collection, maintenance and transmission efforts. The costs of these information services and who pays for these services have not yet been determined. What can be stated with confidence is that, if there is significant value in collecting, maintaining and transmitting genotypic information, mechanisms will eventually be developed to capture that value.

In figure 1, we show total producer revenue as a function of genotypic information. Concavity of the total revenue function implies diminishing marginal value as information increases. If, for example, there are 100 SNPs affecting marbling, the value of the additional information contained in knowledge of the last SNP is likely relatively small, especially since each SNP explains a very small percentage of biological variability. The total cost of collecting genotypic information has a high fixed cost associated with collecting a DNA sample and preparing it for

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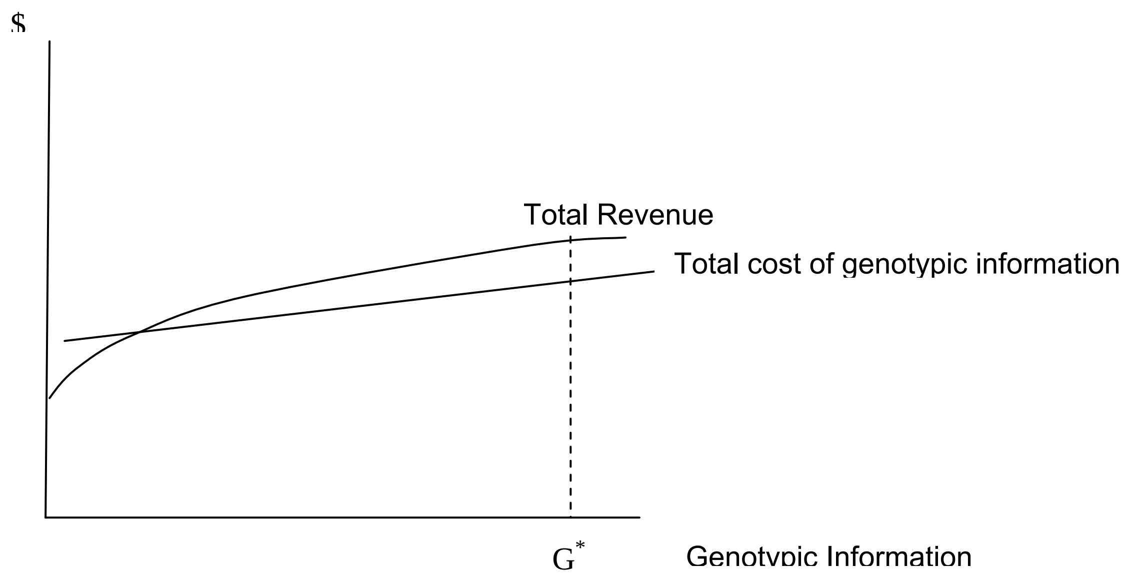
[5]None of the studies were based on feeding trials. Thus, the relationship between genotype, feed intake, and metabolism remain unanswered.

analysis. For illustration, marginal costs of genotypic information are assumed constant in figure 1. With high-throughput DNA analysis, assessing additional SNPs does not require additional analysis time. Hundreds of SNPs can be evaluated simultaneously for each sample.

Figure 1. Total revenue vs. total costs of genotypic information.



A profit-maximizing producer would choose to maximize the difference between total benefits and total costs. In figure 1, this occurs at G^*. At this time, however, additional research is necessary to quantify the benefits and costs of genotyping. DeVuyst et al. (2007) report the value of a single SNP ranges from about $0.01 to over $48 per head, depending on how the information was utilized. Lusk (2007) reports that knowledge of two SNPs adds between $22 and $66 in additional revenue per head. The costs of acquiring genotypic information are also difficult to estimate. A panel of leptin markers costs about $37.50 (Lusk 2007), but that does not include the costs of collecting the DNA sample.

