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Complexity and Obsolete Data Concepts: Canadian Farm Policy, and The Changing Structure of Agriculture

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Complexity and Obsolete Data Concepts: Canadian Farm Policy, and The Changing Structure of Agriculture[1]

Dave Freshwater[2]

> But the idea of the "family farm," with all its value and organizational assumptions, constitutes the central concept around which most of our food and fiber statistics are designed and collected. Yet it has become an increasingly obsolete representation of the reality of the food and fiber sector. The concept guided the early development of agricultural data systems especially during their greatest period of growth in the 1920s and 1930s. The structure of the food and fiber industry today only vaguely resembles the structure that prevailed at that time. The world has changed and the concept has not.
>
> Bonnen 1977, p.387

Agricultural policy has been unusual in that it has specified the ongoing existence of a desired production unit – the family farm, as a policy objective. But, despite decades of policy intervention, the majority of Canadian farms no longer meet the common definition of a family farm. Yet, for the most part, the data collected on farming seems trapped in the use of the older and simpler concept of the family farm. Certainly agriculture is more complex than in the past when the family farm was a useful shorthand expression for the organization of agriculture. Farms now commonly engage in complex marketing arrangements that involve negotiated prices and quality standards. Some farms are completely integrated into processing firms. A large share of farmland is owned by parties who are not considered to be farmers, but in some cases they influence production and marketing decisions. And, most farm households and farm operators now derive a significant portion, if not the majority, of their income from non-farm labor activity. But complexity has another dimension beyond the behavior of farmers and farms. It also describes farm policy. Society now expects more from farm policy than a stable supply of commodities and support for farm income. Reconciling a more nuanced set of policy goals with a heterogeneous structure of agriculture has become a major challenge for providers and analysts of data.

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[1] In the paper the terms firm and farm are used interchangeably, although in some places we employ the phrase "firm/farm" for emphasis purposes.

[2] Professor, Department of Agricultural Economics, the University of Kentucky. Paper developed for a joint AAFC-USDA workshop on Complex Farming Systems, Niagara-On-The-Lake, Ontario, June 27-28, 2011. Useful comments provided by Simon Jette-Nantel are gratefully acknowledged. The opinions in the paper are those of the author and are not to be construed as representing those of the author's employer.

Jim Bonnen would be amused, but not surprised, by the topic and thrust of this paper, for it is surely *déjà vu* in nature. As the paper title and the quote above suggest, the starting place for thinking about data systems is data concepts. And as Bonnen emphasized, data is only a part of an information system. To a great extent we readdress the points he made in the early to mid-1970s, including his presidential address to the American Agricultural Economics Association, which stressed that applied economists should possibly spend as much time understanding where data comes from as on data analysis (Bonnen, 1975). In support of Bonnen's admonition Gardner identifies a number of undesirable analytical consequences that are the result of failing to understand what the data "really describes" (Gardner, 1992). In the article Gardner reviews a number of analytical studies that would clearly have benefitted from a better understanding of how data were collected and defined.

Data and Information

Data are an intermediate stage in creating information. Preceding data collection are data concepts that are grounded in theory and reality. Following data collection is analysis, and it is the three stages that collectively make up the total package that creates the information used for policy: design, implementation and evaluation (Figure 1). The quote from Bonnen recognizes that even in the 1970s the basic way we described the farm/firm was inappropriate. With obsolete data concepts the likelihood of even the best statistical methods producing useful information is small. Thus, the first step in improving agricultural statistics today, as it was in the 1970s, is to understand the structure of farming. But Bonnen makes a second key point about conceptual obsolescence.

Figure 1: An Agricultural Information System

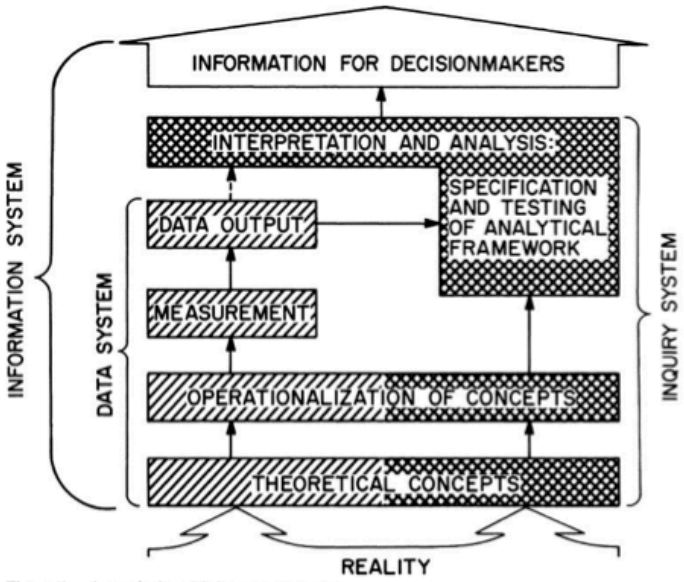


Figure 1. An agricultural information system

source: Bonnen 1977

> Conceptual obsolescence in data is of two types. It can occur not only because of changes in the organization and nature of the food and fiber industry, as just described, but also because the agenda of food and fiber policy (public and private) shifts drastically, as it has recently, changing the questions which the information system is expected to answer. When the questions change, it is almost always found that the conceptual base of some data, especially secondary data, is not a fully appropriate representation and also that some data critical to the new questions are not even being collected.
>
> Bonnen, 1977 p. 388

These two forms of obsolescence define the scope of this paper. Certainly, farming is more complex than it was forty years ago when Bonnen first identified systematic data deficiencies to the agricultural economics profession. But this makes it even more misleading to think that the solution to data deficiencies is simply technical in nature. More money and larger sample sizes cannot resolve the problems of conceptual obsolescence, so we must first resolve the big questions of: what is a farm, who are the relevant farmers for policy, and what does society expect from farms and farmers? It is only then that we can identify appropriate policies and the data systems that support them.

In Canada the last twenty years have seen a major reorientation of farm policy, away from a focus on commodity price support and maintaining levels of farm income, to a focus on business risk management and improving the environmental impact of farming[3]. A clear consequence of moving to whole-farm based, risk management focused policy is that aggregate statistics describing average conditions in the sector are no longer very relevant (Freshwater, 2007a). Instead, much greater detail is required, not just about the farm, but also about how the farm fits into a larger financial structure, since the relevant risk is portfolio dependent.

