Canadian Agri-Food Policy Institute (CAPI)
L'Institut canadien des politiques agro-alimentaires (ICPA)
960 Carling Avenue, CEF
Building 49, Room 318
Ottawa, Ontario
K1A 0C6

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Tel: (613) 759-1902 or (613) 715-5356 **E-mail: jacquesy@capi-icpa.ca**
beauchampp@capi-icpa.ca

Impact of Regulations and Programs on Value-Adding Activities by Farmers: the Case of Western Canadian and U.S. feed and Hog Industries

Simon Weseen, Shon Ferguson, Hartley Furtan and Richard Gray

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1) Introduction

In agriculture, the primary policy issue that governments in both Canada and the United States (U.S.) are concerned with is the level and variability of income for producers. As might be expected, the differing Canadian and U.S. approaches to income stabilization have impacted the value added industry in each country in different ways. In Canada, income stabilization programs create uncertainty thus encouraging primary agriculture to minimize risk. This results in reduced output, meaning that downstream value-added faces high input prices and therefore receives few if any flow-through benefits from the policy. In contrast, U.S. programs encourage primary production, which results in low input prices that can stimulate value-added development.

Free trade between Canada and the U.S. has meant that policies and programs in one country can impact value-added activities in the other and vise-versa. As a result, it is necessary to consider the effect of both Canadian and U.S. policies and programs when determining how value-added activities in each country are impacted.

The weaner and finishing hog industries in Canada[1] and the United States are potential examples of value added industries that have been impacted by differing agriculture policies between the two countries. U.S. price supports have encouraged corn production in that country, while U.S. and Canadian policy has caused Canadian barley producers to reduce feed production and exports. This results in the availability of cheap corn to U.S. livestock producers as a feed input for finishing Canadian weaner hogs. The U.S. is thus developing a value–adding industry on low cost corn that competes directly with the Canadian animal feeding industry.

At present, the welfare effects of these policies on animal feed and hog industries in both Canada and the U.S. are unknown. It is the objective of this paper to determine the extent to which agriculture policies in both countries are influencing value added in the hog sector and to illustrate the net welfare effects of the policies in each country.

The first step in this analysis is to provide a background of major policies and programs in Canada and the U.S., and to discuss their general impacts on agriculture. This is followed by a discussion of how the feed and hog value-added industries have been impacted by policy in each country. The case of hogs is then provided as an example, and an economic model is used to provide empirical estimates of the effect of U.S. corn policy on U.S. and Canadian hog markets. A general discussion of policy impacts on value-added for each country and conclusions follow.

[1] References to Canada in this paper primarily refer to the situation in western Canada, as opposed to Quebec and parts of Ontario.

2) Policies and Programs in Canada and the U.S.

Canada

The majority of farm programs in Canada have focused on the stabilization of income by transferring money to prairie farmers in times of need. The first major stabilization program was the Agriculture Stabilization Act of 1958, in which federal government funds were used to guarantee farmers per unit subsidies when individual commodity prices fell below 90 percent of a three-year moving average (later a five-year moving average). The Act covered a variety of grains and livestock commodities in all provinces and because the program guaranteed financial benefits to producers at no cost to themselves, participation was high. After the creation of the Western Grain Stabilization Act in 1976, a policy that focused on western grain production, support from the Agriculture Stabilization Act went primarily to farmers in eastern Canada (Schmitz et al 2002).

In 1976, the Western Grain Stabilization Act (WGSA) was introduced to alleviate western producer's concerns that CWB delivery quotas were preventing producers from receiving stabilization income on all of their production (delivery was required to receive payment). Under the WGSA, the Western Grain Stabilization Program (WGSP) was created. The WGSP, by design, focused on stabilizing income rather than prices and was expected to complement existing crop insurance programs. Payments were made under the program in 1978 and 1979 and then not again until the mid 1980s after it had been amended under Bill C-33 to eliminate the one year lag in payments and address the concern that increasing grain volumes were restricting pay-out amounts. High pay-outs leading to large deficits in the late 1980s in conjunction with unsatisfactory income protection for producers eventually caused the federal government to abandon the program (Gardner 2002).

In 1984, the Western Grain Transportation Act (WGTA or Crow Benefit) was introduced by the federal government as a means of providing affordable grain transportation rates to producers, while at the same time providing railways with a fair rate of return (i.e. variable costs plus a 20% return on fixed costs). Freight rates for producers were based on distance rather than actual shipping costs. Producers paid between 30% and 50% of the total freight bill, with the balance being paid directly to the railways by the federal government. By the early 1990s, annual subsidies under the WGTA were approximately $700 million, which amounted to approximately 70% of the total grain freight charge (Schmitz et al 2002).

In 1992, subsidies under the WGTA were reduced by 20% in an effort to reduce costs incurred by the federal government and to deal with complaints from the international community that the Crow Benefit was an export subsidy. In 1995, the benefit was eliminated altogether and was replaced with a freight rate cap that ensured railways with a profit equal to what they were earning under the subsidy. Producers were compensated $1.6 billion when the crow was eliminated but wound up with freight rates that were approximately twice as high as they had been under the WGTA (Schmitz et al 2002).

In 1991, under the newly created Farm Income Protection Act, the federal government introduced the Gross Revenue Insurance Program (GRIP) and the Net Income Stabilization Account (NISA). GRIP made crop-specific payments to producers when their level of production multiplied by the average market price fell below their average

yield multiplied by a “target” price. Like crop insurance, producers paid a premium for this coverage, however, approximately two-thirds of the premium was paid by the provincial and federal governments (Gardner, 2002). A mere 18 months after its implementation, the government of Saskatchewan stopped paying its portion of GRIP, suggesting that it was too expensive and was poorly designed (Schmitz et al 2002). Overall, the program had very little support from producers and was eliminated elsewhere in Canada by 1995 (Gardner 2002).

NISA was a voluntary program that allowed producers to deposit up to 2% of their sales into a savings account with the contribution being matched by the federal and provincial governments (~ 50/50 federal/provincial). Money in the NISA account was guaranteed to earn at least the prime interest rate, however long term deposits could earn up to an additional 3% paid equally by the provincial and federal governments. Money could be withdrawn from NISA when a producers farm income fell below 70% of their three-year moving average or when a producer’s income fell below $10,000, a value which was later increased to $20,000 in 1999 (Schmitz et al 2002).

In 1998, the federal government introduced a disaster relief program called Agricultural Income Disaster Assistance (AIDA). Under AIDA, when a producer’s net farm income fell below 70% of a three-year moving average, they were eligible for a pay-out. Payments under AIDA were the responsibility of both the federal and provincial governments with the federal government paying 60% and the provincial government paying 40%.

Upon its implementation there were several criticisms with AIDA. Producers were frustrated by the fact that payouts would be made to individuals who experienced only one year of low income, while those who had suffered through several years of low income immediately prior to 1998 were ineligible for support. In addition, the administration of AIDA was deemed to be cumbersome and expensive to operate. A final criticism of AIDA was that it discouraged trying to stabilize farm income through diversification because producers could only receive payment if total farm income fell below the three-year average. In 2001, AIDA was replaced by the Canadian Farm Income Program (CFIP), although the program remained very similar to AIDA.

The federal government’s most recent attempt at stabilizing farm income occurred through the introduction of the Canadian Agricultural Income Stabilization (CAIS) program, which replaced both NISA and AIDA in 2004. The CAIS program differs from previous income stabilization programs in that farm income triggers both support payments and producer contributions to the program, with producer’s contributions being proportional to their income (i.e. the lower the income level, the less a producer is required to contribute to be eligible for payment). Because CAIS is a relatively new program its performance is difficult to evaluate, however, initial analysis has shown that CAIS does a better job of decreasing income variability than its predecessors (Mussell and Martin 2005).

