

Cropping Diversity And Farm Programs

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Abstract

Cropping diversity along the United States - Canada border of the Great Plains has not been dominated by either country. U.S. wheat policies impacted diversity in both countries through price and in the U.S. by acreage reduction programs. In the 1990s, cropping diversity increased in Canada and declined in the U.S. Since the 1996 U.S. Farm Bill, cropping diversity has increased in the U.S.

Introduction

Cropping diversity has been advocated for national strategic reasons, ecological benefits, managing farm-level risk, and agronomic management. Just and Schmitz, in an empirical study of the effect of national policies on cropping diversity, argue “economists have failed to pick up that gauntlet and investigate in a substantive way the effects of U. S. farm programs on diversification versus specialization” (p.303).

The absence of rigorous research on the policy-cropping diversity link has resulted in weakly founded observations in the popular media. A 1996 *Harper's Magazine* article displayed a vivid colored satellite image of the U.S.-Canada border along west-central Hill County, Montana (Manning). The image showed a solid mosaic of wheat fields to the south and unbroken prairie grassland to the north. Manning concluded “[the boundary] remained invisible until the 1930's, when federally subsidized wheat made it real. ...Politics created the border; subsequent differences in agricultural policy created the two landscapes” (p. 64).

This tiny snapshot of the Canada-U.S. border has unique local natural and institutional factors which distort general inferences. The Canadian side is nearly all land classes 5, 6, and 7

with severe to prohibitive cultivation limitations (Government of Canada). Near the border and south, the land is primarily land class 4 (Montana State University). Most of the Canadian land in this area is owned by the government of Alberta and leased for grazing (AAFRD-PLD). In contrast, the land in Hill County, Montana is generally owned by private farmers.

Valid comparisons requires similar conditions on each side of the border. Fortunately, this holds for large sections of the American-Canadian border in the Great Plains. The objective of this study is to investigate the influence of distinct national agricultural policies on cropping diversity north and south of the Canada-U.S. border in the Great Plains.

Cropping Diversity Background

The northern Great Plains is well suited to short cool season cereal grain production. In the mid 1970s, wheat alone accounted for 41% of the cropland used for crops in the border counties and census districts. Wheat, summer fallow, barley and oats accounted for over 90% of cropland (AAFRD; MA; SAF; USDA-NASS, 1999). Wheat is the dominant crop, but in the past 20 years, oilseed and pulse crops have increased.

Econometric acreage response models including farm programs (for example, Lee and Helmberger; Chembezi and Womak; Ahouissoussi, McIntosh and Wetzstein; and Clark and Klein) are common. Econometric models have limited suitability to study diversification because they exclude minor crops, and can not adequately predict impacts of changes that have very short representations in the data set. Econometric model results of crop diversification are both conceptually and empirically ambiguous (Just and Schmitz).

Methods

To measure cropping diversity, we use the Gini coefficient (GC). The zero-to-one scale GC is commonly used to measure income (Yotopoulos and Nugent) and industry (Hackbart and Anderson; Marshall) concentration. An equal distribution of income, output shares, or crops has as GC of zero. Concentration in only one crop has a GC of one.

Figure 1 illustrates the derivation of the GC. The cumulative percent of cropland area is plotted along the cumulative percent of crops, sorted from lowest to highest land area. The straight line OO' indicates a uniform distribution. The curved line OO' is a hypothetical (Lorenz)

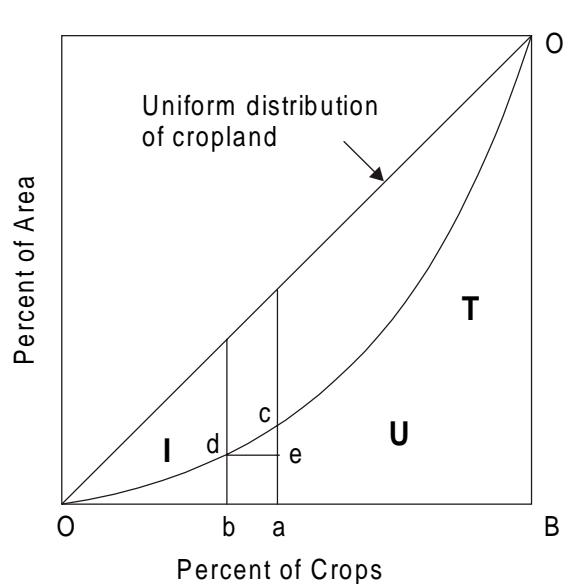


Figure 1. Gini Coefficient Derivation.