Farm Policy, Farm Structure and Farm Data

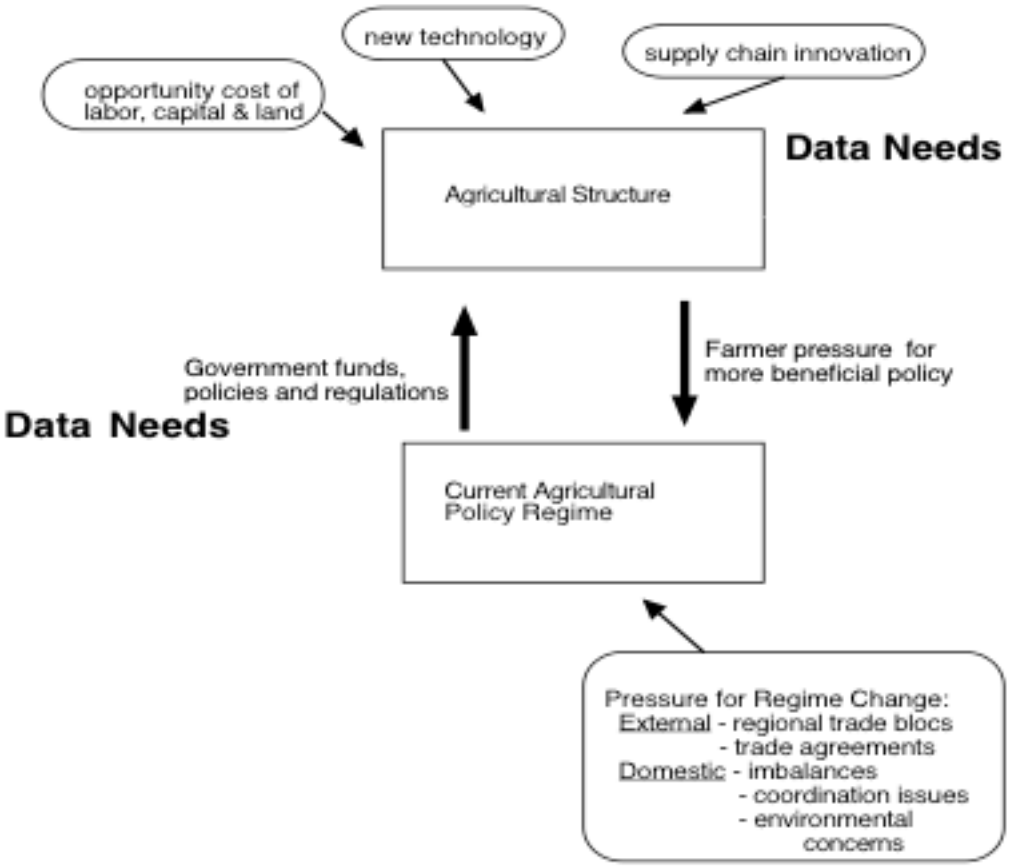
Figure 2 provides a schematic of the major relationships between farm structure and policy[4]. In the figure structure and policy are directly coupled and thus jointly

[3] Certainly, ongoing support for the supply managed commodities remains a departure from this general trend.

[4] The bottom half of the figure is based on Moyers and Josling (pp. 38-42). The top half incorporates the authors' beliefs about the main external drivers of farm structural change. In practice the forces influencing policy and structure are not as specialized as the figure suggests. For example, changes in terms of trade can have a direct effect on

determined. Farmers lobby policy makers for more favorable policy. And, policy influences farm structure by defining a regulatory environment and by providing financial support to farms. Moreover, the nature of this support may disproportionately favor particular sizes of farm, specific commodities or certain regions. In addition, policy may influence structure by constraining farmers' behavior by: restricting production practices, imposing cross-compliance regulations or specifying output quality standards.

Figure 2: Policy and Structure Dynamics



An important difference between structure and policy is that adjustments to farm structure tend to evolve in a fairly continuous way, with farmers continuously adapting to market and non-market signals. Policy, by contrast, largely evolves in jumps, similar to the tectonic forces of geology. As a result, a large amount of the agricultural economics policy literature has focused on the causes of policy inertia (Anderson, 1998; Coleman, 2001, Friedman, 1999; Rauser, 1992). The model of relative stability

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structure if farmers respond in various ways to the change, as well as an indirect effect on structure through policy adjustments.

punctuated by periodic non-marginal changes has led to the idea of policy regimes and regime change as a way to understand how policy evolves (Coleman, Skogstad and Anderson, 1996). The process is similar to Kuhn's description of paradigm shifts in science, particularly in terms of the period when conflicting paradigms struggle for dominance (Kuhn, 1996).

In addition to direct interaction there are important external influences on both structure and policy that also result in pressures for regime change. Moyer and Josling identify five major pressures for policy regime change (pp. 39-43). These are divided into external and domestic pressures. External pressures from broad movements for trade liberalization are well known. The two key elements Moyer and Josling identify are first the rise in regional trade blocs which lead to the integration of agriculture within the member countries. And then, of course, the general reduction of trade barriers through broad multi-lateral agreements that has had significant impact on agricultural policy. But interestingly, despite their trade oriented background, Moyer and Josling believe domestic pressures are more important than external pressures for causing shifts in policy regimes (p. 39). They describe three key domestic forces:

1. An increasing imbalance between production and demand that leads to increases in surplus production that cannot be managed by traditional policies at acceptable costs,

2. Major restructuring of agricultural supply chains in ways that increase functional integration and encourage product differentiation, with these changes being incompatible with existing policy signals for the production of bulk commodities and which lead to undesirable policy outcomes in the form of volatile prices and supply restrictions, and,

3. Growing pressure from citizens for a more environmentally responsive agriculture that produce safe food without adverse consequences for water, soil or wildlife. (pp. 38-39)

Moyer and Josling largely ignore the implications of these forces on the structure of agriculture and focus specifically on the implications for policy regime change. However, linking structural change in farming with shifts in the policy paradigm provides a useful way to understand the evolution of the policy environment. While Moyer and Josling recognize the macro effects of changing farm structure and the changing coordination process for agricultural commodities they leave out the farm level implications. These are important for two reasons. The first is that macro effects are the aggregation of micro decisions. The second is that change in farm structure, particularly as it affects the economic well-being of farm households, remains a specific concern of farm policy, so different structures that lead to the same macro outcome for agriculture could still have very different policy consequences if they result in different distributions of welfare.

Agricultural structure is shown in Figure 2 as evolving from three major pressures. The first is technical change, which makes new inputs and processes available to farmers. This leads to: shifts in the size distribution of farms, changes in the mix of commodities produced, both in an aggregate sense and on a per farm basis, and changes in inputs, including the mix of purchased and self-supplied. The second pressure comes from evolution of the supply chain that coordinates the marketing and transformation of farm commodities. The major transformation here is the importance of non-market coordination forces including vertical integration, contracting and other non-arms length repeated exchanges. The final major pressure is the evolution of opportunity costs for labor, capital and land. Increased opportunity costs for labor initially led farm household members to abandon farming, but now it mainly leads to mixing farm and non-farm employment. Similarly, we have traditionally assumed that the farm enterprise had the fist claim on household capital, but this is no longer as appropriate an assumption as it once was. Finally, land has opportunity costs, not just in conversion to non-farm uses, but increasingly for the production of non-commodity outputs, such as wildlife habitat on recreation amenities.

As Bonnen noted, the agricultural information system has to adapt its concepts and data sets to these sorts of change if it to remain relevant. In the schematic of Figure 2 data plays two distinct roles. The first is to facilitate a better understanding of how structure is evolving and how that leads to pressure from farmers on the current policy regime. This type of data is particularly important when the pressure for policy change is great. When there are competing regimes/paradigms, the choice of which one to embrace should be guided by a sound grasp of what is going on in farming. The second function of data is the more traditional role of supporting the monitoring of policy performance. This includes the collection of traditional forms of: data that support performance indicators, like net farm income; data on cost of production; and data for monitoring compliance with regulations, such as, water quality, soil erosion and nitrogen run-off. It must be recognized that, while these data requirements may be ongoing, their validity and utility may deteriorate over time if the underlying concepts fail to keep up with structural change.

What Does Complexity Entail?