In addition to the support programs described above, federal and provincial governments in Canada offer crop insurance as a means of stabilizing farm income. Crop insurance programs started in 1960 in Manitoba and one year later in Saskatchewan. Initially coverage levels were only 60% of long-term average yields, however, this was later increased to 80%. At present, crop insurance can be purchased by producers in all

provinces, although participation is highest on the prairies, where incomes are more variable.

United States

Policy programs in the U.S. occur as part of Farm Bills that are created in the House of Representatives and approved as acts by the U.S. president every six or seven years. Several supports have been central to U.S. agricultural policy since the Agricultural Adjustment Act of 1970, including direct payments, loan programs, and deficiency payments. Access to some of these supports was initially contingent upon a producer's participation in set-aside programs and the Conservation Reserve Program (CRP), which required producers to take a percentage of their land out of production in order to reduce oversupply of specific crops. In recent Farm Bills, participation in set asides has not been a requirement to receive these payments from the government, however, the CRP still exists. Each of these supports is discussed briefly below.

Direct Payments (e.g. Production Flexibility Contracts (PFCs))

Direct payments are fixed payments made to producers that are independent of crops grown or levels of production. Payments are typically calculated by multiplying a commodity payment rate by a percentage of a farm's base acreage. An example of direct payments are PFCs which were introduced in the 1996 Farm Bill.

Loan Programs (e.g. Loan Deficiency Payments, Marketing Assistance Loans)

Loan programs in the U.S. pay producers a loan deficiency payment on certain crops when the market price falls below the loan rate. The loan rate is essentially a price floor at which producers can take out an advance payment from the Commodity Credit Corporation (CCC) on specific crops, and then repay the loan once the crop had been sold. If producers are unable to repay the loan in full (i.e. if market price was lower than the loan rate), they have the option of defaulting and allowing the CCC to take ownership of the crop at no cost to the producer. In this regard, the loan payment is often termed a "non-recourse loan" because the CCC has no alternative but to take ownership of the crop (Schmitz et al 2002).

Deficiency Payments (now referred to as Counter Cyclical Payments)

A deficiency payment is a payment made by the federal government to producers of specific commodities. It is equal to the difference between the target price[2] and the greater of the market price received for a crop and the loan rate. If the average market price for a specific crop is above the target price then no deficiency payment is made. If the loan rate is above the average market price, then the CCC makes a deficiency payment to the producer equal to the difference between the target price and the loan rate multiplied by the quantity of crop being sold (Schmitz et al 2002).

The supports described above have existed in one form or another since 1970, although they were modified in several ways through the 1990, 1996, and 2002 Farm Bills. In the

[2] The target price is used to calculate the level of deficiency payments received by producers of specific crops (e.g. wheat, corn, and cotton). It is based upon estimates of U.S. national average costs of production for individual crops. Producers are eligible for deficiency payments equal to the difference between the target price and the national average market price for various commodities. Payments occur on an annual basis and are determined at the end of each marketing year (Schmitz, 2002).

late 1980's it was felt that acreage set aside programs in conjunction with the CCC stocks policy were encouraging production elsewhere in the world. In 1990 the Food, Agriculture, Conservation and Trade (FACT) Act was passed which sought to reduce target prices, lower the loan rate (when stocks were high), and reduce the acreage on which deficiency payments were eligible. Although the CRP of 1970 was extended, the role of acreage idling was being reduced in hopes that other nations would respond to increased production in the U.S. by lowering their own levels of production (Gardner 2002).

The Federal Agriculture Improvement and Reform (FAIR) Act of 1996 represented a major shift in direction for agricultural policy in the U.S. as it was intended to reduce decoupled[3] farm subsidies and allow producers to make production decisions based on economic conditions, with the overall goal of reducing government intervention in agriculture. The FAIR Act included the elimination of set-asides, as well as the elimination of target prices and deficiency payments. Instead, fixed payments known as Production Flexibility Contract (PFC) payments were made to producers based on subsidies they were paid or were eligible to be paid between the years 1990-1995. The goal was to have overall payments decline between 1996 and 2002 to the point that they would be lower than historical payment levels. In 1997, decreased demand for U.S. commodities in world markets caused prices to fall and remain low through 2001. In response to low prices, congress supplemented fixed payments with emergency payments that were equal to 50% of fixed payments in 1997 and 100% of fixed payments in the years 1998-2001. The net result of these payments were subsidies that were far in excess of those forecasted when the FAIR Act was initially conceived (Gardner 2002).

The most recent Farm Bill, the Farm Security and Rural Investment Act of 2002 contains elements of both the 1990 and 1996 Farm Bills. Production Flexibility Contracts and loan deficiency payments were extended from the 1996 Farm Bill, while new "Countercyclical Payments were introduced. These payments were essentially a reintroduction of deficiency payments that had existed prior to 1996 except that they did not require producers to participate in set-aside initiatives to be eligible for payments. It is a widely held view that the 2002 Farm Bill abandoned previous attempts to allow market forces to dictate production decisions, and that subsidies would continue to escalate (Gardner 2002).

In addition to the support programs described above, crop insurance has been available to producers in the U.S. since 1938. Participation in the crop insurance program has typically been quite low, as producers have had an abundance of other guaranteed supports available to them at no cost, and have been able to count on the federal government for disaster assistance when required. Participation has increased since 1994, however, when the program was modified to increase payouts substantially (Gardner 2002).

[3] Decoupled payments are support payments made by the government to producers that are not linked to production. Producers receive these payments regardless of quantities produced. Specifically, decoupled payments do not provide incentive to increase or decrease supplies of affected commodities.

The discussion above illustrates that there are a wide range of policies and programs in Canada and the U.S. that can affect producers in each country. Before discussing the impacts of these programs, it is useful to examine the total level of subsidies provided by governments in each country. Table 1 below shows the level of support for wheat, barley, soybeans, and corn as measured by a Producer Support Estimate (PSE), calculated by the Organization for Economic Co-operation and Development (OECD). It is evident in Table 1 that the level of subsidization in the U.S has been substantially higher than in Canada, for these commodities. It also appears that Canada is reducing its level of subsidization, while the opposite trend is occurring in the U.S.

Table 1: Producer Support Estimates (PSE), Canada and the U.S., 1991-2004

Year	Canada Wheat	U.S. Wheat	Canada Barley	U.S. Barley	Canada Soybeans	U.S. Soybeans	Canada Corn	U.S. Corn
			%			%		
1991	42	50	43	42	26	7	25	16
1992	29	34	36	33	18	5	36	20
1993	23	42	32	52	5	10	10	20
1994	14	31	26	45	5	6	5	17
1995	17	15	13	9	5	5	4	6
1996	16	22	14	18	5	5	5	12
1997	7	25	7	25	5	5	6	14
1998	9	38	6	40	7	15	8	28
1999	11	50	7	42	9	24	14	34
2000	14	48	12	42	18	28	25	34
2001	17	42	13	38	33	26	15	26
2002	18	30	23	28	9	13	9	17

Source: OECD Website

3) The Effects of Agriculture Policies in Canada and the U.S.

Although agricultural policy in both Canada and the United States has focused primarily on reducing income variability among producers, it can be shown that the effects of policy on agriculture are different in each nation. Gardner (2002) suggests that policies in both the U.S. and Canada should provide incentive for producers to increase production above levels that would have occurred had the policies not been in place. In theory, this notion is supported by Schmitz et al (2002) who suggest that stabilizing price and income may cause an outward shift in the supply curve as long as producers are risk averse. In reality, however, outward shifts in supply have not occurred in Canada to the same extent that they have in the U.S. For example, barley production in Canada increased by 13.5% between 1991 and 2004, while wheat production actually decreased by 23.6% during that same time period (Statistics Canada 2005). In the U.S., corn production increased by 55% between 1991 and 2004 (USDA NASS, Various Years). Table 2 below shows the Canadian wheat and barley production and U.S. corn production between the years 1991 and 2004.

