Planting Dry Beans on Base Acreage: Economic Tradeoffs

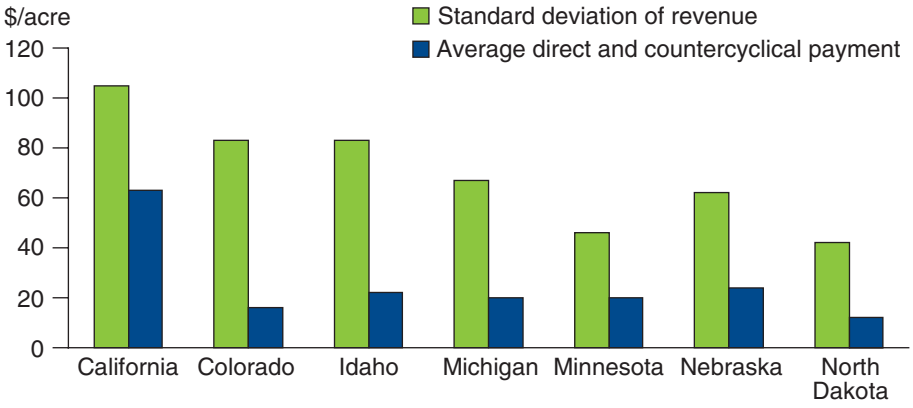
In order to illustrate some of the economic tradeoffs in planting fruit and vegetables on base acreage, we use farm- and market-level analyses in the case of dry bean production. Dry beans are grown commercially in many locations, frequently on farms with base acreage. Almost 1.2 million acres of dry beans were planted on farms with certified acreage in 2003 (table 4).

Dry beans provide an example of the potential market adjustments that could result from relaxed planting restrictions. Dry beans are unique for two reasons: (1) they have more area devoted to them than area for any other fruit and vegetables, and (2) many producers could easily expand production because they already have the experience and equipment needed to produce dry beans.

The tradeoffs between dry bean revenue and program payments vary considerably from one region to the next (fig. 12). Producers are forgoing payments that offset between 25 percent and 47 percent of the variation in revenue from dry beans. Farmers with a planting history in North Dakota are giving up about $11 per acre in payments to plant fruit and vegetables, such as dry beans. If payments were not reduced when dry bean plantings increased, how much would these farmers raise production? Would producers who do not have a history of planting fruit and vegetables elect to produce dry beans or some other crop? We now look at tradeoffs for a farm in Cass County, ND, and then consider the potential overall market adjustments if dry bean acreage expanded nationally.

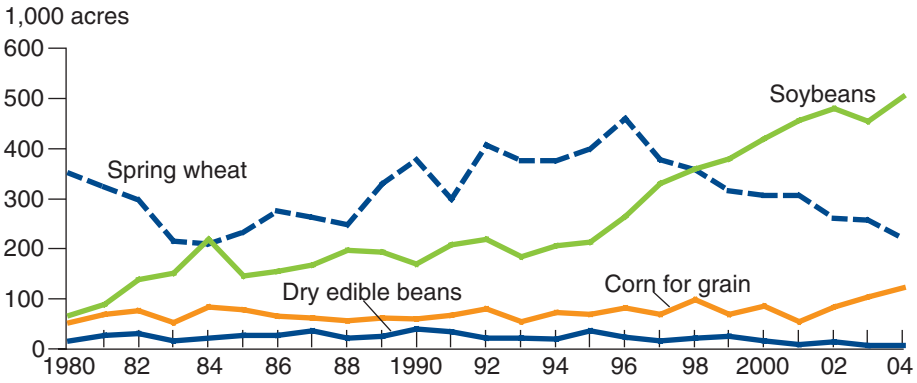
Our analysis of overall market effects was complicated by the lack of comprehensive and consistent data, the large number of commodities, and the limited estimates of relevant economic parameters. We use breakeven analysis and a simple market equilibrium simulation model to illustrate the basic economic tradeoffs. While a more extensive simulation would be informative, a comprehensive model that includes fruit and vegetable markets is not available. Building such a model would have been beyond the scope of this analysis.