curve with a nonuniform distribution. Crops at the lower left of the non uniform distribution represent minor crops and crops along the upper right represent major crops. The area between the straight and curved OO' lines, I, indicates the equality of the distribution of land. Defining U to be the area below the curved OO' line and T to be the total area below the straight OO' line (area OBO'), the GC is defined as $GC = I/T$, or, $1-U/T$.

The minimum value is zero (equal distribution) and the maximum is one (all land in one crop).

For discrete intervals, the area of U in interval ab, U_{ab} , is approximated by:

$$(1) U_{ab} = \frac{1}{2}(ab)(bd + ac)$$

where the variables are as illustrated in Figure 1. By summing over the crop population percent

intervals, GC can be expressed as:

$$(2) GC = 1 - \frac{\sum_{i=1}^N (ab)(bd + ac)}{100^2}$$

where the variables are as defined in Figure 1, N is the total number of discrete crop population percent intervals, and units of measurement are cumulative percentages.

The GC trends for Canada and the U.S. are presented graphically. Graphic exposition can provide insights regarding structural or policy change that have been difficult to uncover with previous econometric analyses (Just and Schmitz). The graphic comparisons could suggest fruitful frameworks for future econometric research on cropping diversity and policy.

Data

The units of analysis are the aggregated crop acres of 19 border counties for the U.S., and eight border crop reporting districts for Canada, from the eastern slope of the Rocky Mountains of Montana-Alberta to western Minnesota-eastern Manitoba. Gini coefficients are calculated for each country using annual crop and summer fallow acreage data for 1975-1997.

Results and Discussion

Contrary to the inferences from the satellite image, Figure 2 reveals that neither Canada nor the U.S. has dominated cropping concentration during 1975-97. Each has been characterized by periods of more or less diversity. There were time periods when producers