Table 2: Corn Production, U.S., Barley Production and Non-Durum Wheat Production, Canada, 1991-2004

Year	Corn Production U.S.		Barley Production Canada		Non-Durum Wheat Production Canada	
	(1000 MT)	Annual % Chg	(000 tonnes)	Annual % Chg	(000 tonnes)	Annual % Chg
1991	189,868	-	11,617		27,360	
1992	240,719	27%	11,032	-5%	26,739	-2%
1993	160,986	-33%	12,972	18%	23,867	-11%
1994	255,295	59%	11,692	-10%	18,285	-23%
1995	187,970	-26%	13,032	11%	20,341	11%
1996	234,518	25%	15,562	19%	25,175	24%
1997	233,864	0%	13,534	-13%	19,929	-21%
1998	247,882	6%	12,709	-6%	18,040	-9%
1999	239,549	-3%	13,196	4%	22,619	25%
2000	251,854	5%	13,229	0%	20,827	-8%
2001	241,377	-4%	10,846	-18%	17,581	-16%
2002	227,767	-6%	7,489	-31%	12,321	-30%
2003	256,905	13%	12,328	65%	19,272	56%
2004	294,990	15%	13,186	7%	20,898	8%

Source: USDA FAS (2005), Statistics Canada (2005)

Schmitz et al (2002) suggest that income uncertainty and political uncertainty have caused the failure of many stabilization programs in Canada. Income uncertainty occurs because policy makers estimate income trends as being level or increasing in the long run when in fact they are decreasing. Stabilization programs are then designed based on that false information. Because of this, payments to producers end up increasing over time and the program ends up accumulating a large debt. An example of this occurred with the WGSP, first introduced in 1976 when grain prices were relatively strong. Initially the program was financially successful, however, in the 1985 Farm Bill, the U.S. lowered the loan rate on wheat by a dollar (U.S.) and introduced its Export Enhancement Program (EEP). This legislation caused a downward shift in the trajectory of farm income in Canada, and eventually caused the WGSP to go bankrupt. Although, policy makers had accurately estimated current farm incomes when developing the program, they did not accurately forecast changes in farm income that could occur over the entire life of the program.

Political uncertainty occurs because changes in governments or government priorities occur frequently and often lead to cancellations or changes in farm income stabilization programs. This instability means that producers are often uncertain about potential

benefits that they will be receiving and respond by reducing output over the case where program payouts are certain (Schmitz et al 2002). In the U.S., Farm Bills are typically updated every six or seven years, so producers can be certain about program payouts during this time.

Furtan (2005) suggests that designing individual programs to provide support for vertical components of the supply chain rather than having separate programs for each horizontal component (as is done in the U.S.) can lead to decreased output. In Canada, programs like NISA, AIDA, CFIP and now CAIS only provide payments to producers if total farm income falls below specified levels. In the case of a producer who grows barley to use as feed in the livestock component of his/her farm, low barley prices are not enough to ensure that he/she is eligible for a subsidy. This is because low barley prices reduce input costs for his/her livestock feeding operation, which leads to increased profitability of that component of his/her farm. This offsetting effect of barley and livestock production will often leave net farm income above the level that makes producers eligible for a government payment. In the U.S., subsidies are geared towards individual commodities, so regardless of what happens to other components of a farmers operation, he/she will receive payment if specific commodity prices are low.

More recently, others have suggested (Groenewegen, 2005), that the reduction in feed grain production in Canada may be partially attributable to regulations affecting variety registration like the Kernel Visual Identification (KVD) regulation. This regulation requires that new wheat varieties be visually identifiable as fitting into one of the existing variety classes[4]. These additional requirements are viewed by some to be a major constraint to expanding the crop yields in western Canada because they restrict the characteristics that new varieties can exhibit. However, a recent study by Oleson (2003) estimated the increased yields from removing the KVD requirement on the licensing of new wheat varieties to be small. Nonetheless, this regulation remains a hotly contested issue in western Canada.

There are several other reasons why Canadian programs have not encouraged an outward shift in supply, while U.S. programs have. According to Gardner (2002), Canada has moved towards market-oriented risk policies that encourage producers to make production decisions based on market conditions. Canadian programs like those described above are government subsidized income insurance policies that do not encourage production of specific commodities, and they do not guarantee payments above what the market would provide in a successful crop year. This contrasts U.S. programs, where government subsidies ensure that prices do not fall below predetermined levels (through the creation of a floor price).

Gardner (2002) identifies loan programs, production flexibility contracts (PFCs), and crop insurance programs as the three main sources of increased supply for certain commodities in the U.S. Figure 1 below illustrates how loan programs can increase supply.

In absence of a loan program, equilibrium price and quantity occurs where the supply curve (S) intersects the demand curve (D). At this intersection, farmers will produce quantity (Q_m) and receive price (P_m) for their crops. If a loan program is implemented, producers are guaranteed to receive the loan rate (P_L) for their crops and will respond by

[4] The KVD requirement does not apply to barley.

increasing the quantity produced to (Q_L). At this quantity, the market will clear at a new lower price (P_c) and producers will receive a loan deficiency payment equal to (P_L-P_C) Q_L. If the market price is higher than the loan rate, producers can sell their crop at the market price and will not receive a loan deficiency payment.

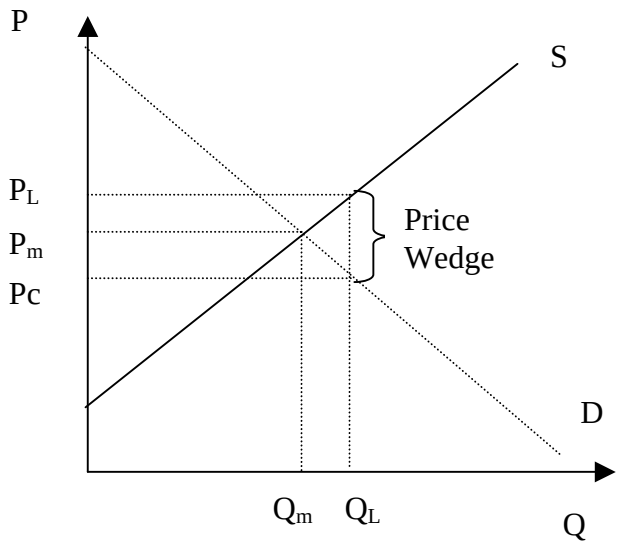

Figure 1: Effect of Loan Program on Supply

It is important to note that the loan program not only increases the supply of specific commodities but it also reduces the price at which these commodities are purchased by downstream buyers. Gardner (2002) notes that the "price wedge" between the price that producers receive for crops and the price that buyers pay is a direct subsidy that producers factor into subsequent production decisions (i.e. because they know they will receive the loan rate, they make production decisions off the supply curve at that price). Using the "price wedge" and supply and demand elasticities, Gardner calculates the expected impacts on market prices and quantity produced. At a 20% price wedge (which is an approximate average for corn, soybeans, wheat and cotton in the years 1999 and 2000), he estimates an output increase of 2.9% and a market price decrease of 5.8%. Table 3 below shows prices, loan rates, revenues, and price wedges for corn and soybeans in the years 1999 to 2004. As will be discussed later, reduced commodity prices can have positive implications for value-added programs that depend on these commodities as inputs.

