The Farm Business Environment and New Generation Cooperatives as an Innovation Strategy

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Complexity theory has emerged as a relatively new line of research to study the evolutionary behavior of the firm. Recent articles (Leifer, 1989; Stacey, 1995; MacIntosh and Maclean, 1999) follow the foundation work of Prigogine and Stengers' (1984) theory of how physical objects behave at the edge of chaos. This theory provides a framework for analyzing firm behavior where disequilibrium and entropy are the norms and firms attempt to navigate in highly dynamic and nonlinear business environments[2].

The literature to date has served to integrate the physical theories with managerial and organizational applications. The goal of these theoretical exercises is to understand change which is radical, all-encompassing and rapid (MacIntosh and Maclean, 1999). In dynamic and non linear environments firms are challenged by two competing strategies; exploiting their own bureaucracies to address the short run and operational while harnessing the power of informal networks and self reorganization properties for addressing acute uncertainties and the long run (Stacey, 1995).

Consistent with Austrian economics (Schumpeter, 1934) the edge of chaos is necessary for economic growth by inciting creativity and innovation. Feedback is both positive and negative in an environment of disorder. This creates new patterns, order, direction, and correspondingly innovation. Complexity theory, applied to organizational behavior, serves as a foundation for theorists to depart from the Newtonian paradigm of underlying system equilibrium and move to an alternative where disequilibrium is the

[2] See Levy (1994) as well who writes about managerial applications of chaos theory.

norm. This places the organization continually at odds with its environment (Leifer, 1989). Any stability is assumed to be short-lived at best. This paradigm is especially appealing to better understand knowledge-based economies where, diseconomies are common, informal networks are highly valuable, and end-user preferences are significant, dynamic, and highly non linear. Taken to its most extreme, planning is futile as even small events create unexpected outcomes (Levy, 1994; Stacey, 1995).

While the literature has focused on and developed theory about existence in an environment of acute flux, little work has been done about the dimensions of the edge of chaos. How do firms know the difference between short-term turbulence and structural change? What about the edge of the edge of chaos? What firm level properties and processes lead to innovation and rejuvenation? In application this is a significant challenge for managers and organizations.

Similarly, are only far-from-equilibrium states recognized ex-post? While the literature emphasises environmental hostility and a lack of fitness as important characteristics of operating far-from-equilibrium, are there dimensions other than hostility that affect organizational behavior as firms operate in unstable environments? The complexity literature appears to assume that the environment at the bifurcation point is clearly understood. Somehow drawing from the behavior of physical systems we can impute what the edge of chaos is like. We disagree. In this manuscript we extend the complexity model of the firm by drawing on the literature of organizations and their environment. Specifically we attempt to accomplish four objectives: 1) develop the notion of environmental munificence more explicitly; 2) differentiate munificence from hostility where hostility is decidedly temporal and munificence is not; 3) model munificence as a dampening as well as nurturing force; 4) empirically operationalize this more complex view of the decent towards chaos.

Firms do not entirely manage their environments nor are they entirely managed by their environments. This debate has been ongoing as organizational theorists attempt to sort out firm-level capabilities, i.e. contingency theory (Lawrence and Lorsch, 1967; Carroll, 1988) from population level forces (Hannan and Freeman, 1977). It is not well understood which force trumps in the evolutionary process. Generally speaking as environments become increasingly more unpredictable generalist firms (R-types) have the highest probability of survival because of their adaptability and low bureaucracy costs. Specialist firms (K-types) with fixed capital and an efficiency orientation are preferred in stable environments (Zammuto, 1988). The behavior of these archetypes becomes quite interesting when they are removed from their static niche environments and forced to compete for survival in a more realistic dynamic and complex world (Ng and Goldsmith, 1998).

The organizational behavior literature dealing with dynamic environments demonstrates an important element missing from the current complexity theory literature. The business environment is not simply life at the edge of chaos or among perpetual trigger events (Leifer, 1989), but a dynamic process, of varying degrees of ill-fitness. Brown and Eisenhardt (2001) describe a continual change process while others (Tushman and Romanelli, 1985; Anderson and Tushman, 2001) describe the notion of punctuated equilibrium. This dynamic process involves both convergence (incremental behavior) and reorientation (discontinuous changes in strategy).