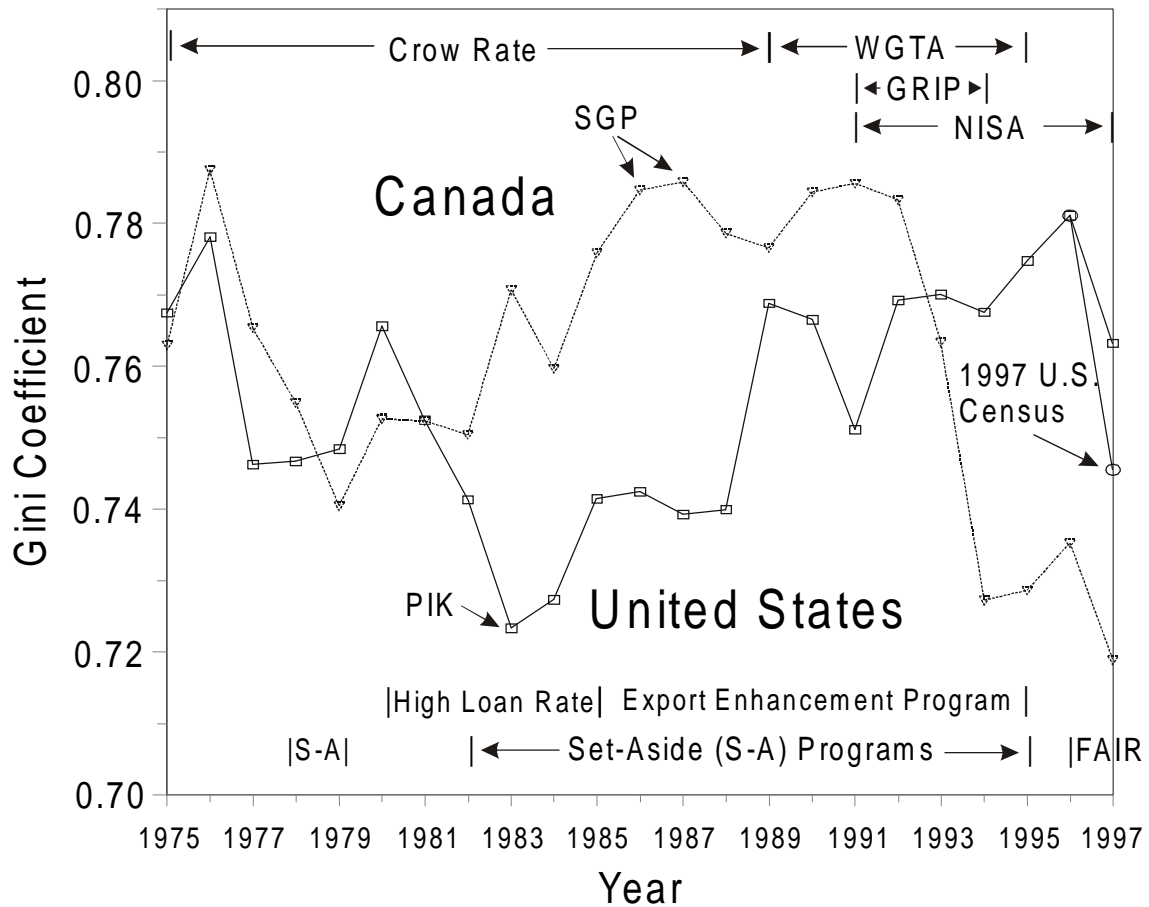


Figure 2. Gini Coefficients of U.S. and Canada border districts, 1975-1997.

in the U.S. and Canada followed common trends of diversity, and other times when trends diverged. Oilseed acreages -- sunflower, flaxseed and soybean in the U.S. and canola and flaxseed in Canada -- had a major role in diversity. Summer fallow acres, the second major land use in these regions in the mid 1970s, decreased 42% over the 23 years. The data are divided into four time periods associated with similar or divergent trends between Canada and the U.S. We discuss unique national policies (Gardner; Huff; Knutson, Penn and Flinchbaugh; Meilke and Warley) which might contribute to the diversity trends of each country during each of the four periods.

1975-81: Common Trends

Both American and Canadian northern Great Plains farmers shared a common pattern of diversity in the late 1970s (Figure 2). World market prices dominated national policy differences. Following the high grain prices of 1975 (Figure 3), growers boosted wheat plantings causing the 1976 GC peak. With the 1976-78 decline in wheat prices, the lower GC reflected

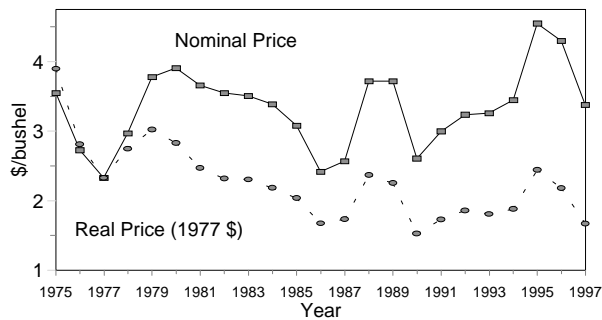


Figure 3. Nominal and Real Wheat Prices.

Wheat set-aside programs were in effect in the U.S. during 1978 and 1979, but no similar restrictions existed in Canada.

Canadian prairie farmers harvested constant wheat and cereal acreages over 1975-81, but increased canola, flaxseed and sunflower with a corresponding decline in summer fallow and oats. The Crow Rate lowered the cost of moving all major grains by rail. A two-price wheat system attempted to increase the domestic wheat price, but was discontinued. The Western Grains Stabilization Program (WGSP) had the objective of stabilizing prairie-wide net cash flow with producers and government contributing to the program.

movement toward greater diversity in both countries, especially Canada. Oilseeds, primarily canola, enjoyed high relative prices during this period and was the main Canadian diversification crop (Figure 4). After wheat prices rose in 1979 and 1980, both countries made the expected response toward wheat.