Figure 12
Dry beans: Variation in revenue per acre compared with direct and countercyclical payments



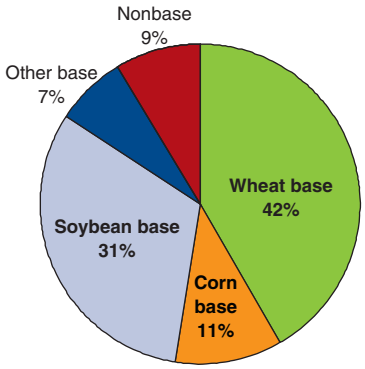
Source: Compiled by the Economic Research Service, USDA, from data from the Farm Service Agency and the National Agricultural Statistics Service, both USDA.

Figure 13
Area planted by crop, Cass County, ND



Source: National Agricultural Statistics Service, USDA.

Figure 14
Base acreage as a share of total cropland, Cass County, ND



Source: Compiled by the Economic Research Service, USDA, from Farm Service Agency, USDA, data.

Farm-Level Analysis of Planting Restrictions: Cass County, ND

Analyzing farm-level tradeoffs between producing program crops and fruit and vegetables illustrates the potential impacts of eliminating planting restrictions. We selected Cass County, ND, as a representative county for a case study. Cass County is located in the Red River Valley in eastern North Dakota. Spring wheat was historically the dominant crop, but it has been overtaken by soybeans in recent years (fig. 13). Dry edible beans represent an alternative to program crops in Cass County. Base acreage accounts for about 91 percent of cropland in Cass County (fig.14). Wheat accounts for the largest share of base acreage, followed by soybeans and corn. Other base acreage (7 percent of total cropland) consists largely of barley and sunflowers.

Breakeven Analysis

One way to analyze cropping alternatives is with breakeven analysis, which identifies prices for which the alternative practices produce identical net returns. We are interested in identifying price relationships that would induce a producer to shift acreage out of a program crop and into dry edible beans. This analysis builds on an earlier study by Westcott and Zepp, conducted when the current planting restrictions were initially considered. Although dry edible beans offer a high expected market return, they do not qualify for direct and countercyclical payments (or payments under the marketing loan program). The availability of direct and countercyclical payments can make program crops (or any permitted alternative) more attractive than a fruit and vegetable (table 5). In deciding whether or not to plant dry beans on base acreage, a

farmer would consider if dry edible beans would be planted on all or only part of his or her base acreage and if the farm has a history of planting fruit and vegetables. For a farmer without history, all of the direct and countercyclical payments likely would be forfeited if any base acreage were planted to dry edible beans (see "Illustration of Payment Reductions When Fruit and Vegetables Are Planted on Base Acreage," pp. 4-8). Thus, under current program rules, these producers are unlikely to plant dry edible beans on base acreage.

A farm with a history of planting fruit and vegetables would face different constraints. In this case, the farmer must give up only the payments associated with the base acreage used to produce dry edible beans. Breakeven prices for dry edible beans compared with prices for corn, soybeans, and spring wheat are shown in figure 15 for a farm with a planting history. If

Table 5
Components of expected revenue per acre, Cass County, ND

Component	Unit	Spring wheat	Soybeans	Corn	Dry edible beans
Program parameters:[1]					
Loan rate	$/bu	2.75	5.00	1.95	NA
Direct payment rate	$/bu	.52	.44	.28	NA
Target price	$/bu	3.92	5.80	2.63	NA
Direct payment yield	bu/acre	35.1	29.1	80.3	NA
Countercyclical payment yield	bu/acre	37.9	32.4	94.7	NA
Market parameters:					
Expected yield per acre planted[2]	bu/acre; lbs/acre for dry beans	46	33	122.9	1,479
Expected price[3]	$/bu; $/cwt for dry beans	3.27	5.50	2.06	19.00
Variable cost	$/acre	87.70	73.10	172.30	130.10
Expected per acre revenue:					
From market sources[4]	$/acre	62.72	108.40	80.87	150.91
From direct and countercyclical payment[5]	$/acre	19.70	10.88	42.45	NA
From market revenue plus payments	$/acre	82.42	119.28	123.33	150.91

NA = Not applicable.

[1]Based on Farm Service Agency data for Cass County, ND.

[2]Planted yields, rather than harvested yields, are used to capture the impacts of abandoned acres on crop revenue.

[3]For program crops (spring wheat, soybeans, and corn), expected prices for 2005 are based on regressions of the State-average marketing-year average price on harvest-period futures, quoted at planting time. For dry edible beans, the expected price is based on a regression of State-average price on planting-period (April) price received and change in yield for a weighted average of all dry edible beans.

[4]Ignores covariance of price and yield.