The final observation depends upon the organization of the cattle industry. The expected value of the information initially represents unclaimed rents. Rent distribution will depend upon the relative market power of market participants. Research has identified the potential for increasing market power by livestock processors resulting in part from increasing concentration (Schroeter 1988; Sexton 2000). Reliance by processors on production contracts might result in a greater share of the rents accruing to processors. Conversely, were significant numbers of animals to enter the market without contracts, sufficient incentives must be provided to suppliers to provide the optimal mix of animals with differing levels of genotypic information. Incentives would require at least some sharing of the potential rents between buyers and sellers in the market. Further, given that collection and maintenance of genomic information is costly, the costs of producing animals with known genetic markers are likely higher than for animals with unknown genetic markers. There will likely be a need to share rents between economic agents in the livestock production sector in order to provide incentives to all participants to collect and maintain the genetic data.

Additional research is necessary to quantify demands for different information sets, a necessary component to determine the expected value of genetic information underlying figure 1. Industry studies should also project rent distribution and possibly contract design to ensure sufficient incentives exist for suppliers to provide the optimal levels of genetic information collected.

We have discussed how genetic markers affect producers and processors. There are also, however, consumer effects. Beef demand is affected by prices and quality attributes of competing meats. If genetic information can be used to increase the quality and consistency of beef products, there may be an outward shift in consumer demand for beef (Hennessy, Miranowski, and Babcock 2004). More genetic markers for marbling and tenderness are becoming known, though a large number of genes are involved in determining these traits. MMI Genomics utilizes 128 SNPs to predict marbling and 11 SNPs for tenderness (Ishmael 2007). Consumer willingness to pay for higher quality and more consistent quality meat will determine the economic viability of testing large numbers of markers. Until lower cost methods of testing for these markers are available and markets develop to reward desirable genomic structure, rent capture associated with this genetic information will be elusive.

Promising Genetic Research and Economics

On-going biological research programs, both privately and publicly funded, are identifying SNPs and their biological impact on livestock. Hocquette et al. (2007) report that an EU-funded project to identify SNPs in cattle genes has found 710 SNPs in 209 genes. Hocquette et al. (2007) also list commercial testing services currently being offered for marbling, tenderness, milk fat yield, milk yield, feed efficiency and other beef and dairy animal traits. These tests are in addition to the MMI tests for marbling (89 markers), tenderness (11 markers) and daily gain (92 markers) (Ishmael 2007). Economists have considered few of these markers and their impact on profitability for seed stock producers, cow-calf producers, feedlot operators, meat processors and retailers.

Although tenderness and other desirable attributes have been the subject of several experimental economics studies (e.g., Melton, Huffman, and Shogren 1996; Lusk et al. 2001), two important points are yet to be addressed. The first point is the effectiveness of the link between profitability in the various steps of production and consumer demand. If consumers are willing to pay for desirable attributes, how will profits be divided among supply chain agents? The second point concerns signaling of product quality (e.g., tenderness) to the consumer. Testing of individual carcasses and cuts is unlikely to prove profitable. However, DNA-based information might provide evidence of likely tenderness and other desirable attributes. Since genomic testing of individual animals is currently cost prohibitive, testing for various markers may best occur at the seed stock level. If genomic information relating to end product quality can be credibly relayed from seed stock producers to cow-calf producers to feedlot operators to processors to retailers to consumers, markets may reward testing for these markers and to credibly relay the production-related genomic information among agents in the supply chain.

Scientists are quickly unraveling the genetic code of animals and plants. Applied scientists are finding important pathways between genotype and crop and livestock growth and metabolism. Economists have long used both traditional (e.g., Babcock 1990) and more innovative methods (e.g., Hennessey et al. 2004) to assess the expected value of information embedded in the biological relationships. Vast research needs exist. Much still needs to be learned about how various SNPs influence economically-relevant biology. Collaboration among animal scientists and economists is essential to realize the economic benefits embedded in an animal's genes. In order to realize those benefits, economists and their biological sciences colleagues must develop an improved understanding of

- The relationships between genetic markers and cattle performance factors (i.e., feed intake and feed efficiency);
- The relationships between genetic markers and yield grade factors;
- The relationship between genetic markers and quality grade (i.e., marbling);
- The relationship between genetic markers, desirable consumer attributes (e.g., tenderness, flavor, texture, and juiciness) and consumer willingness-to-pay;
- How markers contribute to seed-stock producers', cow-calf producers', feedlot operators' and packers' profitability; and
- The costs of obtaining genotypic information and credibly relaying that information through the supply-demand chain.

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