The background paper for the workshop describes various practices adopted by large farms that differentiate their behavior from the standard model of the family farm (anonymous, p.2). The differences described largely involve marketing and management functions of the farm. This suggests the problem of complexity is not a production issue *per se*. If we accept this to be the case, then it is not surprising that we have difficulty in capturing the changes in behavior because the main focus of our existing data system is on the production of agricultural output and the income that results, assuming parametric prices. But if how commodities are marketed affects how commodities are produced then we have to expand the scope of the data we collect.

Essentially what we are now seeing is an environment where prices for many farms are not parametric to the firm/farm, but are endogenous and determined through a repeated bargaining process or through something other than a competitive spot market. This is important for three reasons. The first is it means that to understand farms we need to consider more than their production decisions. The second important point is that there is a considerable range of alternatives to spot markets, so diverse behavior is present and this is further complicated by the ongoing use of spot markets by some producers, including the majority for some commodities. The third point is perhaps the most important. Prices are signals for future behavior, as well as rewards for past actions. Changes in relative prices provide signals for desired levels of future farm output and if these signals are distorted then resource misallocation can occur. If observed prices reflect more than a simple exchange, or fail to capture a significant share of transactions, the value of prices as signals for future action is impeded.

While it might be possible to get better output and income data by refining survey instruments and sample frames to better capture the actual production and earnings of farm enterprises that fall outside the current data collection process, this approach only papers over the cracks. If the observed behavior of farmers has changed, we should ask why this has happened and examine whether the current data concepts, which underpin our data collection methods, are still valid. In particular, if the structure of agriculture has changed and the policy context has changed, we should first ask what it is we now want to know about farms and farming, and only then move on to how we go about collecting the data.

A complicating factor in data collection and analysis is the longstanding interest in the level of aggregate production as well as in farm household well-being. The distinction leads to the necessity to collect data that describes conditions in the sector (aggregate output and prices by commodity, stocks and planting decisions, exports and imports) and conditions of farm families (the distribution of income, distribution of support, sources of income, allocation of labor). However, increasing complexity has effectively decoupled these two data streams. Knowing levels of aggregate production now tells us little about the well-being of farm households, and *vice versa*, whereas it did when the majority of farms were full-time family enterprises that accounted for the majority of output.

Our position is that the discussions of complexity, as described in the background paper for this workshop (anonymous), and in other papers by Blandford; and by Johnson, Morehart, Culver, Poppe and Salvioni, are actually responses to the issues of: what are farms, who are the farmers and what are their objectives, and what are the objectives of farm policy? These three papers focus on important, but instrumental, issues, such as, the role of contracts, changes in tenure patterns and the importance of measuring the value of all outputs, not just commodity outputs. But the authors do not ask why these changes are taking place, nor how the changes influence and are influenced by policy. Fundamentally, complexity in farmer behavior is driven by farm decision makers having

new objectives and reacting to new opportunities and constraints[5] and understanding the forces that drive behavior is the first step in constructing new data concepts.

The Nature of the Farm

A central conceptual question is what is a farm? Typical answers to this question in Canada in the past involved the production and sale of some minimum value of specific commodities. More recently the census definition of a farm has eliminated any minimum sales requirement (Statistics Canada, 2009). But the definition continues to only reflect one perspective of the enterprise, and implicitly makes assumptions about the objectives and organization of the firm. In particular, the standard concept of the farm focuses on production of commodities as the defining attribute. Allen and Lueck approach the concept of a farm from a different direction by seeing the farm as a nexus of contracts (1998; 2002). This is consistent with modern theories of the firm that have shifted the focus of analysis from how the firm makes things to how the firm organizes its activity (Barry, Sonka and Lajli, p. 1221; Kroszner and Putterman, p.7; You, p. 442).

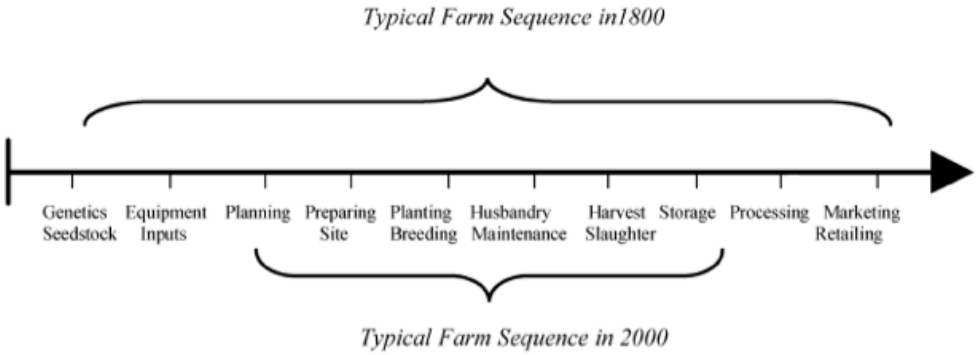
A useful starting point for a discussion of the economic nature of the farm is Coase's theory of the firm where he examined the make versus buy decision (Coase, 1937). Coase observed that a firm chooses those goods and services it produces internally and those that it purchases from an outside vendor. Various factors influence this decision, including the availability and price of external goods and services, and of course the level of transactions costs. Using this approach, while the firm still remains engaged in production, the important economic decisions are how it assembles the resources it needs for production, not the specific mix of inputs or the volume of output. Over time farming has moved from a situation where the vast majority of the production requirements were produced on the farm to a situation where the vast majority are purchased. That is, the "make versus purchase" decision has changed considerably. Mechanization replaced animal traction, synthetic fertilizer and pesticides became available, and farmers increasingly purchase seed and replacement livestock externally rather than using on-farm genetic material (Cochrane, 1993; Mundlak, 2000).

Part of this process has been an increasing specialization of farms in a small number of commodities (Dimitri ,Effland and Conklin, 2005). Moreover, farming has also moved to reduce the role of farmers in the producer to consumer food supply chain (Barry, Sonka, Lajli). Far more of the processing and marketing functions are carried out beyond the farm gate than in the past. The result has been a far higher degree of specialization. Allen and Lueck discuss this change in their review of contracts and use Figure 3 to show the changing sequence of farm based activities from 1800 to the end of the 20th century (2005). Contracts can be said to be important for examining agricultural structure because they extend Coase's make versus buy decision in an important way. An

[5] It is the decision maker that is the focus, and not the farm, because the farm is a geographical space that provides the location where the consequences of decisions are observed.

exchange takes place, but it is not a normal market exchange. Contracts introduce an exchange process that is outside the traditional model of agricultural markets idealized in models of perfect competition (MacDonald *et. al.*). And, because contracts are used more by larger producers and are more common in some commodities than others, our understanding of behavior becomes more difficult for firms engaged in contracting, if only because the data and information are often proprietary and specific to each farm/firm.

Figure 3



source: Allen and Lueck

Just as the farm is increasingly integrated into the food and fiber supply chains, so too are farms integrated into the larger rural economy. When farming was the dominant economic activity in rural areas and important consequence was that farm resources, labor, capital and land, had low opportunity costs. Spatial isolation made connections to the urban economy expensive and time consuming, so it was hard to identify nonfarm opportunities and difficult to act upon them without giving up the farm. But for the majority of farms in a modern rural economy this no longer the case. In particular labor and land have important opportunity costs. This can be seen in the declining share of "full time" farms and the prevalence of off-farm employment among operators in all size classes of farm in Canada (Jette-Nantel *et. al.,* 2011). Off-farm income has been the main reason that farm households now have average incomes in excess of the Canadian household average.