[5]Assumes that land planted to the program crop is base for that crop.

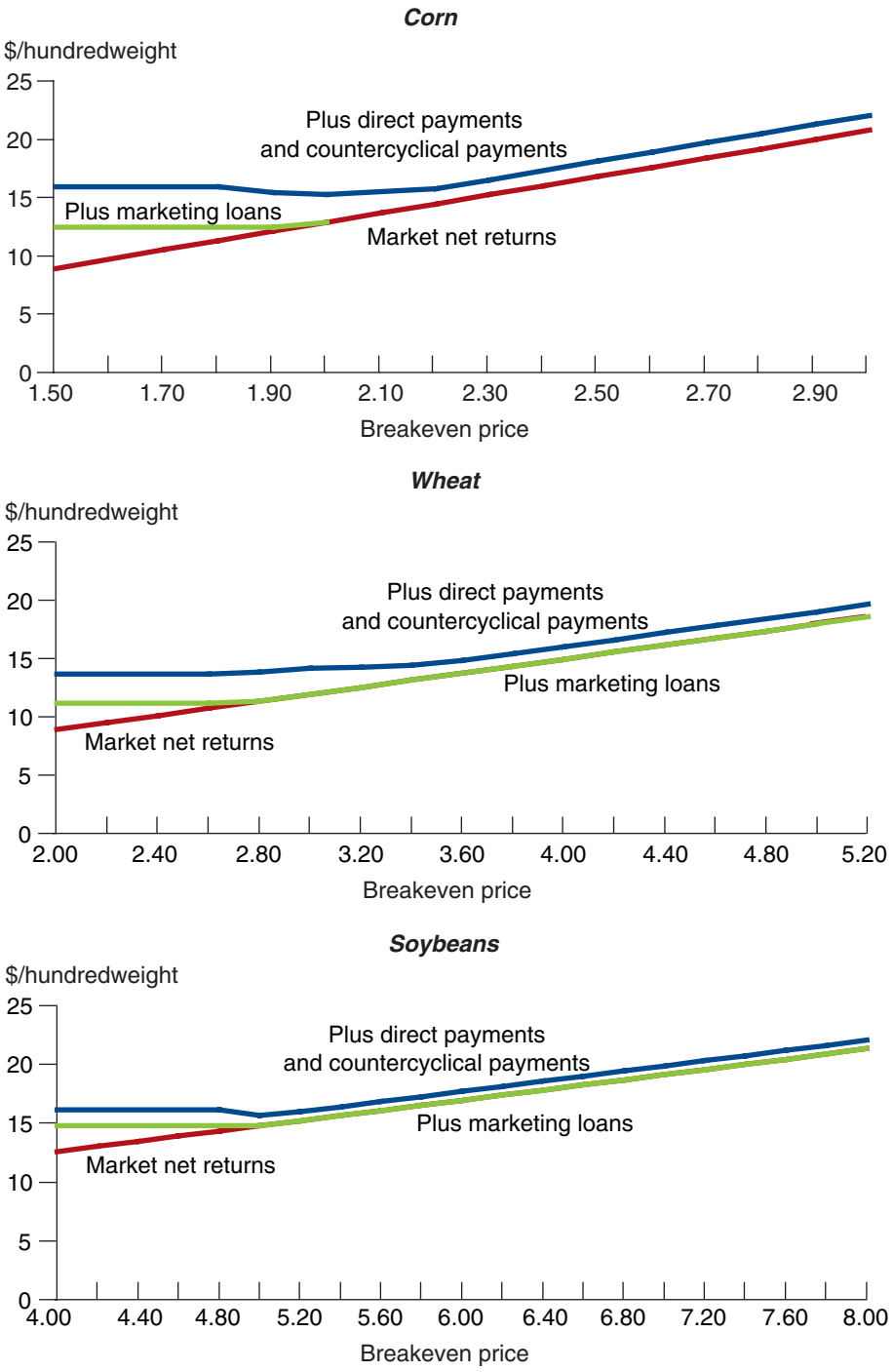
Sources: Calculations from Farm Service Agency, USDA; North Dakota State University Extension Service; National Agricultural Statistics Service, USDA; and Economic Research Service, USDA.

planting restrictions were relaxed, producers would compare market revenue for corn, soybeans, and spring wheat with market revenue for dry beans.