1982-88: U.S. Policies Boost Wheat in Canada

The 1980 U.S. Farm Bill increased the U.S. loan rate for wheat from \$2.50/bu in 1980 to \$3/bu in 1981 and to a high of \$3.65/bu in 1983. During this period market prices were often

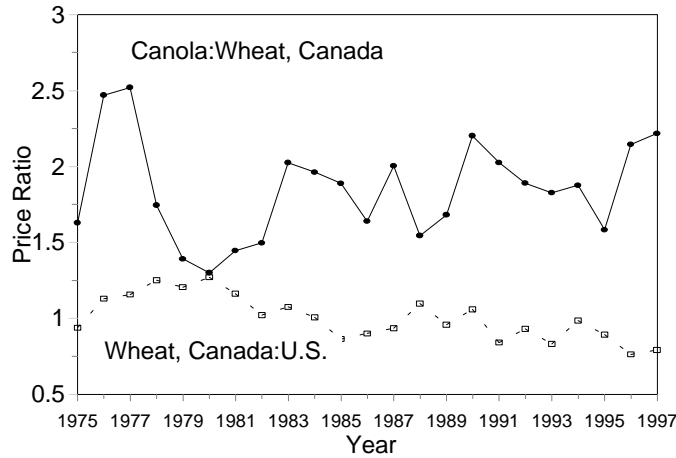


Figure 4. Relative Prices.

below the loan rate and U.S. wheat growers forfeited their grain to the Commodity Credit Corporation (CCC). The CCC held nearly one billion bushels of wheat by 1986. The U.S. loan rate provided a world market floor price for wheat and boosted wheat production in Canada and elsewhere. The GCs moved in opposite directions for Canada and the

U.S. after 1981. Canada's GC climbed toward increasing specialization -- more wheat -- through 1985, the last year of high U.S. loan rates, and for two years after. The loan rate was reduced nearly 40% in 1986, but the target price was maintained.

U.S. wheat programs during 1982-88 restricted wheat plantings to historical base acres net of any set-aside requirement for participating growers, reducing the GC for U.S. border counties. Sunflower, flaxseed, dry bean, corn and soybean acres increased in the U.S. during this period. The 1983 Payment in Kind (PIK) program removed 17.7 million acres of wheat from U.S. croplands (USDA-ERS). U.S. annual acreage reduction programs for wheat reached a record 27.5% by 1987 and 1988. In addition, the Conservation Reserve Program (CRP) started removing highly erodible land from production in 1986 under 10 year contracts. The U.S. Export

Enhancement Program (EEP) was initiated in 1985, averaging 415 million dollars per year for wheat during 1985 to 1988, and was 850 million dollars in 1988.

The deteriorating profitability of wheat contributed to the leveling off of the Canadian GC in 1987 and its downturn in 1988 (Figure 2). The Canadian price for hard red spring wheat fell below the U.S. spring wheat price by 1985 (Figure 4). Payments were made from Canada's WGSP, depleting program funds. Additional payments to all producers were instituted with the Special Grains Program (SGP) in 1986 and 1987, a short-term program.

1989-96: U.S. Specialization Rebounds, Canada Diversifies

The drought of 1988 reduced grain stocks and strengthened prices (Figure 3). Higher wheat prices and lower government set-aside rates contributed to a rapid rise in the U.S. border counties' GC (Figure 2). U.S. wheat set-aside rates decreased from 27.5% in 1988 to 10 % in 1989 and to zero in 1995. EEP wheat expenditures averaged over 600 million dollars per year over 1989-95, exceeding 850 million dollars in 1993 and approaching one billion dollars in 1994. No similar export subsidies existed in Canada. Wheat acreage along the U.S. border counties increased 22%, and summer fallow declined 30% during 1989-96.