Moreover, off-farm employment has not only raised Canadian farm household incomes, it is now perhaps the dominant strategy for farm risk management (Freshwater and Jette-Nantel, 2011). By building a portfolio of income sources that are relatively uncorrelated, farm households may be able to accept more risk in their farm activity, with little impact on aggregate portfolio risk and higher returns, especially if they can convince governments to "top load" risk mitigation payments . If we only measure risk in terms of variability of farm income instead of total income then it may appear to

policy makers as though the underlying risk inherent in agriculture has significantly increased, when in fact it is has changed very little and by increasing farm risk the performance of the portfolio is improved.

Who are the Farmers?

While it is difficult to separate the definition of a farm from the definition of a farmer they are distinct concepts from the perspective of agricultural policy. Policy has always had two interwoven themes. The first is a concern with the production of commodities, and from this perspective it is the farm that is important. However, a second major theme of policy has been the well-being of the farmer and the farm family.

As farms have altered the mix of activities they are engaged in, the question of what functions are required to be carried out in order to be considered a farmer has become more challenging. What does an operator do? Is it simply decision-making, which is the implication of modern "nexus of contracts" perspectives on the nature of the firm, or is engagement in actual production by the operator important? Is a land-owner who engages in share-contracts where she makes some decisions an operator? If the farm is an incidental business with negative net farm income, is the owner an operator? In a vertically integrated structure where the "farmer" supplies labor and some capital but plays no meaningful role in decision- making, is that person an operator?

Finally, if we believe that the appropriate focus of agricultural policy is the aggregate level of output of commodity and perhaps non-commodity outputs, should we even address the issue of operator well-being? Since farm households are now on average better-off than the average Canadian household, has this policy focus become obsolete?

But, if Canadian policy is now focusing on business risk management, and is providing support to farm enterprises, because there is a perception that farming is inherently too risky to be left on its own, then surely we need to gather data and assess it to see if farms do face excessive risk. And, just as surely, the information we are interested in will concern how risk affects people and not just commodities. Risk is a relative concept specific to a particular farm. Importantly, the risk of two identical farms can be different if the two farms are embedded in different portfolios of assets and incomes. High risk on one farm may be inconsequential in a portfolio where it is uncorrelated with other forms of income and wealth. Or, it could be high for a full-time farmer who has no portfolio diversification effects. Since the connection to these portfolios is through the operator/owner, the only way we can assess risk is by looking more deeply at the individuals who control the farm and have claims on its income.

Getting the definition of the farmer correct is crucial if we are to understand the management objectives of the farm. Simple farm/firm enterprise profit maximization models underpin the definition of the family farm. But the people on this traditional full-time family farm, almost by definition, have no significant non-farm opportunities for their labor and capital, so the standard model of the firm is largely consistent with the actual behavior of the family. However, when both farm labor and capital have

opportunity costs; or the farm is integrated into a larger decision-making structure, say a household or a corporation; or even if a long-term contract exists, then the standard model of the firm, with its assumption of profit maximization and parametric prices, may be too simplistic.

Complexity, Structural Change and the Objectives of Agricultural Policy?

Changes in behavior have led to high levels of structural heterogeneity in agriculture. Farms now differ in terms of: size, the mix of inputs purchased, the number and type of commodities produced, and the mechanisms by which outputs are marketed. At a minimum this heterogeneity makes it difficult to speak meaningfully about the sector or industry, and makes policy more problematic to design and implement (Blandford, p. 31). Historically policy was developed on a commodity basis, but today if only a small proportion of farms produce any specific subset of commodities and if commodity support flows mainly to the subset of these farms that account for the majority of production, then can policy be effective? The shift in Canada to a farm specific gross margin approach for the entire farm business is one way of addressing the increasingly diverse structure of agriculture, but the new policy approach raises other issues.

As noted earlier, agricultural policy has historically had two distinct concerns; the level of output and the well-being of farmers – that is, a concern with farms/firms as producers of commodities and with farm families as the people engaged in agricultural production. When policy was first instituted in the 1930s these were compatible perspectives, because farms were of fairly uniform size and had a considerable overlap in the range of commodities produced. Support for a small number of major commodities provided support for the vast majority of farmers because most farms produced at least one of the supported commodities[6]. And farm households benefitted relatively evenly from the support provided.

In Canada an alternative perspective on the dual nature of agricultural policy was emphasized by Crown and Heady, who in 1972 proposed a major reform of Canadian agricultural policy that would shift the focus from commodity support to income support, but with different programs for commercial and noncommercial farmers. Their work in a sense anticipated the Canadian policy reforms of the 1990s in that they too emphasize the importance of income stabilization for commercial farms. “The need for stabilization policies has long been recognized because of the nature of production cycles, weather variation, market fluctuations, and so on. However in the past it has been price stability that was sought, not necessarily income stability.” (Crown and Heady, p108). But Crown and Heady envisioned an adjustment of sub-commercial

[6] In Canada policy has also had important geographic and commodity differences. Western Canada tended to receive policy that was much more geared to facilitating exports while supporting incomes, while Eastern Canada received policy that raised farm incomes by managing the volume of production in domestic markets (Drummond, Anderson and Kerr, 1966).

farmers out of the sector over time and with government support, so that only commercial farmers would remain (p. 109).

The approach of Crown and Heady differs little from the current policy and analytical focus on large farms, because they account for the majority of production. Because Crown and Heady focused on the farm, rather than the farm household and because they assume objectives of enterprise profit management it seemed inevitable to them that sub-commercial farms should, and would, disappear. But they didn't, which begs the question of why not? The only sensible answer is that the assumptions underpinning the analysis of Crown and Heady were incorrect, i.e. their concepts were flawed. Commercial farms may well be understood by appealing to a standard model of the firm, but small farms typically require a more complex approach that involves household utility maximization and portfolio analysis.

We suggest that if the standard model of a farm as a profit maximizing firm failed to forecast behavior in the 1970s, it is clearly a poor model for the analysis of farm policy today. Complexities in farming have only increased and farming has evolved form the simple dual structure described by Crown and Heady into something that is far more heterogeneous. Returning to Bonnen, we clearly need better data concepts.

Some may propose that non-commercial farms should be ignored for policy purposes, which is fundamentally the Crown and Heady approach. But a number of rebuttals to this approach exist.