For any given price expectation for corn, soybeans, or spring wheat, expected dry bean prices above the breakeven line favor production of dry beans. An estimated expected price of $19/hundredweight (cwt) for dry edible beans

Figure 15

Breakeven price of dry beans compared with corn, soybeans, and wheat



Source: Compiled by the Economic Research Service, USDA, from Farm Service Agency, USDA, data.

suggests that dry edible beans would displace the three program crops, which is a curious result given the small share of dry edible beans in actual harvested acreage. Several interpretations are possible. First, the crop budgets used in this analysis might not represent actual cost differences experienced by producers.[22] Second, agronomic or rotation factors or perceptions of risk may prevent large acreage shifts into dry edible beans. For example, dry beans are subject to different price and yield risks than are program crops. Third, if producers are unable (for rotational or other reasons) to shift entirely into dry edible beans, the loss of program payments may provide a strong disincentive. Fourth, the farmer may not have a marketing contract.

[22]The results are consistent with 2005 crop budgets prepared by Swenson and Haugen, which show relatively high returns for dry edible beans in the southern Red River Valley.

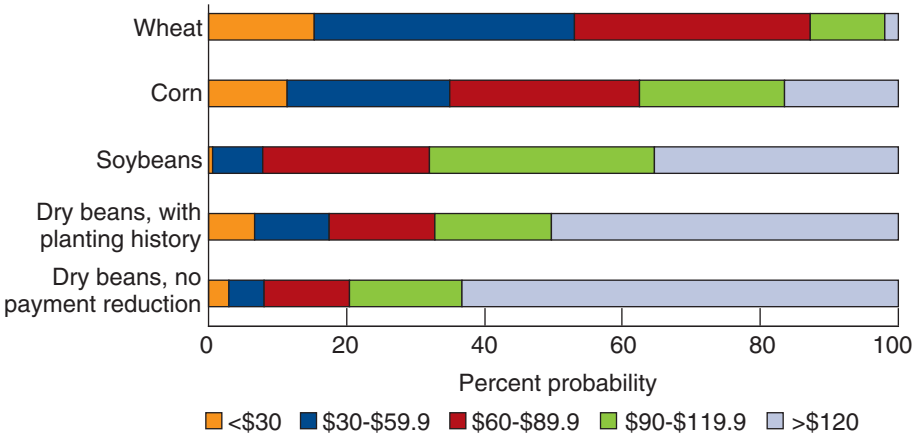
Farm-Level Simulations

Farm-level simulations extend breakeven analysis to account for correlations between variables. This approach provides a more comprehensive way to evaluate cropping choices by taking into account variation in prices and yields. We extended our analysis for Cass County by treating prices and yields as random variables in order to illustrate the impacts of risk in a farmer's decisionmaking. We developed the analysis from the perspective of a farmer who is considering cropping alternatives in April. Sources of risk include expected yields, local (State) cash prices, and national average prices (used in calculating countercyclical payments).[23]

[23]Distributions of the random variables (i.e., standard deviations and correlations) are consistent with data from the last 24 years. The simulations involve 1,000 random draws from a multivariate normal distribution. Variances and covariances were derived from regression residuals.

Figure 16 summarizes the results from farm-level simulations. Net return distributions are displayed as horizontal bars. For individual crops, the bars show the probability of net returns (dollars/acre) falling within a given range, price, and yield risk. Dry beans have considerable upside potential (chance of high per acre returns) and moderate downside risk, even when direct and countercyclical payments must be forfeited. The top three bars compare program crops: soybeans, corn, and wheat. The distribution of net returns for soybeans is particularly interesting. Under current planting rules, the farm-level simulations indicate that soybeans exhibit less downside risk than dry edible beans do, which could be an important consideration in planting decisions. For a producer with a fruit and vegetable planting history, the additional risk of

Figure 16
Probability of net returns for dry beans and program crops falling within a given range, Cass County, ND



Source: Economic Research Service, USDA.

dry beans would have to be weighed, along with the chance of higher per acre returns, when considering whether to plant dry edible beans or soybeans.

Illustration of Market Adjustments

While farm-level analysis can illustrate the incentives to producers, it does not illustrate effects of planting restrictions, or their removal, at the national market level. The following example omits regional detail, but it does indicate the overall effects of eliminating current planting restrictions.