Table 3: U.S. Corn and Soybeans Average Farm Prices, Loan Rates, Average Farmer Revenue and Price Wedges, 1999-2004

Year	Average Farm Price		Loan Rate		Average Farmer Revenue[1]		Price Wedge*	
	$USD/bu							
	Corn	Soybeans	Corn	Soybeans	Corn	Soybeans	Corn	Soybeans
1999	1.82	4.63	1.89	5.26	2.08	5.51	14.0%	18.9%
2000	1.85	4.54	1.89	5.26	2.11	5.46	14.1%	20.4%
2001	1.87	4.30	1.89	5.26	1.99	5.49	6.7%	27.7%
2002	2.32	5.53	1.98	5.00	2.32	5.54	0.1%	0.1%
2003	2.45	7.34	1.98	5.00	2.46	7.34	0.3%	0.0%
2004	1.95	5.10	1.95	5.00	2.18	5.19	11.6%	1.8%

[1]Revenue refers to the sum of average farm price and loan benefit on a dollar (U.S.) per bushel basis.
* The price wedge is the % difference between the average farm price and the average farmer revenue.
Source: USDA FSA (2005), USDA NASS (Various years)

Production Flexibility Contracts (PFCs) are less obvious in their effect on commodity supply. Gardner (2002) describes 4 ways that production can be increased under PFCs including, 1) wealth effects, 2) insurance effects, 3) anticipatory effects, and 4) the absence of complete decoupling. Gardner says that wealth effects occur because PFCs are a guaranteed annual flow of income to producers that result in increased wealth, and that producers respond to this increase in wealth by investing some it into the farm, which leads to an output effect. As described above, insurance effects occur because insurance has the effect of reducing income variability which causes risk averse producers to increase output. Unlike wealth and insurance effects, anticipatory effects will not necessarily increase output. Instead, they may prevent a producer from reducing output in response to market conditions because the producer knows that existing programs will be updated by government to account for existing production. This phenomenon directly contrasts the Canadian situation of political uncertainty that was alluded to earlier. Like anticipatory effects, the absence of complete decoupling can prevent a market encouraged reduction in output. Although PFC payments are not dependant on acreage, Gardner (2002) notes that they cannot be considered decoupled. Only certain commodities are eligible for price support, thus encouraging producers to continue producing these specific crops instead of switching to crops like fruits and vegetables, which may generate higher returns (Gardner 2002).

In addition to loan programs and PFCs, Gardner (2002) describes crop insurance programs as the third main cause of increased commodity supply in the U.S.. He notes that crop insurance subsidies have increased substantially during the last 10 years and are now high enough to encourage production on land where the risk of crop failure is high. He notes that $3 billion in crop insurance payments would be enough to increase U.S. crop acreage by between 0.5 and 10.0 percent.

It is evident from this discussion that a primary effect of income stabilization programs in the U.S. has been an increased supply and reduced price of certain commodities, while in Canada this has occurred to a lesser extent[5]. Because many of these commodities including corn, soybeans and barley are inputs in value-added industries like livestock feeding, reduced prices can stimulate growth in these industries. The next section of the paper describes the effects of policies and programs in Canada and the U.S. on the hog industries in each country.

4) The Case of Hogs

The case of weaner hog and finished hog production in Canada and the U.S. is an excellent example of the effect of agricultural policy on value-added within and across borders. In Canada, the repeal of the Western Grain Transportation Act (WGTA) in 1995 created an incentive to feed livestock on the prairies instead of export grains. This contributed to a 34% increase in the Canadian hog inventory from 1994 to 2003. During this time, growth in weaner hog production outpaced growth in feeder hog production, and weaner hog exports increased by 972% (USDA FAS 2005). Most of the weaner hogs were exported to the U.S., particularly the states of Minnesota and Iowa. Corn and finished hogs are also traded between Canada and the U.S. The markets for feed grains, weaner hogs and finished hogs in Canada and the U.S. are thus considered to be integrated (Haley 2004). Table 4 below shows Canadian hog inventory, hogs born in Canada, and Canadian weaner exports to the U.S. between the years 1994 and 2004.

[5] Although the policies and programs described in this section are believed to stimulate increases in output for many commodities, it is important to remember that some U.S. programs have the opposite effect on supply. As mentioned earlier, under the CRP, producers receive subsidies for taking land out of production. Although the long-run effect of this program is difficult to quantify, it is clear that the program has had an off-setting effect on the supply increases caused by U.S loan programs. The same holds true for set-aside programs, which also require producers to take land out of production. Although these programs are presently less prominent than in previous Farm Bills, the acreage that they account for is still quite substantial (34 million acres under the CRP). However, the extent to which they constrain the ability of U.S. corn growers to increase supply in response to previously mentioned programs in unknown.

Table 4: Canadian Hog Inventory, Hogs Born and Weaner Hog Exports to U.S., 1994-2004

Year	Hog Inventory in Canada	Hogs Born in Canada	Canadian Weaner Exports to U.S.
		(000 head)	
1994	43,551.3	19,837.8	399.6
1995	46,088.9	20,665.7	650.5
1996	45,960.9	20,726.6	767.0
1997	46,958.4	22,089.0	987.3
1998	49,451.5	24,763.1	1466.1
1999	50,882.4	26,962.0	2083.4
2000	53,508.3	28,369.8	2334.8
2001	56,419.9	30,800.8	3168.8
2002	58,688.6	32,406.2	3757.4
2003	58,433.4	34,204.6	4971.0
2004	58,735.7	36,082.8	5626.9

Source: Statistics Canada (2005), USDA FAS (2005)

Evidence suggests that Canada has a comparative advantage in producing weaner hogs, while the U.S. Corn Belt States have a comparative advantage in producing finished hogs (Haley 2004). These comparative advantages are a result of differences in the natural characteristics of each region, as well as differences in government policies in Canada and the U.S. Each country has specialized towards the product that it can more efficiently produce, given the effects of market forces and government policy in each region.

In the case of producing weaner hogs, Canada has an advantage because its cool climate and low herd densities (Haley 2004). These factors contribute to a lower incidence of disease in farrowing barns, which results in more pigs per litter and more pigs per breeding animal per year in Canada. In contrast, the warmer climate and closer distances between barns in the U.S. results in greater disease and thus lower farrowing productivity. In addition, hogs have been produced for much longer in the Corn Belt than in many parts of Canada, which contributes to Canada's disease advantage. The devaluing of the Canadian dollar between 1996 and 2002 also made weaner exports more lucrative to Canadian weaner hog producers (Haley 2004).

In the case of finished hogs, the U.S. Corn Belt States have an advantage for two main reasons. The first reason is related to U.S. hog slaughtering plant sector. The slaughter plants in the U.S. generally enjoy lower costs due to lower U.S. wages and more flexible work rules that allow Saturday slaughters and second shifts, which is a practice less common in Canadian plants (Haley 2004). In addition, the bulk of North American hog slaughter capacity is in the Corn Belt (Haley 2004). The efficiency of U.S. plants plus

the large slaughter capacity in the Corn Belt States has resulted in the Corn Belt plants paying higher prices for finished hogs than Canadian plants (Haley 2004). In contrast, finished hog prices in western Canada are generally set at the Corn Belt price less a basis for transportation. Figure 2 illustrates the price transmission for finished hogs between Western Canada and the U.S.