Munificence has traditionally been viewed as a bounty from which firm fitness and survival are enhanced (Staw and Szwajkowski, 1975; Mintzberg, 1979; Dess and Beard, 1984; Anderson and Tushman, 2001). The notion being that the more resources available to firms the greater their ability to grow and thrive. Dess and Beard's (1984) seminal work, and the extensions that followed (Castrogiovanni, 1991; Rasheed and Prescott, 1992, Anderson and Tushman, 2001) empirically link munificence, complexity and dynamics in the environment with firm response.

The over-abstractions involved in the Dess and Beard taxonomy were addressed by Castrogiovanni (1991). He offers a structured framework by which researchers can invoke greater precision in their analysis and discussion of business behavior and the environment. The Castrogiovanni taxonomy involves five categories that pertain to specific levels of analysis representing the environmental system of the firm: the macro environment; the aggregation environment; the task environment; the sub-environment, and the resource pool (Figure 1). That is if we want to understand what drives a firm's fitness, munificence, complexity, and dynamic properties need to be understood at these five levels. By adding greater rigor to the Dess and Beard framework, Castrogiovanni directs researchers to correct for over simplification and is a lesson students of complexity theory can apply to their models.

The Dess and Beard concept of munificence becomes more complex with analysis across the various levels. The taxonomy highlights opportunities for substitution and cross utilization of resources and heterogeneous issues of competition (inter-firm, inter-industry, and intra-industry) (Castrogiovanni, 1991). This appears consistent with the notion of epistasis where landscape ruggedness is a positive function of industry complexity and degree of necessary inter-firm linkages (McKelvey, 1999). If indeed environmental munificence contains redundancies, compensating factors, and opposing forces across multiple dimensions and multiple levels, then firms at any one time can face a very conflicting set of signals about their environment and performance and correspondingly are challenged by a conflicting set of alternatives.

While disequilibrium as the norm and an on-going struggle for fitness make sense in this Schumpeterian world of unrelenting competition, firm responses may be varied. While the complexity literature has focused on life at the edge of chaos, understanding firm behavior in the decent to chaos may be more important for understanding optimum firm performance. In the limit, we would argue that the edge of chaos is a myth, in that it is not a discrete state. In reality it is a continuum whereby the complexity described by Castrogiovanni makes numerous types of firm-level responses possible at any time, whether they be punctuated, continuous, or radical. For example, even when managers think they are at the edge of chaos they may still have internal resources at their disposal or rates of change may not in fact be relatively acute. At any point in time comparable firms within an industry may be driven to exit, to innovate at the margin (short jumping), innovate at the architectural level (long jumping), or diversify outside of their immediate industry (cross jumping).

Part of the confusion about the decent towards bifurcation is that authors have been unclear about the time dimension relevant to the firm's response. That is, when does environmental deterioration become "hostile?" Khandwalla (1973) and Mintzberg (1979) defined hostility as the opposite of munificence without a time dimension. The complexity literature, though describing the state of the edge of chaos well, leaves the temporal nature untouched. Other authors have been less explicit about the difference between hostility and munificence but more explicit about the temporal dimension of munificence: less than one year decline/growth (Fredrickson and Iaquinto, 1989); annual decline/growth (Dess and Beard, 1984; Rasheed and Prescott, 1992; Anderson and Tushman, 2001); a two year decline/growth (Fredrickson and Iaquinto, 1989; a five year decline/growth (Staw and Szwajkowski, 1975).

While certain environmental effects do vary over time, stable environmental features too affect firm strategy and the evolutionary path. For example, one can certainly imagine certain regions of the country more conducive to innovation than others. The bounty of available resources might not be temporal but a structural feature of the location, e.g. the human resources associated with Silicon Valley. Alternatively temporal flows of available resources too affect organizational response. To account for differing dynamic properties in the environment we extend the Castrogiovanni taxonomy to include temporal dimensions at each level.