We focus again on dry edible beans. To quantify the effect of eliminating planting restrictions, we start with a two-way classification scheme for available cropland in the 18 States where dry edible beans are grown. First, land is divided between dry edible beans and a composite of grains, oilseeds, and other unrestricted crops. Second, land is divided between program participants and nonparticipants. This framework gives us a way to illustrate the market impacts on different types of producers: those who collect direct and countercyclical payments (and are subject to planting restrictions) and those who do not. Dry edible beans account for about 1.4 million acres nationally out of an estimated 218 million acres of available cropland in the 18 States (table 6).[24] Program participants control about 84 percent of dry bean acreage and 86 percent of acreage planted to other crops, excluding fruit and vegetables. Although per acre gross revenue is higher for dry edible beans than for other crops, dry edible beans account for only 0.8 percent of the combined market value of crops in the analysis.

To illustrate the effects of a policy change, we use information on acreage and gross returns in a simple model of market equilibrium (see box, "Modeling Market Impacts"). The model differentiates program participants from nonparticipants and derives supply functions (for dry edible beans and for a composite of unrestricted crops) for each group. If planting restrictions were eliminated, program participants would no longer lose direct and countercyclical payments when they grow dry edible beans. This change can be

Table 6
Acreage and market value of dry edible beans and other crops in 18 States where dry edible beans are produced

Crop	Program participant	Nonparticipant	Total	Market value	Average gross return
	----------*Million acres*----------			*Million dollars*	*$/acre*
Dry edible beans	1.18	0.23	1.41	430	305.8
Other[1]	186.39	30.68	217.07	56,677	261.1
Total	187.57	30.91	218.48	57,107	NA
			Shares		
Dry edible beans	.837	.163	1	.008	NA
Other	.859	.141	1	.992	NA

NA = Not applicable.
[1]Includes grains, oilseeds, hay, and other crops not subject to acreage restrictions.

Source: Authors' calculations based on acreage data from the 2002 Agricultural Census, 2003 National Agricultural Statistics Service, USDA, acreage reports, and 2003 Farm Service Agency, USDA, compliance reports. Average gross returns were derived from Table 9-23 in USDA-NASS Agricultural Statistics, 2004. These are multiplied by total acreages to obtain estimated market value.

[24]Cropland estimates are based on the 2002 Agricultural Census. Available cropland excludes land that is idled or planted to other fruit and vegetables. Land controlled by program participants (by crop) was obtained from USDA-FSA compliance reports. Land controlled by nonparticipants is calculated as a residual. The analysis is limited to 18 States for which USDA's National Agricultural Statistics Service reports dry bean production: California, Colorado, Idaho, Kansas, Michigan, Minnesota, Montana, Nebraska, New Mexico, New York, North Dakota, Oregon, South Dakota, Texas, Utah, Washington, Wisconsin, and Wyoming.

Modeling Market Impacts

To estimate the aggregate impact of eliminating planting restrictions, we use a simple model of market equilibrium for the 18 States where dry edible beans are produced. We calibrate supply and demand functions to reproduce the current equilibrium—specifically, national acreage and average market returns for two types of crops: dry edible beans and a composite of unrestricted crops. Supplies of both types are divided between program participants and nonparticipants. We shift the supply of dry edible beans by participants to reflect the elimination of planting restrictions and recalculate the market equilibrium for both crop types.

Acreage planted to dry edible beans (and other crops) depends on relative returns, but cropland is not perfectly substitutable across uses. We capture this variable with an elasticity of transformation, τ, reflecting the cost or difficulty of shifting cropland. Higher values of τ (in absolute terms) correspond to less difficulty in switching and translate into larger cross-price effects—making acreage more responsive to changes in relative returns.

We derive demand and supply functions from market data (acreage, gross returns per acre, and market value of production) and various elasticities. Let ε denote the overall elasticity of supply ($\varepsilon>0$) and τ the elasticity of transformation ($\tau>0$) between vegetables and other crops. These variables are related to direct and cross-price elasticities of supply as follows:

$$\varepsilon_{ii} = s_i\varepsilon - s_j\tau$$

$$\varepsilon_{ij} = s_j(\varepsilon + \tau)$$

where ε_{ii} and ε_{ij} are direct and cross-price elasticities and s_i is the share of crop i in total market value ($s_i + s_j = 1$). The relative magnitude of ε and τ governs the size of direct and cross-price effects in the model. Large values of τ (in absolute terms) signify easier transformation of land from other crops to dry edible beans or vice versa. Parameter assumptions are shown in the table.