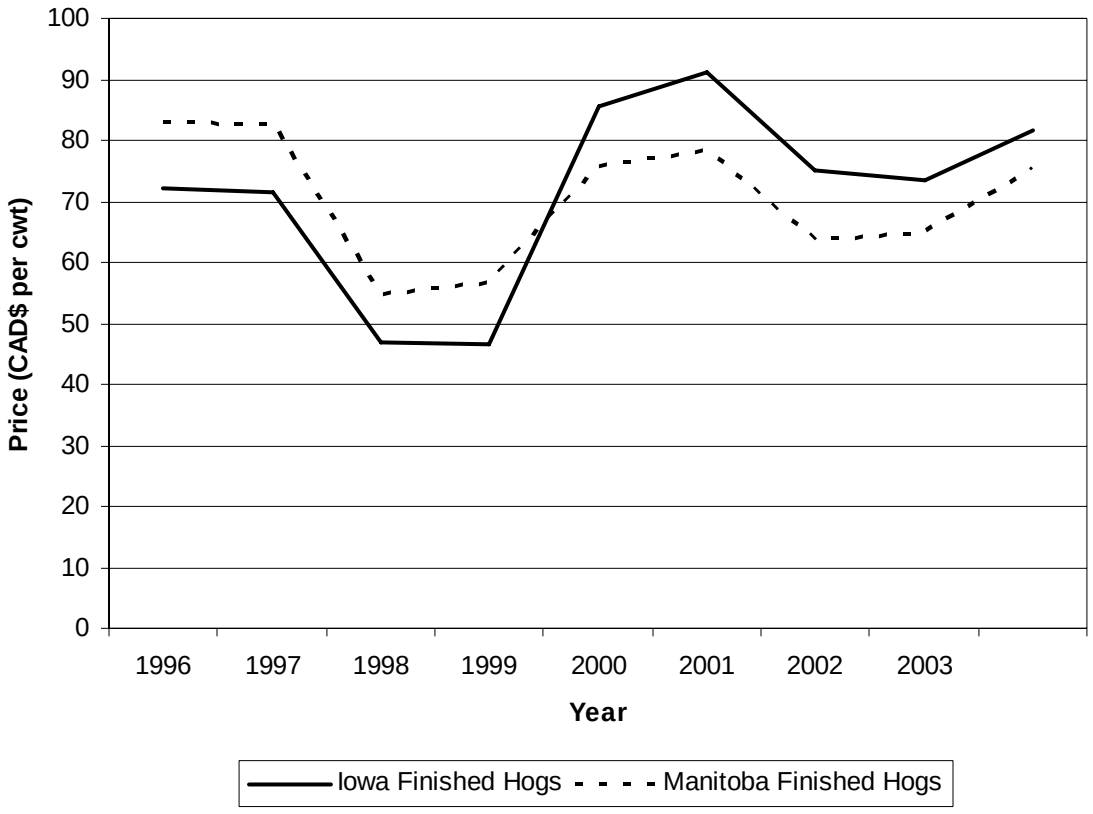

Figure 2: Iowa and Manitoba Finished Hog Prices, 1996-2004
Source: Lawrence (2004), USDA NASS (2004)

The second reason for the comparative advantage of U.S. Corn Belt States in finishing hogs is related to their close proximity to cheap and plentiful feed. Corn and soybeans are a major constituent of hog finishing rations, and are a large portion of production costs. It thus makes sense that hog finishing operations are located close to the supply of these commodities. In addition, U.S. agricultural policy has acted to increase the supply of corn and soybeans, which has benefited hog producers by providing lower-priced feed sources. As mentioned earlier, the Loan Deficiency Payment (LDP) for U.S. commodities has been shown to directly increase production in many years, which has contributed to the increases in corn and soybean production in the U.S.

In contrast to the U.S. situation, there is no evidence that Canadian agricultural policy has increased the supply of wheat and barley used in hog feed rations. A lack of commodity support programs in Canada has encouraged producers to grow a variety of specialty crops in order to maintain farm incomes. The result has been a decrease in the supply of feed grains in Western Canada (Kraft and Rude 2002) and feed deficits in both

Manitoba and Alberta. Table 5 below shows the sources and total uses of feed grains in the Prairie Provinces in 2001.

Table 5: Sources and Total Uses of Feed Grains, Prairie Provinces, 2001

	Manitoba	Saskatchewan	Alberta
		(000 tonnes)	
Total Feed, Waste, Dockage	1549	3734	4856
Livestock Feed Requirement	2601	1786	5082
Net Surplus	-1052	1948	-226

Source: Kraft and Rude (2002)

5) Modelling the Effect of U.S. Policy on Value-Added and Trade

The effect of U.S. corn subsidies on Canadian and U.S. feed grain and finished hog markets can be illustrated in terms of supply and demand. First, the effect of U.S. corn policy on U.S. and Canadian feed grain production and trade is discussed. Second, the effects of U.S. corn policy on the finished hog and weaner hog markets are described.

Effect of U.S. Policy on U.S. and Canadian Corn/Feed Grain Markets

The effect of the U.S. corn LDP on U.S. and Canadian feed markets (in years where the market price is below the LDP) is given in Figure 3. In this stylized illustration, prior to the 2002 U.S. Farm Bill, U.S. domestic supply is S_{us}, U.S. domestic demand is D_{us}, and total demand for U.S. production (which includes foreign excess demand) is TD. Canadian domestic supply and demand is S_{can} and D_{can} respectively. Under free trade the equilibrium price is p_1 and the equilibrium quantity in the U.S is q_1.

Suppose the U.S. government imposed a LDP p_L for farmers that is facilitated by means of a subsidy. Price p_L induces U.S. farmers to produce and sell quantity q_2. The world market clears at price p_2 and the U.S. government ends up paying a subsidy of $p_L - p_2$ on each unit of output. U.S. producers gain producer surplus given by area $a+b+c$, while U.S. consumers gain area e and foreign consumers gain area $f+g$. The subsidy costs U.S. taxpayers area $a+b+c+d+e+f+g$, and the deadweight loss equals area d.

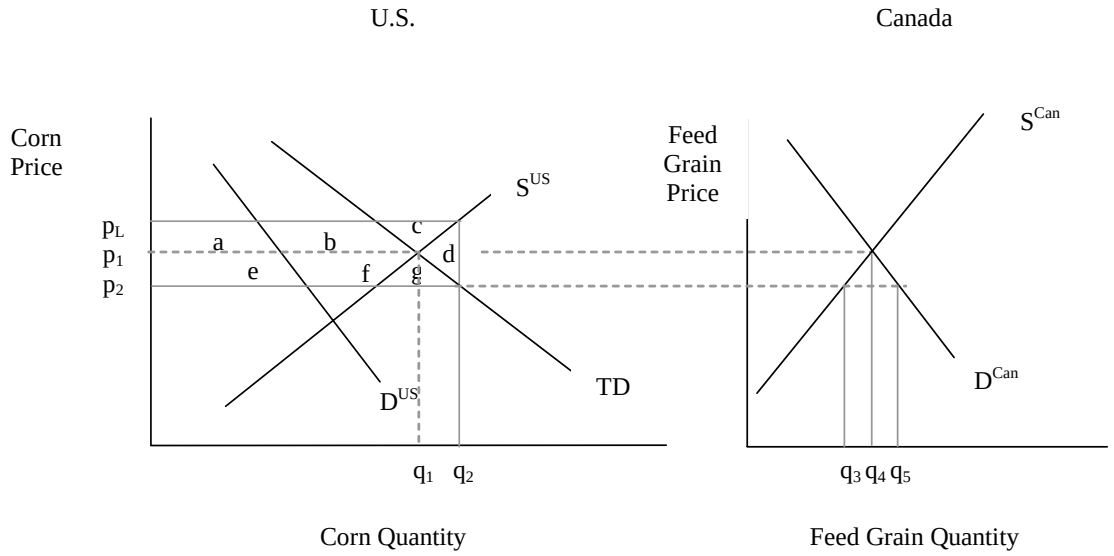

Figure 3 - Effect of Loan Deficiency Payment on U.S. and Canadian Production and Trade

The U.S. corn LDP also affects Canada because it reduces the world price for corn and other feed grains. The price of Canadian feed grain is closely tied with the U.S. corn price due to free trade. In this stylized illustration the world price is p_1 and Canada produces and consumes q_4 before the corn LDP is implemented. In a year where the U.S. Loan Deficiency Payment maintains a price of p_L, Canadian feed grain producers respond to a new world price of p_2 and produce q_3. Canadian consumers of feed grains benefit from a lower price and consume q_5, leading to imports of $q_5 - q_3$. The U.S. policy can thus result in Canada becoming a net importer of feed grains. Figure 3 can also describe the effect on individual Canadian provinces. The U.S. corn policy would cause a province with a feed grain surplus (e.g. Saskatchewan) to decrease its net exports of feed grains. The U.S. corn policy would cause a province which has a feed grain deficit (e.g. Alberta and Manitoba) to further increase its net imports of feed grains. The western provinces together had a narrow surplus of feed grain in the late 1990's, which could easily turn into a feed deficit situation if drought lowered production, or demand for feed grains increased (Kraft and Rude 2002).