Using this extension, munificence might better represent the more static structural environmental features, and hostility the first derivative of the temporal environment. Thus at any one time the environment could be hostile and munificent. For example, over the short run (i.e. two years) performance at the task level is poor, but the resource pool may be deep enough to allow the firm to weather the turbulence with only moderate adaptation. In foresight is a firm myopic or patient? Ex-post, environmental munificence's muting of hostile signals may have been to the long run detriment of the firm. Under such complexities, the edge of chaos becomes much less definable or, in practicality, unknowable.

Also unclear are the signs of the forces emerging from the environment. Des & Beard, (1984) proposed that high munificence may allow for the accumulation of slack, in the context of that used by Cyert & March, (1963), which can provide a buffer in times of relative scarcity. We can imagine this buffer limiting adaptive behavior. The complexity literature, drawing from theories of thermodynamics, posits that greater innovative activity is correlated with declining levels of munificence. The edge of chaos is a space of frenetic search and energy importation (dissipation).

Alternatively, Yasai-Ardekani, (1989) finds that high munificence environments result in decentralization of decision making, and a general opening of the organizational structure to permit an effective and timely response to environmental demands. That is, munificence at the task and sub-environment levels results in the ability to fluidly (and radically) respond to environmental context. In low munificence environments on the other hand, pressures stimulate procedure formalization and centralization of decision-making in want of greater control and efficiencies, (Yasai-Ardekani, 1989). This would restrict innovative activity and limit organizational adaptation to incrementalism. This is consistent with Kahnwallas (1973) finding that scarcity of resources leads to avoidance of excessive risk taking by firms, and greater attention to conservation of resources. The finance literature also supports this notion of decreasing risk aversion with increasing wealth (Rosenzweig and Binswanger, 1993; Blake, 1996).

Still the notion of a direct mapping between environment and risk taking may not be entirely uniform (Ng and Goldsmith, 1998). In immature environments, R-type generalist firms dominate because of their flexible architectures. Current wealth and option values are low, and failure relatively painless (Ng and Goldsmith, 1998). These are the most dynamic environments in terms of innovation. The risk taking is driven by the allure of first-mover-benefits, future wealth, and relatively little downside risk. Alternatively, in very mature environments where competition wanes, K-type specialists dominate. But eventually wealth declines as markets shift and assets become cumbersome to redeploy. In such an advanced state the firm struggles in its search for fitness hesitating to radically reconfigure (Hannan and Freeman, 1977). In such hostile environment short-term down-side risk of reorientation is high and, though not globally optimal, incrementalism may be preferred.

Therefore wealth may at times serve as an inertial force inhibiting risk taking and architectural innovation or a liberating force providing the necessary resources for exploration. Therefore the expected direction of the effects on the firm from munificence and hostility may be unclear or contradictory when trying to empirically analyze firm behavior vis-à-vis their environment. Munificence and hostility can be either pulling or pushing forces as the firm interacts with its multi-layered environment. The lack of precision that authors (Castrogiovanni, 1991; McArthur & Nystrom, 1991) have been concerned with is due to the contradictory forces driving firm-level innovation and the continuum of response alternatives available to the firm.

Empirical Setting

Because of these complexities more grounded empirical work is needed to better understand the behavior of firms as they operate in declining environments. The following empirical exercise explores adaptive responses on the decent towards bifurcation. The models has two overall objectives; to provide insight into the differences between hostility and munificence, and second by empiricizing Castrogiovanni's taxonomy, provide a greater understanding of the firm's decent.

To do this US agriculture, specifically crop production, serves as the empirical setting to explore the above theory. Reports of severe economic hardship at the farm level of the US agriculture industry are familiar; "farmers are hurting right now"[3] (Washington Post, 2002). The agricultural business environment continues to change as the industry shifts from a commodity paradigm with isolated organizations to one involving greater product and service differentiation with greater interconnectedness. Biotechnologies, industrial concentration, shifts in power distribution within the supply chain, and incessantly changing consumer demands, are just a few examples of the forces effecting change (Goldsmith and Gow, 2001). Meanwhile, it appears farm performance continues to decline. Over recent years there has been a continuous flow of reports about the economic stress in farm communities: "US Farms Under Considerable Stress, Study Shows" (AgNews, 1999); "Gloom and Doom, Ideas From Washington" was the title of a conference discussing ideas for improving the "well being of struggling US farmers" (Successful Farming, 1999). The theme for the National Corn Growers 1999 convention was "Call for Survival: a Rally to Address the Crisis in Agriculture." The association even made the registration fee voluntary in recognition of the "severe financial hardships facing many producers."