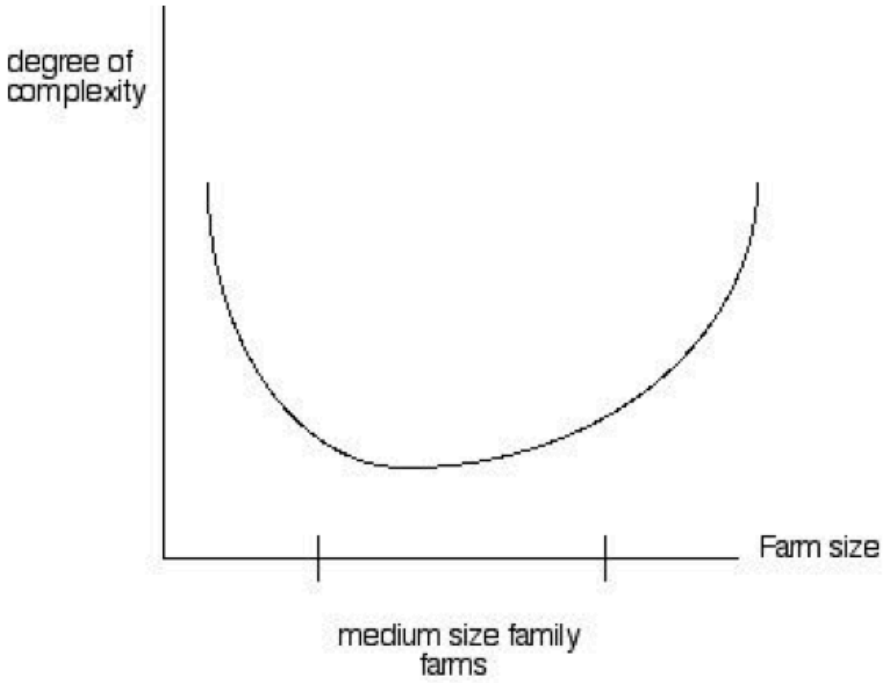
> First, there is no obvious or clean determination of commercial. Any criterion is essentially arbitrary and it is impossible to explain how the farm that just qualifies as commercial is meaningfully different from the farm that just fails to qualify.
>
> Second, the resulting number of farms would be rather small. From a political perspective the main reason for having a definition of a farm that maximizes farm numbers is that it maximizes farm numbers. This allows average levels of government expenditure per farm to look more reasonable to the average citizen than would be the case if the denominator was twenty percent, or less, of the current number of farms.
>
> Third, small farms account for a much larger share of farmland than their share of output, which is increasingly important as farm policy includes non-commodity concerns. In particular, small farms may be more useful in meeting agri-environmental targets, especially for amenity and habitat objectives, because they: are less likely to be engaged in monoculture, are more likely to employ extensive production methods, and are often located on more marginal land, which has an inherently higher environmental impact.
>
> Fourth, in terms of behavior, it is increasingly less clear that large farms fit neatly into the simple profit maximizing model of the firm/farm. This is as much true for

assumptions about objectives as it is for behavior. While large farms may not have the same objective function as small farms it is increasingly clear that a simple profit maximizing model of the farm enterprise is appropriate.

Fifth, while the volume of commodity output is a focus of agricultural policy, the well-being of farm households has always been another focus. If the domain of agricultural policy is redefined to exclude all but the largest farms, then it is relevant to ask, why we might need policy for farms, and what should be done to support low income households who are engaged in farming but are not eligible for farm policy support?

It seems that the inevitable conclusion to be drawn is that the only farms that are not complex, are the full-time family-size farms that are the archetype of our current data systems and policy. As noted earlier, behaviorally these farms tend to focus on maximizing profit from the enterprise, because it is the dominant source of household income. They rely mainly on spot markets to buy and sell. The farm has the first claim on family labor and capital. And, policies providing income support are crucial for these enterprises because they have "all their eggs in one basket". The farm is their only meaningful investment and source of income. Both smaller and larger farms diverge form these conditions in significant ways, which makes them inherently more complex, and because farms of these types are dominant in agriculture we need to rethink our data and policy concepts. Figure 4 suggests how complexity relates to farm size. The least complex farms are the traditional focus of agricultural policy - the medium size farms where the farm is the focus of the household and an objective of profit maximization at the farm enterprise level makes sense. By contrast, both large farms

Figure 4: Farm Size and Degree of Complexity



and small farms are characterized by complexity. For large farms this reflects, the role of contracts, complex ownership arrangements and the decision to purchase many of the functions that a farm is typically seen as carrying out internally. For small farms the complexity largely arises from objectives that can conflict with enterprise profit maximization. For both large and small farms, labor, management, capital and even land, can have significant opportunity costs that lead to these factors being used for something other than farm production.

Over time a small share of farms, the largest, have accounted for an increasing share of output for virtually all commodities. Instead of there being a relatively flat and symmetric farm size distribution that would reflect medium size farms producing the majority of output, now a small number of large farms produce the vast majority of output and a large number of small farms produce a small share of output. From a commodity perspective the main focus of policy should be large farms. But from a farm household perspective the main focus should be small farms, because they are both the bulk of the farm population and low income is more common among small farms. Further, if policy goals are broadened to include agri-environmental outcomes, small farms may be important because they manage a large share of the land base and often they are both more amenable to extensive approaches that increase noncommodity production and operate on land that is both more environmentally fragile and has high amenity value.

In the middle part of the twentieth century both farm numbers and farm output were dominated by full time, family size farms. While this term has no consistent definition it is generally held to cover farms where a single farm household: supplies the majority of the labor and capital, lives on the farm and intends to pass the farm on to subsequent generations. In addition, income from the farm, including government support, is sufficient to provide a reasonable living for the family and support an on-going business. Large and small are imprecise terms, but farms with less than $50,000 in sales are certainly small, while farms with more than $1 million in cash receipts are large.

Figures 5 and 6 provide some basic information from census data for small and large farms using constant dollar sales classes, with the GDP deflator as the basis for adjustment. The share of small farms in the total population has increased slightly over the interval, even as the total number of farms in this group has declined, and is just over 50% of all farms. These farms have been getting physically smaller over time as their share of the land base is declining, even as their numbers decrease. And their share of farm receipts is declining so that they now account for less than 5% of sales. Moreover the majority of these farms have negative net farm income, with only 35 - 45% reporting positive net farm income across the census periods. Average net realized income has fallen from -$3,206 in 1986 to -$5,119 in 2006.

By contrast, large farms remain a small share of all farms although they have roughly doubled in number between 1989 and 2006. They account for just over 2.5% of all farms in 2006. But they now produce just under 40% of all cash receipts on just under 10% of

the farmland. Clearly the value of their output is growing much faster than their numbers and their land base. Between 83% and 92% of these farms reported positive net operating income over the five census periods and this income has increased from an average of $211,845 in 1986 to $379,035 in 2006.