The drought of 2001 and 2002 is an example of how a decrease in the supply of western Canadian feed grains increased the price of barley. During this time, feed grains needed to be brought from further away, which increased the import basis and increased the price of feed grain in western Canada, although the world price of feed grains was unaffected by the prairie drought. As illustrated in Figure 4, the 2001-2002 drought caused the price of Lethbridge barley to increase relative to the Iowa corn price.

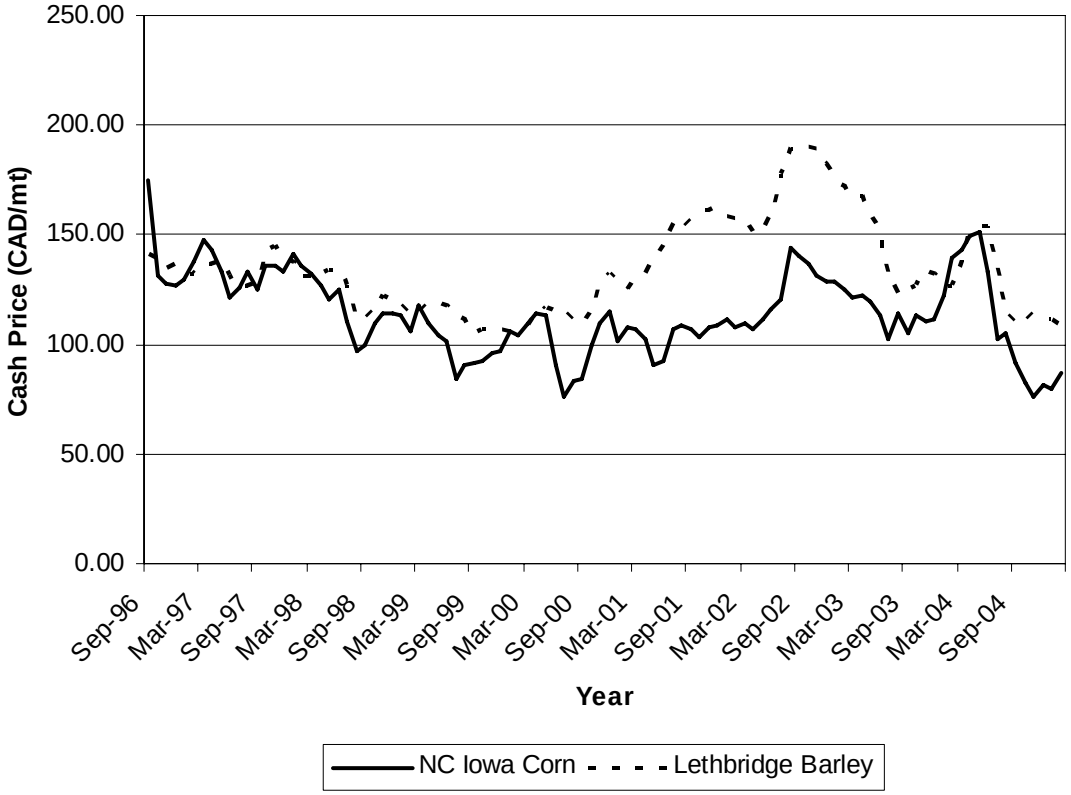

Figure 4 - Iowa Corn and Lethbridge Barley Prices

Source: MGEX (2005), WCE (2005)

Corn imports from the U.S. to Canada have increased in the past decade, from about 1 mmt in 1995 to about 4 mmt in 2003 (USDA FAS 2005), with most of the increase heading for Alberta, Manitoba and Ontario. This has occurred at the same time as barley production has increased slightly and wheat production has decreased in Canada. Table 6 below shows Canadian imports of corn from the U.S. between 1994 and 2004.

Table 6: Canadian Corn imports from the U.S. 1994-2004

Year	Corn Imports from U.S. (000 tonnes)
1994	719
1995	1,025
1996	860
1997	1,038
1998	1,168
1999	964
2000	1,486
2001	3,033
2002	4,103
2003	3,486
2004	1,997

Source: USDA FAS (2005)

Effect of U.S. Policy on U.S. and Canadian Finished Hog Markets

The effect of the U.S. corn LDP on U.S. and Canadian weaner and finished hog markets is given in Figure 5[6]. The illustration given in Figure 5 assumes that two inputs are used to produce finished hogs: corn and weaners. Prior to U.S. government intervention, the U.S. supply of corn and weaners is $S_c^{U.S.}$ and $S_w^{U.S.}$ respectively. These input supply curves are combined in fixed proportions to derive the supply curve for finished hogs, $S_h^{U.S.}$. The pre-intervention world demand for U.S. finished hogs is defined by TD_h. The demand for U.S. corn and weaners, which is derived from the finished hog demand curve, is TD_c and TD_w respectively. It is assumed that world prices are determined in the U.S. market. Given free trade in feed grains, weaners and finished hogs between Canada and the U.S., the equilibrium prices for all three goods are identical between the two countries. The supply and demand for finished hogs, weaner hogs and feed grains in Canada is represented by S_h^{Can}, D_h^{Can}, S_w^{Can}, D_w^{Can}, S_c^{Can} and D_c^{Can} respectively. It is assumed that Canada is a price taker for finished hogs, weaner hogs and feed grains.

[6] Note that the Loan Deficiency Payment is only a distortion in years where the market price is below the Loan Rate.