The figure provides an overview of market effects.* In the upper panel, supply of dry edible beans (acreage) is divided between program participants and nonparticipants. When planting restrictions are eliminated, participant supply of dry edible beans shifts to the right, which increases total supply of dry edible beans, thus lowering the price (average gross return per acre) for both participants and nonparticipants and causing nonparticipants to reduce acreage.

The lower panel shows the supply of other crops (acreage), which is also divided between program participants and nonparticipants. The participants' supply function shifts to the left, causing an overall reduction in supply of other crops, which leads to a modest price increase (average gross return per acre). Acreage planted to other crops falls for program participants (as the shift in the supply curve dominates the movement along the curve) and rises for nonparticipants, reflecting only a movement along the supply curve.

*Full details are available from the authors. The figure provides a simplified view of market equilibrium. Supplies in the analysis are jointly determined by gross returns per acre for both types of crops (dry edible beans and other crops)—something that is hard to convey graphically.

Parameter assumptions for aggregate analysis[1]

Parameter	Base-case value
Elasticity of transformation, τ	-5
Overall elasticity of supply	.1
Demand elasticity for dry beans	-.4
Demand elasticity for other crops	-.4
Average DCP payment ($/acre)	19.3

[1]Elasticities assumptions are educated guesses by the authors.

Supply shifts from eliminating planting restrictions

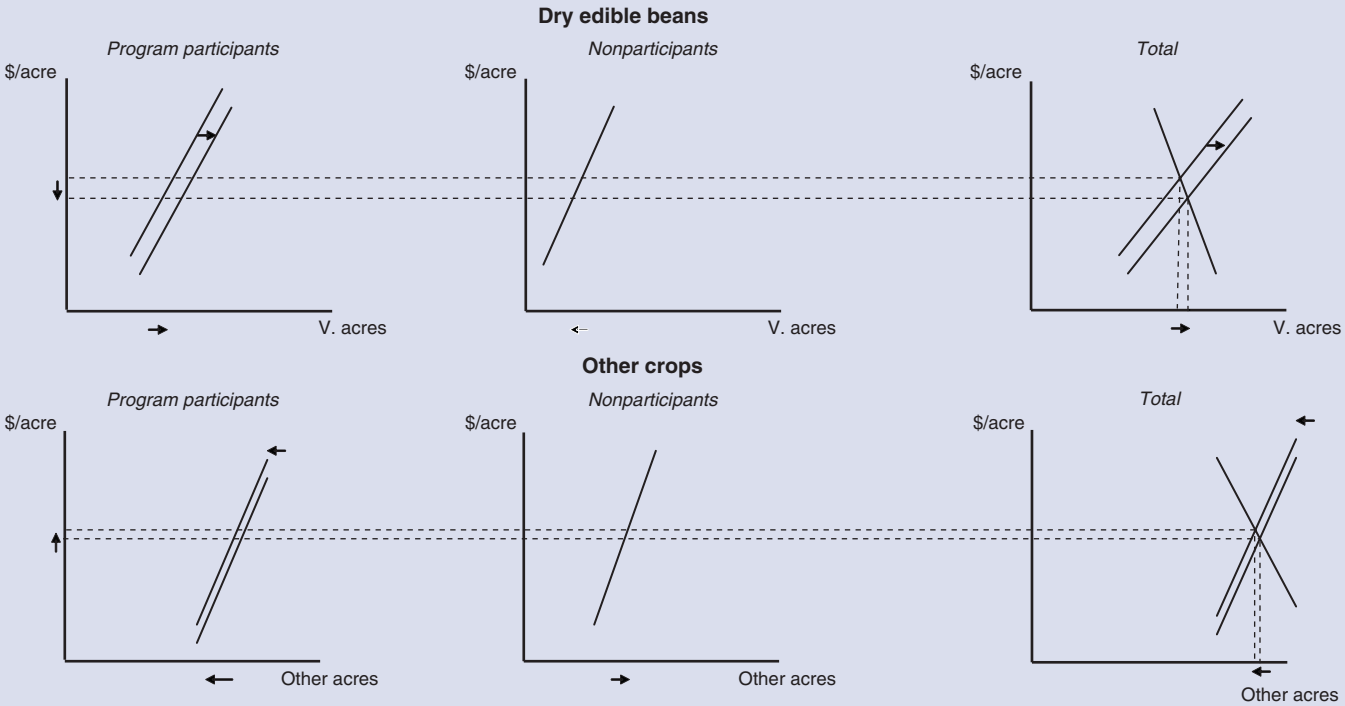


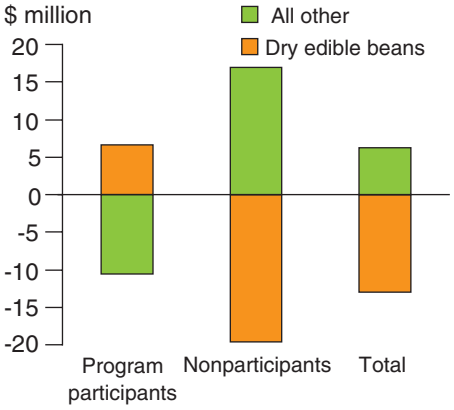
Table 7
Market impacts of eliminating planting restrictions for dry edible beans, 18 States

Item	Program participants	Nonparticipants	Total
		1,000 acres	
Change in:			
Acreage—			
Dry edible beans	83 (41 to 124)[1]	-56 (-88 to -24)	27 (14 to 41)
Other	-92 (-41 to -146)	56 (24 to 89)	-36 (-13 to -61)
		$ million	
Change in:			
Revenue—			
Dry edible beans	7 (-5 to 19)	-20 (-29 to -10)	-13 (-18 to -8)
Other	-11 (-24 to 13)	17 (8 to 29)	6 (1 to 33)
Total	-4 (-13 to 23)	-3 (-5 to 1)	-7 (-17 to 24)

[1]Numbers in parentheses indicate a range of market impacts for +/-50 percent changes in four critical parameters—the overall supply elasticity, transformation elasticity, and demand eslasticities for dry beans and other crops—in various permutations.

Source: Economic Research Service, USDA.

Figure 17
Change in market revenue for dry edible beans and other crops with planting restrictions eliminated



Source: Economic Research Service, USDA.

represented as a shift in the supply of dry edible beans by program participants. We assume that growers allocate land between dry edible beans and other crops, while recognizing that cropland is not perfectly substitutable across uses. As program participants expand their supply of dry edible beans, they simultaneously reduce their acreage of other crops. These supply shifts induce changes in market equilibrium, altering returns for both participants and nonparticipants.