Figure 5

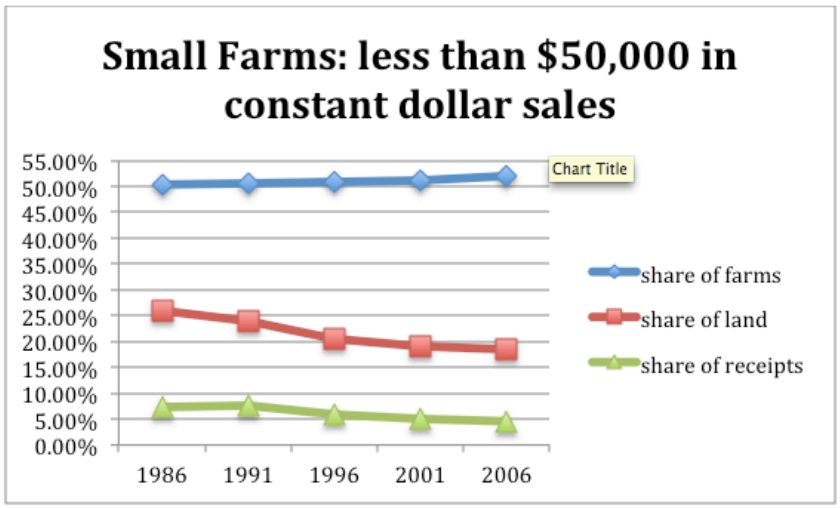
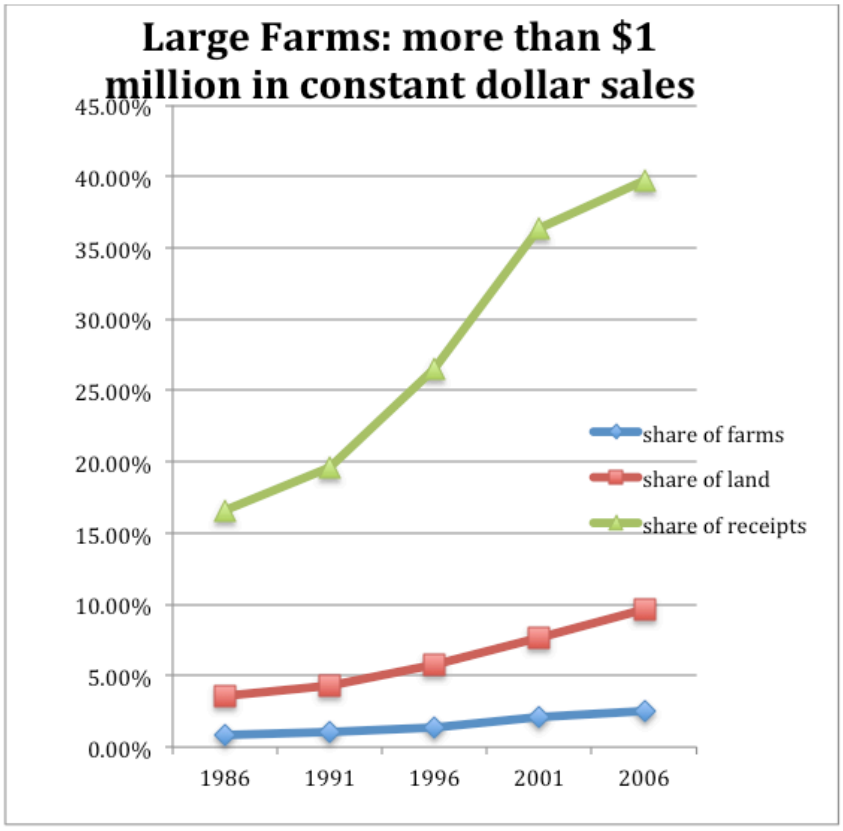


Figure 6



Farm numbers declined from 293,000 to 229,000 between 1986 and 2006, with more of the decline occurring in the middle of the sales distribution, even using these very conservative definitions of large and small farms. Both the extreme size classes have grown in relative terms over time and collectively now account for about 55% of all farms. Clearly something other than profit motivates farms with sales less than $50,000 since they persist as the majority of all farms while consistently losing money over the twenty year interval. And, the largest farms more than doubled their share of output while increasing the absolute number of farms in the category, even after adjusting for inflation.

Responding to Complexity

Clearly farming has become far more heterogeneous over time. This alone results in complexity for data collection. While it may have been possible to ignore corporate farms as outliers playing only a minor role in agriculture in the past, this is no longer possible. Another clear consequence of heterogeneity is that it is increasingly difficult to speak of the sector, or "the industry" in a meaningful way. Not only do farms have a variety of objectives, but vertical integration and a variety of supply chain relationships make it hard to know where to place the farm gate. While the simple data concepts based on the full time family farm that managed risk by producing a diverse set of commodities no longer make sense, it is hard to identify precisely what data concepts should replace them.

This task is far beyond the scope of this paper, but we consider four of the main influences of complexity in the remainder of this section. How agricultural policy is defined and redefined must influence the data that is collected. As farm households have become integrated with the rest of the economy the objectives of the farm have changed to reflect the significant opportunity costs of committing labor, capital and land to the farm enterprise. In response the organization of farms has changed, in part in response to changing objectives and opportunities, but also because of evolving supply chains. Finally, although net farm income remains the dominant summary indicator of the performance and well-being of agriculture, it no longer provides good information.

<u>New Policy Goals</u>

The current generation of Canadian agricultural policy, Growing Forward, no longer mentions family farms or farm income in the key policy objectives. The three main categories of policy objectives are: a competitive and innovative sector, a sector that contributes to society's priorities and a sector that is proactive in managing risk. Looking below these broad statements reveals concerns with: food safety, environmental protection, better regulatory performance and improving market access. The main link

to the traditional “farm problem” focus on farm financial performance is the set of Business Risk Management (BRM) programs.

The scope of agricultural policy now extends well beyond the production of commodities on the farm (Skogstad, 2011). Food processing is now a key element as the word “Agri-Food“ in the name of the department suggests. Similarly, the environmental impacts of farming are a major part of AAFC’s responsibilities. Policy now looks forward and backward from farm production in defining the sector and this broader perspective can lead to regulations and programs that may not be optimal for farming narrowly defined in terms of commodity production.

BRM programs have moved beyond supporting the level of farm income to mitigating risk. But this policy shift has increased the importance of accurate farm level data and in more fully understanding the objectives that the owners and operators have for the farm enterprise. Because the level of risk is specific to an individual farm and its management, and because the impact of risk on the farm owners is affected by how the farm fits into the complete portfolio of income sources and assets of the household or corporation, it is crucial for sound public policy that data is not only collected at the farm level but also in a way that includes all other elements of the income generating portfolio.

Beyond BRM, assessing how well other policy objectives are met would seem to require major data collection initiatives that go far beyond the traditional set of agricultural statistics. Assessing environmental performance seems to require farm level information on soil water and habitat quality. Food safety requires traceability. Regulatory performance requires the government to measure its own activity, and so on. Returning to Figure 2 , if the policy regime has changed then data will be needed that supports the policies that implement the objectives.

Most importantly while the objectives in Growing Forward are couched in terms of “the sector” there is considerable ambiguity in what this covers. Clearly it goes beyond production agriculture, but how far? In addition, the broad policy statements are silent on who are the farmers and farms of interest. When the focus is productivity and competitiveness are small farms important? While Growing Forward recognizes some of the connections of agriculture to other parts of the economy, for example science and innovation, and environmental impacts, it is silent on other aspects such as, rural development.

Farm Decision-Makers Objectives

Ultimately the behavior of farm operators and other decision makers is driven by their objectives for the farm. Once the decision locus for managing the farm moves beyond the farm business the a variety of objectives become possible, and these in turn can lead to important differences in observed behavior. Plausible objectives might include:

1. Maximize enterprise profit
2. Maximize profit subject to preserving supply chain relationships
3. Maximize holding company profit (farm is embedded in a group of enterprises with common ownership)
4. Maximize household utility
5. Maximize tax shield benefits
6. Maximize long-term, multi-generational viability

Beyond difference in objectives, it is important to also recognize the impact of constraints. For example, incomplete markets, uncertainty and asymmetric information may lead to behavioral differences even for farms with the same objective because the constraints facing specific farms may vary considerably. Policy either alters objectives or modifies constraints as a way to influence behavior.

In particular, the large number of small farms makes thinking about diverse objectives important. The economic performance of the sector improves considerably if farms with sales of less than $10,000 are excluded, because these farms account for a very small share of sales but a large share of expenses. But in Canada negative net market income characterizes all farms with sales of less than $100,000. If only commodity production is considered this sort of truncation of farm numbers may seem appropriate. However, if the goals of agricultural policy extend beyond increasing the volume of commodity output then it becomes harder to rationalize eliminating the majority of farms and farm households from consideration.