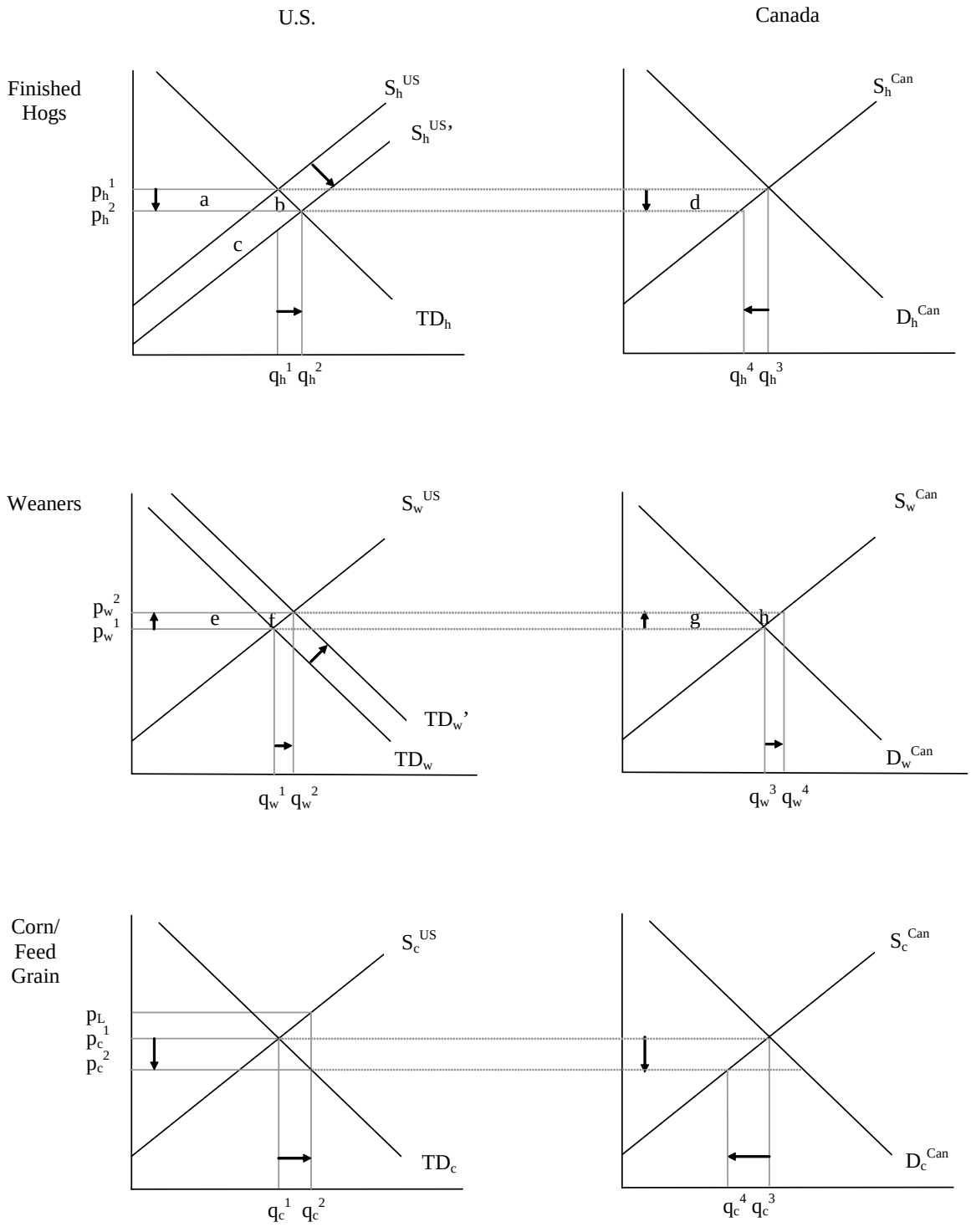

Figure 5 – Value Added and Trade Effects of U.S. Corn Policy

U.S. Effects

The effect of the U.S. corn LDP on U.S. corn, weaner and finished hog markets is given on the left side of Figure 5. Similar to the previous figure, suppose the U.S. government imposed a LDP p_L for farmers that is facilitated by means of a subsidy. Price p_L induces U.S. corn farmers to produce and sell quantity q_c^2. The world market clears at price p_c^2 and the U.S. government ends up paying a subsidy of $p_L - p_c^2$ on each unit of output. From the perspective of the U.S. hog feeding industry, corn inputs become cheaper because of the lower corn price, shifting the supply curve out to $S_h^{U.S.'}$ in the finished hog market. The price of finished hogs decreases to p_h^2 and the quantity of finished hogs increases to q_h^2. U.S. hog producers gain producer surplus given by area $c - a$. Consumers of finished hogs gain economic welfare equal to area $a + b$. The total economic surplus gain in the U.S. finished hog market equals area $b + c$.

In the U.S., an increase in the production of finished hogs leads to an increase in the demand for weaners[7] to TD_w'. The price and quantity of weaners therefore increases to p_w^2 and q_w^2 respectively. U.S. weaner producers unambiguously gain economic welfare from the U.S. policy intervention, equal to area $e + f$ in Figure 5. On the other hand, U.S. hog finishers may gain or lose economic welfare, depending on the relative sizes of areas a and c in Figure 5.

Canadian Effects

The effect of the U.S. corn policy on Canadian feed grain, weaner and finished hog markets is given on the right side of Figure 5. As described in figure 3, the U.S. Loan Deficiency Payment lowers the world price of corn to p_c^2 and decreases the output of Canadian feed grain producers to q_c^4. Canadian feed grain producers lose economic welfare as a result.

In the finished hog market, Canadian finished hog prices decrease to p_h^2. Canadian finished hog producers thus lose economic welfare equal to area d. In the weaner market, however, the Canadian price increases to p_w^2, with a corresponding increase in Canadian weaner output to q_w^4. Canadian weaner producers thus gain economic welfare due to the U.S. corn policy, equal to area $g + h$.

The model in Figure 5 does not include potential second round effects. It does not incorporate the effect of increased corn supply on the supply curve in the Canadian finished hog market and it does not incorporate changes in the Canadian feed grains basis. A decrease in the world price of feed grains could contribute to an outward shift of the Canadian finished hog supply curve, while transportation costs associated with importing corn from the U.S. will lessen the impact of reduced feed grain prices. It is important to remember that these two second round effects have opposing effects on the supply curve for Canadian finished hog production and will therefore offset each other to some extent. Furthermore, as second round effects, they are likely to be much smaller than the first round effects captured by the model.

Overall, U.S. corn producers win, while Canadian feed grain producers lose from the U.S. policy. U.S. finished hog producers may win or lose, while Canadian finished hog

[7] An increase in demand for the non-subsidized input assumes that cheaper corn cannot be substituted for other inputs (i.e. the two inputs are used in fixed proportions). Under a subsidized input, demand for the other input will increase if $\sigma > -\eta$, where σ is the elasticity of substitution between the two inputs and η is the elasticity of output demand (Gardner 1987).

producers surely lose from the U.S. policy. The weaner market is the only market where producers in both Canada and the U.S. gain from the U.S. corn LDP. There is no mistaking that the U.S. policy of supporting corn prices increases the production of finished hogs and weaner hogs in the U.S. The present level of U.S. finished hog production can thus be partially attributed to U.S. agricultural policy. In addition, the faster growth of weaner hog production in Canada, compared to Canadian finished hog production, can also be partially attributed to the same U.S. agricultural policy.

Empirical Estimates

The effect of the corn LDP on U.S. prices and output of corn, weaners and finished hogs can be calculated using the variable proportions model described by Gardner (1987), and using a zero elasticity of substitution. Given that prices for feed grains, weaners and finished hogs are set in the U.S., the effect of the corn LDP on corresponding Canadian prices and output can also be calculated.

The effect of the 2004 corn LDP on price, output and producer surplus in the finished hog, weaner and corn/barley market is given in Table 7. The U.S. corn subsidy increased the producer surplus of U.S. corn producers by $1.37 billion dollars in 2004. The corn subsidy also increased the producer surplus of U.S. and Canada weaner producers, but decreased the producer surplus of finished hog producers in both the U.S. and Canada. Canadian finished hog production decreased by 263 thousand head because of the U.S. corn subsidy in 2004.

Table 7: Output and Price Effects of the U.S. Corn Loan Deficiency Payment, 2004.

Commodity	Price Change	U.S. Effects		Canada Effects	
		Output	Producer Surplus	Output	Producer Surplus
	$CAD per head, mt (%)	*000 head, mt (%)*	*000 $CAD*	*000 head, mt (%)*	*000 $CAD*
Finished Hogs	-2.56 (-1.71%)	990 (0.94%)	-269,016	-240 (-0.80%)	-76,355
Corn / Barley	-6.57 (-6.90%)	13,865 (4.70%)	1,325,666	-170 (-1.38%)	-80,391
Weaners	2.09 (3.48%)	952 (0.94%)	212,509	322 (0.94%)	71,786

Elasticity of U.S. corn and Canada barley supply = 0.2 (Gardner 2002)
Elasticity of U.S. and Canada weaner hog supply = 0.27 (UNCTAD ATPSM, Author's calculations)
Elasticity of U.S. finished hog demand = -0.55 (UNCTAD ATPSM)
Source: USDA NASS (Various years), USDA FSA (2005), Statistics Canada (2005), Author's Calculations

The effect of the U.S. Loan Deficiency Payment on Canadian weaner production is given in Table 8. The U.S. subsidy lowered Canadian Finished Hog production by an average of 177 thousand head per year over the 1999-2004 period. In addition, the U.S. subsidy explains about one third of the increases in weaner exports to the U.S. over the 1999-2004 period. The Loan Deficiency Payment thus has a large effect on hog production in Canada.