Under full planting flexibility, program participants would expand dry edible bean plantings by about 83,000 acres, nonparticipants would reduce dry edible bean plantings, leaving a net increase of about 27,000 acres (table 7), and gross returns per acre for dry edible beans decline by about 4.9 percent. Program participants would reduce plantings of other crops, nonparticipants would increase plantings, total acreage for other crops would decline slightly, and gross returns per acre would be virtually unchanged (i.e., an increase of 0.03 percent).

If planting restrictions were eliminated, changes in revenue for both groups of producers would be offset, leaving small net impacts on total revenue (fig. 17).[25] Total revenue would decline by 0.01 percent for program

[25]Program participants in States not included in the 18 dry edible bean States used for this analysis would also be affected by any price changes for other crops.

participants and by 0.03 percent for nonparticipants. If program participants are forgoing direct and countercyclical payments under current program rules, they would retain these payments with elimination of planting restrictions. The net change in revenue would actually be negative for program participants, which is counterintuitive because the end of restrictions means that participants no longer lose government payments when they grow dry edible beans. The reason is that, with the end of restrictions, dry bean plantings would increase and gross returns fall. Program participants would increase plantings of the higher valued crop but would suffer the effects of a price decline for dry edible beans. Because participants already account for the vast majority of dry bean acreage, the price decline would substantially offset the revenue effects of new plantings.

These modeling results should be viewed as illustrative, given uncertainty about the underlying parameters. The estimated impacts depend on the assumptions of the model.[26] Nevertheless, several points emerge clearly from the illustration:

- Eliminating planting restrictions induces a shift in planting of dry edible beans. Dry bean acreage would expand for program participants and decline for nonparticipants.
- A net increase in dry bean acreage would push down the average return per acre. Plantings of other crops simultaneously would decline slightly, and prices would increase slightly.
- Program participants would not necessarily gain market revenue from the policy change. Price declines for dry beans would negate some of the potential gain from planting flexibility. The effect on nonparticipants would also be ambiguous, with losses in revenue from dry beans offset (in part) by gains in revenue from other crops.