Diversity of objectives is not just a small farm issue. Large farms can be organized into multiple specialized corporate entities that engage in transfer pricing to shift profits. These corporate entities can also have non-farm subsidiaries that can play a role in the allocation of capital and labor. Many large farms in Canada rely on off-farm income to a significant extent. It is striking how many operators of very large farms engage in non-farm employment activity. In 2008 for farms with more than $1 million in sales about 66% of farm operators reported off-farm wage and salary income ($54,145 per reporting operator), and 9% of the farms in this sales class reported non-farm self-employment income ($26,999 per reporting operator). Average net market income for farms in this category was $103,171, so if farms with operators with off-farm earned income also earned the average level of net farm income they generated about 75 % more in earnings than the market provided to the farm.

Farm Organization

How farms are organized is mainly determined by: the objectives of the firm owner, the policy regime in place at the time and the exchange relationships in which the farm operates. These exchange relationships include markets, but they can also include contracts, barter and reciprocity. The policy regime includes not just farm policy but all forms of policy that affect farms (Freshwater and Reimer). For instance one might expect fewer farms in Canada to be involved in off-farm employment than in the United

States because of universal access to health care. For US farm households the direct purchase of health insurance is both expensive and of limited benefit, which encourages one member of the farm household to find employment that offers employer provided health insurance for the entire family.

Vertical coordination in supply chains has increased as processors try to brand their products to achieve better prices and try to achieve better control over the quality and timing of their purchases. At the farm level this has led to stricter quality standards and more precise delivery schedules than can be achieved through spot markets. Because the terms of contracts can vary over time and among farms our understanding of farm level decisions is impaired as is our ability to measure the returns to farms and farmers. As contracts displace spot markets the value of prices captured by traditional data methods declines.

An under-investigated aspect of organization is the impact of the tax code on farm decisions. For different sales classes different organizational forms may be more advantageous. Incorporating imposes a number of accounting and organizational requirements on a firm, but it can provide benefits for, estate management, payment of family labor, control of assets, and financing. Corporations are particularly important for farms where multiple individuals are investors. Typically these are larger farms that can be motivated by financial returns, but can also be owned by religious groups or other organizations. Corporate farms are by far the most common organizational form for farms with sales in excess of $1 million. While in most cases a corporate farm is simply a large family farm, a significant share of these farms (13.5%) do not appear to be closely held. Non-family corporations make up 11% of farms with between $1 million and $5 million in sales and and these non-family corporations account for 31% of farms with sales in excess of $5 million.

Farm Income

Aggregate net farm income remains the summary performance indicator for agriculture, despite it being one of the most flawed concepts in the agricultural data complex. The ongoing importance of net farm income as a politically sensitive statistic cannot be overstated. As recently as 2004 the major producer interest group in Canada, the Canadian Federation of Agriculture, used several years of reported low levels of realized net farm income to press for higher levels of support. Yet, while reported income levels were low, there was no indication from coincident indicators of financial stress, such as, farm foreclosure rates, draw downs in government sponsored revenue insurance funds, and levels of capital outlays by farmers, that a financial crisis existed (Freshwater, 2007b).

While political pressure from farmers continues to emphasize the level of farm income, this is no longer a policy priority in the stated objectives of AAFC. The policy shift in Canada from supporting levels of farm income to reducing the variability of farm income at the individual farm level has greatly reduced the value of focusing on aggregate net

farm income. The problem is that for over seventy-five years this statistic has been the starting point for discussing agricultural policy and the condition of agriculture. But now improving the way aggregate farm income is measured is not particularly useful in understanding how well farm households are doing, or even for assessing the impact of the BRM programs.

In those parts of agriculture where there is vertical integration, transfer pricing decisions will affect income at the farm level. This means that even if we are able to determine prices at which exchanges take place the price may not mean what we think it does, because it does not reflect an arm's length transaction. In addition, net farm income is highly volatile both for legitimate and statistical reasons since it is the difference between two estimates - gross income and expenditures. Aggregated income also tells us little about sub-sector conditions. Some commodities may be generating high levels of income while other are not. Indeed crops and livestock net incomes tend to be consistently negatively correlated. But if we are interested in the condition of farmers estimated net income per farm is an even more flawed indicator. Averages may have been meaningful when the farm sales distribution was well behaved, but with heterogeneous farms an average is a highly flawed. Moreover, there are good reasons to believe that reported net income systematically understates actual farm income (Freshwater, 2007b).

Differences in objectives can cloud the interpretation of performance metrics. Recent calculations by AAFC show that large farms have higher rates of return on assets (ROA) than do small farms. Rates of return between 2000 and 2009 averaged 6.15% for farms in the $1 million plus sales class and 2.11% for farms with sales between $30,000 and $250,000. In general, farms with sales greater than $250,000 had an ROA at least double the average for farms with sales less than $250,000. If we suppose that farms are invariant in terms of objectives and structure across size classes these results would suggest that further increases in the role of large farms could enhance the competitiveness of Canadian agriculture.

But this conclusion may be premature. Clearly since the majority of farms with sales below $100,000 have negative net farm income they will necessarily have a negative ROA. But if their objective was not profit maximization and they show no sign of abandoning the sector it may be irrelevant to press for farm consolidation. Second, it appears that ROA for large farms is more variable than for smaller farms. Large farms experience higher rates of profit in periods of high prices, but ROAs tend to converge across sales classes to the level of small farms during low price intervals. This suggests that income stabilization programs, like the BRM suite, may provide disproportionate benefits to larger farms, because they have higher farm earnings variability. In this case large size farm profitability may be in part an artifact of policy. Further, if large farms were simply technically more efficient it is not clear why their ROA should collapse during down-turns.

Conclusions

Increasing complexity in agriculture has made many of the statistics that are collected to assess the economic performance of agriculture unreliable, and perhaps irrelevant. While we may still have great confidence in our measurement of physical quantities, our ability to understand revenues, costs and returns to farming has become impaired. Improving the data system for agriculture has to start with the fundamental elements that produce data concepts, just as Bonnen identified decades ago. While the family farm/firm remains the basic production unit of agriculture, it is now a production unit that is integrated into a more complex decision making environment. Large farms behave differently than small farms, but they are both complex. And, to develop better information on how they behave we will need to think about them differently than in the past.

For most Canadian farms agricultural policy now supports farm income by reducing the variability of income. The rationale for this shift in policy regimes reflects complicated domestic and external forces, including: efforts to reduce U.S. trade conflicts, a desire for greater predictability in outlays by the Canadian government, and a weakened rationale for supporting the level of farm income (Hedley and Freshwater, 2004). But the implications of moving to individual farm support from commodity support are huge for data collection and analysis. Risk is an inherently subjective concept that is only partially captured by the variance of agricultural prices or income. Consequently, if policy is to actually reduce risk, rather than simply supplement income through a different mechanism, far more data has to be collected about how farm income and its variability contributes to the stream of total income of decision-makers. When examining the performance of a portfolio it is crucial to adopt a multi-year perspective, and not just think of a series of annual snapshots.

An important decision will have to be made about which farms are part of the data collection system. Guidance for this must come from the objectives of Canadian public policy. If agricultural policy is largely restricted to the analysis of commodities and the development of markets then we may be able to greatly reduce the number of farms in the domain. Potentially only farms with sales greater than $250,000 need be examined, since these farms account for 75% of the value of production and typically generate enough net farm income to allow full time farming. However, this would reduce the farm population of interest to less than 17% of the current 230,000 farms, and reduce the amount if land in “farming” to about 40% of the current land base. This might have significant political ramifications for the continued existence of farm programs and the fulfillment of the current policy objectives in Growing Forward.