Table 8: Loan Deficiency Payment Effects on Hog Production, 1999-2004

Year	Corn LDP Payment Price Wedge	Changes in Hog Production Due to Corn LDP (000 head)				Change in Weaner Exports to U.S. (000 head)
		U.S. Finished	U.S. Weaner	Canada Finished	Canada Weaner	
1999	14.0%	1,195 (1.13%)	1,149 (1.13%)	-290 (-0.97%)	388 (1.13%)	617
2000	14.1%	1,204 (1.14%)	1,157 (1.14%)	-292 (-0.98%)	391 (1.14%)	251
2001	6.7%	572 (0.54%)	550 (0.54%)	-139 (-0.46%)	186 (0.54%)	834
2002	0.1%	8.5 (0.01%)	8.2 (0.01%)	-2.1 (-0.01%)	2.8 (0.01%)	589
2003	0.3%	25.6 (0.02%)	24.6 (0.02%)	-6.2 (-0.02%	8.3 (0.02%)	1215
2004	11.6%	990 (0.94%)	952 (0.94%)	-240 (-0.80%)	321.5 (-0.94%)	656
1999-2004 Average	7.8%	666	640	162	216	694

Source: USDA FAS (2005), Author's Calculations

6) Discussion and Conclusions

The results of this analysis show that the U.S. loan programs since 1996 have had a positive effect on the supply of corn in that country, which has caused a decrease in the world price for corn and other feed grains. Lower prices for feed barley and wheat have contributed to an overall decreased production of those commodities in Canada, which, in conjunction with an expanding weaner hog industry and recent droughts, have contributed to an emerging feed deficit in western Canada. In recent years, this has resulted in increases in Canadian imports of U.S. corn. Because corn must be transported from the U.S Corn Belt, value-added hog production in Canada becomes more expensive than if Canada were to supply the feed itself.

Despite the increasing feed requirements in western Canada, it is likely that U.S. loan programs will continue to encourage corn and soybean production in that country and

discourage feed wheat and barley production in Canada because of the lower world price. As a result, the weaner hog industry in Canada will have to increasingly rely on U.S. corn as a feed input. In the long-run, this could put Canada at a disadvantage relative to the U.S. in value-added hog production because U.S. hog producers are located adjacent to a cheap supply of feed.

The supply and price effects illustrated in this analysis can have positive implications for other value-added sectors as well including ethanol, high fructose corn, and bioplastics, for example. In the U.S., each of these industries has experienced recent growth and each relies heavily on corn as an input for production. It could therefore be argued that the expansion of these value-added industries is partially attributable to having a cheap and plentiful supply of corn. Overall, companies in the U.S. can be relatively confident that they will have corn to use as a cheap input well into the future, and they are therefore willing to invest in a variety of industries that rely on it.

The same holds true when it comes to investing in research and innovation. Research dollars will be directed towards finding alternative uses for plentiful commodities like corn and soybeans as opposed to finding uses for commodities that experience volatile prices and unreliable supply. This is especially true in cases where the return on research investment dollars is not realized until well into the future. In Canada, the political and income uncertainty associated with farm programs means that most commodities experience volatile prices and supply. Research investment in these commodities could be improved if investors faced less uncertainty regarding long-term supply, prices, and ultimately, whether research investments would yield positive returns.

Value-added industries like these may also benefit from a first mover advantage. As a value-added industry is developed, it may initially require government subsidization to be economically profitable. Over time, however, innovation may lead to improvements in technology, thus making an industry efficient to the point that support is not required to earn a profit. This is often referred to in economic literature as the “infant industry argument”, a situation where industry is protected through production subsidies, tariffs or quotas until it acquires the knowledge that enables it to become self-sufficient (Melitz, 1999). It has been argued that this was the strategy employed by the U.S. and several European countries during the rapid industrialization that occurred in these countries before the turn of the 20th century (Suranovic 1997).

In the case of expanding and developing value-added industries, it is also important to note that subsidies on certain inputs will often directly benefit non-subsidized inputs as well. In the case of hog production, it is the availability of cheap corn that has facilitated the growth of the hog industry. However, there are many other inputs that are required in the production of hogs, and as more hogs are produced, the demand for these inputs will increase as well. This results in flow-through benefits both for value-added industries as well as industries that provide other inputs for value-added industry.

Flow-through benefits for downstream industry resulting from income stabilization programs in Canada and the U.S. will ultimately determine the extent to which rural development occurs in each country. In the U.S., price support programs have been effective at stabilizing producer incomes, and have contributed to the development of value-added industries. This additional economic activity is likely to benefit rural economies by creating jobs and increasing the demand for groceries, building supplies, and a multitude of other goods and services. In Canada, the multiplier effect resulting

from flow-through benefits has not been as large and the rural economy has experienced a reduction in economic activity.

It is important to mention the impact of environmental regulations on value-added in agriculture. Although this issue is not dealt with in this paper, it is clear that such regulations are becoming more stringent and can increase costs substantially in certain sectors, like the hog sector. While necessary for environmental protection, these higher costs can act as a barrier to entry and can potentially lead to underinvestment in certain value-added industries. If regulations are stricter in Canada than the U.S., industry growth in Canada could be impacted negatively. Policy makers therefore need to consider these impacts when developing environmental regulations.

An important follow up to discussing the effects of income stabilization programs in Canada on value-added activities and innovation is to identify ways in which Canadian policy makers can better achieve their objectives. The results of this analysis suggest that policy makers in Canada need to consider the effects of U.S. programs in addition to their own when making policies. The agriculture industries in the two countries have become very integrated through free trade, and programs in U.S. have had a tremendous impact on Canadian agriculture.

In addition to considering the impact of U.S. programs on Canadian agriculture, policy makers in Canada need to decide what the objective of a policy or program in Canada will be. Once this is done, the costs and benefits of that program can be estimated. Although U.S. programs are more expensive to operate and result in a deadweight loss that is borne by taxpayers in that country, they achieve the goal of stabilizing producer income and stimulating downstream value-added. If this is the objective of Canadian agricultural policy makers, then the U.S. model might be a good one to consider. In contrast, if the goal of policy makers is to benefit society as a whole, then these additional costs borne by the general public need to be offset against the net benefits created for the agriculture sector.

One possibility for offering a moderate level of support to the feed and hog industries would be to stimulate production through price supports to the point that poor growing seasons do not result in Canada being a net importer of feed grains at high prices, as occurred in 2001 and 2002. A price support would encourage producers to grow feed grains and would ensure that feed inventories remain high enough that value-added industries like the hog feeding industry would always have access to relatively cheap feed.

Finally, we would like to acknowledge the limitations of this study. It should be noted that the effects of programs like the CRP and set-aside, which create incentives for producers to reduce output, were not captured in this analysis. Changes in recent Farm Bills that reduce the impact of these programs, however, suggest that the impact of this is likely to be small. This is further supported by the fact that other supply increasing programs like PFCs and crop insurance were not included in the analysis.

In addition to the overall effects shown in this case study, it is important to emphasize that there may be a second round effect resulting from the U.S. loan program that we did not capture in our model. Despite additional transportation costs associated with importing corn, it should be noted that decreased corn prices could potentially cause an outward shift in the Canadian hog finishing industry similar to that which is occurring in

the U.S. hog industry. In effect, this outward shift will partially offset the disadvantage caused by decreased feed production in Canada.

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