Cropping concentration in Canada remained stable at a relatively high level during 1989-92, but decreased dramatically starting in 1993 because wheat declined 12%, summer fallow declined 10%, canola increased 83%, and special crops (dry peas, lentil, canary seed and mustard) increased 79% (Figure 2). The expansion of alternate crops also corresponded to technology improvements in crop cultivars, weed control, and planting equipment, that allowed these crops to be successfully grown in regions and on soils previously considered inappropriate.

Rail costs were increased in 1989 by the Western Grains Transportation Act (WGTA). The WGTA was discontinued in 1995 and producers began paying the full cost of grain transportation by rail, about an additional \$CDN 0.50/bu. In 1991, the WGSP was discontinued. The Gross Revenue Insurance Program (GRIP) was initiated as a short-term program (1991-1994) and the Net Income Stabilization Account (NISA) as a long-term program to stabilize and maintain farm incomes. Individual personal NISA accounts are to even out net income. The price of canola relative to wheat was high in the early 1990s, but below the previous high in 1976-77 (Figure 4).

1997-future: U.S. Policy Reform Increases Diversity ?

The 1996 U.S. Farm Bill (FAIR) decoupled subsidies from historical base acres of grains, permitting farmers to select crops without constraints. This policy, together with a softening in wheat prices in 1996 may have contributed to the increase in diversity for the U.S. border counties in 1997 after several years of increasing concentration (Figure 2). The decline in the U.S. GC was larger when Census of Agriculture data are used. The latter includes dry peas, canola, mustard, and lentils, unlike the USDA-NASS data. Plantings of these crops in the border counties increased from near zero in 1992 to nearly 200,000 acres in 1997, mostly in North Dakota (USDA, 1997; USDC). One year does not make a trend, but the appearance of alternative crops in North Dakota during an era of relatively strong wheat prices suggests the 1996 Farm Bill supports the movement toward cropping diversity in the northern plains.

Canadian border districts showed a similar increase in cropping diversity, although there was no parallel policy shift. The GC decline in 1997 was a continuation of the trend interrupted by the high wheat prices of 1995. Acreages of canola, dry peas, lentils, mustard and canary seed

were 15% greater in 1999 than in 1997, indicating these crops have become integral components of crop rotations in the prairies.

Conclusions

This analysis has shown that the claim cited in the introduction of greater policy-induced cropping concentration on the U.S. side of the border in the northern plains cannot be supported. Indeed, U.S. acreage restrictions appear to have reduced concentration in wheat in some periods. The GC for the American and Canadian northern plains border areas showed neither country dominated in cropping diversity throughout the 23 years, but cropping patterns were slightly more concentrated in the Canadian border districts for the first two-thirds of the period.

Wheat acres was the major determinant of the GC in both countries, however, its dominance declined in the 1990s. Peaks in the U.S. GC were due to high wheat acreage and the low in 1983 was the result of wheat land removed from production by the PIK program. In Canada, the GC trend was due to changes in wheat, fallow and canola acreage, but since 1992 mustard, lentils, dry peas and canary seed have played an increasingly important role.

Wheat base acreage restrictions and land idling programs appear to have caused U.S. northern plains farmers to lag their Canadian neighbors in switching to alternative crops like canola, mustard, peas, and lentils. Acreages of these alternative crops have increased following the 1996 Farm Bill, especially in the central and eastern border counties of North Dakota. Base acres also slowed the decline in summer fallow in the U.S. relative to Canada.

Canadian policy impacts are less easily detected because Canada has more often relied on decoupled income supports and transportation subsidies rather than on direct acreage restrictions

and price supports. The decoupling of subsidies in the 1996 U.S. Farm Bill provided a more similar policy environment in the U.S. and Canadian. Diversity trends in the two countries appear to be converging, but will require more years to confirm.

Developing econometric acreage response models for the U.S.-Canadian plains may be challenging because of recent discrete changes in technology as well as in national policies. The need for summer fallow in the Great Plains has been reduced by water conserving reduce tillage, more affordable chemical weed control, and drought tolerant crop cultivars. During the late 1990s, these technologies and more flexible policies have fostered diverse cropping systems that were not considered 10 or 15 years ago by northern plains farmers on both sides of the border.

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