If on the other hand the domain of farming is left as it is currently defined, it is impossible to maintain the current information system with its dependence on the fiction of homogeneity embedded in the idea of the family farm. Major investments in rethinking how data should be collected and interpreted will be required. Since both large and small farms have complex organizational structures this will be an expensive

proposition. It means that managers of data systems cannot simply focus on doing a better job of understanding how large farms behave, although they certainly must do this, if only because large farms account for the majority of commodity production. Small farms, while less significant for the production of commodities, play an important role in resource use and in generating political support for agriculture. Irrespective of how the definition of farms is made, because policy has expanded its domain beyond levels of output and the well being of farm households to include: environmental impacts, food safety and other concerns, the scope of agricultural data collection must also expand. This suggests another way the agricultural data system has become complex – for we now need a much richer stream of data that tells us more things about farms and their environment in order to adequately understand how agriculture is behaving and how policy is influencing its performance.

References

Allen, Douglas and Dean Lueck, 1998. The Nature of the Farm. *The Journal of Law and Economics.* 41 pp. 343-386.

Allen, Douglas and Dean Lueck, 2002. *The Nature of the Farm: Contracts, Risk and Organization in Agriculture.* MIT Press, Cambridge: MA.

Allen, Douglas and Dean Lueck, 2005. Agricultural Contracts. in C. Menard and M. Shirley (eds.) *Handbook of New Institutional Economics* Springer. Amsterdam.

anonymous. 2011. Complex Farming Establishments. Background paper prepared for the AAFC-USDA workshop on Complex Farming Systems, Niagara-On-The-Lake, Ontario, June 27-28, 2011.

Barry, Peter, Steven Sonka and Kaouthar Lajili. 1992. Vertical Coordination, Financial Structure and the Changing Theory of the Firm. *American Journal of Agricultural Economics* 74:5 pp. 1219-1225.

Blandford, David. 2007. *Information Deficiencies in Agricultural Policy Design, Implementation and Monitoring*. OECD Food, Agriculture and Fisheries Working papers, No. 6. OECD: Paris.

Bonnen, James. 1975. Improving Information on Agriculture and Rural Life. *American Journal of Agricultural Economics.* 57:5 pp. 753-763.

Bonnen James, 1977. Assessment of the Current Agricultural Data Base: An Information System Approach. in Lee Martin (ed.) *A Survey of Agricultural Economics Literature: Volume 2*. University of Minnesota Press, Minneapolis: MN.

Coase, Ronald. 1937. The Nature of the Firm. reprinted in Kroszner, Randall and Louis Putterman (eds.) T*he Economic Nature of the Firm* 3rd edition. Cambridge University Press, Cambridge: UK.

Cochran, Willard. 1993. *The Development of American Agriculture: A Historical Analysis.* 2nd edition. University of Minnesota Press, Minneapolis: MN.

Coleman, William. 2001. Agricultural Policy Reform and Policy Convergence: An Actor-Centered Institutionalist Approach. *Journal of Comparative Policy Analysis*. 3 pp. 219-241.

Coleman, William, Grace Skogstad and Michael Atkinson. 1996. Paradigm Shifts and Policy Networks: Cumulative Change in Agriculture. *Journal of Public Policy*. 16:3 pp. 273-301.

Crown, Robert and Earl Heady. 1972. *Policy Integration in Canadian Agriculture*. Iowa State University Press. Ames: IA.

Dimitri, Carolyn, Anne Effland and Neilson Conklin. 2005. *The 20th Century Transformation of U.S. Agriculture and Farm Policy.* EIB 3, USDA-ERS: Washington, D.C.

Drummond, W. M., W. J. Anderson and T. C. Kerr. 1966. *A Review of Agricultural Policy in Canada.* Agricultural Economics Research Council of Canada. Ottawa.

Freshwater, David and Bill Reimer. 1995. Socio-economic Policies as Causal Forces for the Structure of Agriculture. *Canadian Journal of Agricultural Economics and Farm Management*: special edition vol. 43, no. 5.

Freshwater, David. 2007a. Measuring Farm Net Income To Better Achieve Policy Objectives. presented at the Agriculture Canada and Statistics Canada Joint Workshop on Farm Income, Ottawa, Mar. 5, 2007. available http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1231957193695&lang=eng

Freshwater. David. 2007b. The Economic Well-Being of Farmers as a National Public Policy Issue. principal paper Annual Meeting of the Canadian Agricultural Economics Association, Portland, OR, July 2007.

Freshwater, David and Simon Jette-Nantel. 2011. Risk Management and the Role of Off-Farm Income. Presented at the OECD Workshop on Risk Management. Paris November, 2010.

Friedman, Lee. 1999. Peanuts Envy? *Journal of Policy Analysis and Management* 18:2 pp. 211-225.

Gardner, Bruce. 1992. How the Data We Make Can Unmake Us: Annals of Factology. *American Journal of Agricultural Economics*. 74:5 pp. 1066-1075.

Hedley, Douglas and David Freshwater. Agricultural Policy Reform in Canada; Progress and Problems. Presented at the OECD workshop on Agricultural Policy Reform, Paris: France, November 2004.

Jette-Nantel, Simon, David Freshwater, Martin Beaulieu and Ani Katchova 2011. Income Variability and oOff-Farm Diversification in Canadian Agriculture. *Agricultural Finance Review* (forthcoming)

Johnson, Jim, Mitch Morehart, Dave Culver, Krijn Poppe and Cristina Salvioni. 2009. Ownership, Governance and the Measurement of Income from Farms and Farm Households: Evidence from National Surveys. Plenary session presentation Wye City Group Global Conference, FAO: Rome.

Kroszner, Randall and Louis Putterman. 2009. Reintroducing The Economic Nature of the Firm. in Kroszner, Randall and Louis Putterman (eds.) T*he Economic Nature of the Firm* 3rd edition. Cambridge University Press, Cambridge: UK.

Kuhn, Thomas. 1996. *The Structure of Scientific Revolutions.* 3rd edition. University of Chicago Press. Chicago: IL.

MacDonald, James, Janet Perry, Mary Ahearn, David Banker, William Chambers, Carolyn Dimitri, Nigel Key, Kenneth Nelson and Leland Southern. 2004. *Contracts, Markets and Prices: Organizing the Production and Use of Commodities* AER 837. USDA-ERS: Washington, D.C.

Moyers, Wayne and Tim Josling. 2002. *Agricultural Policy Reform*. Ashgate Publishing. Aldershot: UK.

Mundlak, Yair. 200 *Agriculture and Economic Growth: Theory and Measurement*. Harvard University Press: Cambridge, MA.

Rauser, Gordon. 1992. Predatory Versus productive Government: The Case of U.S. Agricultural Policies. *Journal of Economic Perspectives* 6:1 pp. 133-157.

Skogstad, Grace. 2011. *An Overview of Policy Goals , Objectives, and Instruments for the Agri-Food Sector*. Advancing a Policy Dialogue Series II, Canadian Agricultural Policy Institute: Ottawa.

Statistics Canada. 2009. *2006 Census of Agriculture.* Statistics Canada: Ottawa. available: http://www.statcan.gc.ca/pub/95-629-x/2007000/4123857-eng.htm

You, Jong-Il. 1995. Small Firms in Economic Theory. *Cambridge Journal of Economics*. 19 pp. 441-462.