[26]Results of sensitivity analysis—moving individual parameters up and down by 50 percent—support the view that, for dry edible beans, market impacts from relaxing planting restrictions are likely to be fairly modest (table 7).

Market Adjustments for Other Fruit and Vegetables

The previous section illustrates that, at the aggregate level, removing planting restrictions would lower dry edible bean revenues but have offsetting revenue impacts for program crops. Whether or not similar impacts would occur for other commodities that use less land and for which prices might be more sensitive to shifts in supply is not clear.

Rather than attempt to model market adjustments for other crops in a similar way, we discuss potential adjustments in qualitative terms. The preceding sections provide the basis for observations on barriers to entry, where land use shifts would be most significant, and how different categories of farmers would be affected.

As described earlier, entry into fruit and vegetable production frequently requires a detailed understanding of marketing arrangements and demand potential as well as specialized production requirements. For a producer of program crops, switching into production of processed vegetables is likely to require small startup costs. However, many of these products are sold under contractual agreements with processors, so potential for market expansion may be constrained by the ability to get a contract. Products for

the fresh market must meet stringent standards for taste and appearance. Meeting these standards requires unique production skills and access to labor for harvest to ensure product quality. If a producer can overcome these barriers, the magnitude of government payments may be small relative to the differences in expected net returns. FSA reports that many producers have already made this kind of switch when economic conditions warrant.

As we have seen, the importance of base acreage varies substantially across regions, which has implications for the types of commodities that might be affected by a policy change (fig. 10). If sufficient nonbase cropland is available, current planting restrictions are not a limiting factor for producers who want to expand production of fruit and vegetables. Base acreage is less important in regions where citrus crops are grown, for example, but are more important in areas where dry beans, processing vegetables, and potatoes are grown. The regional variation in average payment levels is a complicating factor. With the much higher average levels of payments per acre in such areas as California and southwest Georgia, removal of planting restrictions could induce increased production of some commodities, such as processing vegetables.

Impacts on farmers would also vary across the three general groups affected: program producers with a planting history, program producers with no planting history, and nonparticipants. For participants with history, startup costs would be lower because they have experience and may have made some of the necessary capital investments. These producers can expand under current rules by giving up payments on an acre-for-acre basis, and many have already done so. Producers without history face a high payment reduction with current rules, but they also face higher startup costs, making it difficult for us to draw firm conclusions about their likely response to a policy reform. For nonparticipants, changes in net returns would be driven by price changes resulting from acreage shifts by current program participants.

The analysis thus far indicates that removing planting restrictions for wild rice, fruit, and vegetables could result in changes in crop production and prices. As our market-level analysis for dry beans illustrates, market adjustments would not be limited to fruit and vegetables. Plantings of both fruit and vegetables and program crops would adjust to the new market environment. Based on experience with other policy reforms, we would expect much of the market adjustment to occur in the first couple of years (see box, “Lessons Learned From Policy Changes for Peanuts: Markets Adjust”). After some initial market adjustments, prices would be likely to stabilize near longrun equilibrium levels as producers gain experience in the new market environment.

Lessons Learned From Policy Changes for Peanuts: Markets Adjust

With passage of the 2002 Farm Act, the longstanding peanut marketing quota and price support system was replaced by the same set of supports available to producers of other program crops—with marketing loans, direct payments, and countercyclical payments, including planting flexibility. With the policy change, less competitive peanut producers reduced output, most likely by switching to other crops (Dohlman et al.). At the same time, production began to expand in areas where peanut yields tend to be higher—perhaps reflecting better growing conditions or management practices. This outcome is not entirely surprising because the old quota program constrained production and supported prices.

Removal of marketing restrictions for peanuts in 2002 resulted in measurable shifts in production and adjustments in prices. Although planted acreage remained stable in Alabama and Georgia and increased in Florida and South Carolina, acreage significantly fell in other peanut-producing States. In Virginia and Oklahoma, plantings fell about 55 percent between 2001 and 2003; in Texas, they fell 35 percent. The transition was marked by somewhat lower prices, reflecting the loss of quota price support. However, markets quickly found equilibrium production and price levels and, by 2003 and 2004, production patterns appeared to be responding to market incentives.

Regional and local shifts in fruit and vegetable production are likely as more efficient producers expand their market share at the expense of less efficient producers. Specialized production practices and marketing arrangements associated with many fruit and vegetable crops will mitigate the adjustments somewhat.