The average return on assets for US agricultural enterprises at the producer level was 21 percent lower during the 1990-2000 decade than throughout 1960-1970 (ERS, 2000a, b). Further, relative farm income (Figure 2) has decreased at an average rate of 4

[3] A comment by Chuck Conner, Special Assistant to the President for Agricultural Trade and Food Assistance.

percent per year over the last decade (ERS, 2000a; BEA, 2001). Nominal crop prices have been static, if not declining, while the volatility of prices remains high. For example, the average nominal price of a weighted basket of corn, soybean, and wheat has declined at an average rate of 1 percent per year over the last 10 years (NASS, 2001), while price volatility on a year-to-year basis ranges between 10-15 percent (NASS, 2001). Using Illinois crop farmers as an example, every year over the 5 year period 1996-2000, farmers experienced an average loss of $19,300 on corn and soy production alone (FBFM, 2001). This is equivalent to a 1.5 billion dollar loss for the state, and if extrapolated, a loss of $ 4.7 billion each year for the nation. Not only have losses been incurred over recent years, but they have increasing as well. Over the last 20 years, losses have risen at an average rate of 8 percent per year.

The ability for crop farmers to sustain these substantial losses is partly attributable to increasing government support. Over the last 20 years, government payments to the agricultural industry have increased at an average rate of $520 million per year (ERS, 2001a). In 2000 alone, government payments to the agricultural industry amounted to a total of $23 billion (ERS, 2001a). Further, the 2002 Farm Bill, at $180 billion, more than doubles the support to agriculture (Elliott, 2002). The need for these transfers indicates a fundamental structural problem of fitness at the farm level.

The objective of the empirical analysis is to explore how farmers are responding to this apparent hostile environment. To analyze farmers' adaptive practices a cross-sectional time series representing crop production (corn, soybeans and wheat) in nine US Midwestern states[4] from 1963 – 1999 is employed (Table 1). Agriculture being a competitive industry, allows for relatively high degrees of homogeneity compared to

[4] Ohio, Illinois, Indiana, North Dakota, South Dakota, Minnesota Kansas, Nebraska, and Iowa

other industries. Technology and information technologies are relatively symmetric across the industry. This reduces the immeasurable idiosyncratic effects found in traditional cross-sectional series. In crop production the business form too is relatively homogeneous being comprised of small corporations underlayed by family ownership and control. Market prices are exogenous and government payments are allocated by crop not be region. These features not only allow for less "noise" arising from the data, but also easier imputation of managerial behavior from industry-level responses. This research studies five adaptive responses (dependent variables); increasing scale, increasing specialization, ex-industry diversification, exit and architectural innovation (Table 2). Two regression models, munificence and hostility, are built to analyze in forces affecting strategic choice.

Operational Measures[5]

Incremental change (short jumping) – Romanelli and Tushman (1994) operationally define incremental change as small-scale changes of internal power distributions and market breadth, across a considerable time period. Prahalad (1993) describes this as addressing the productivity gap; a focus on improving performance across existing dimensions of the firm. Incremental changes are consistent with low risk, and reversibility that have little affect on the underlying deep structure of the organization.

Average rate of change of farm size is the first dependent variable analyzed. It reflects reinvestment associated with scale economies; "doing what one does better." The second incremental strategy modeled is the degree of specialization (the percentage of farm area used for the production of corn, soy and wheat). This reflects a strategy of

[5] Summary statistics shown in Table 4.

not only increasing efficiency through focus, but also is reflective of environmental risk. In crop production, diversification is a strategy to manage risk. If one crop fails or one crop's price falls, the remainder of the cropping portfolio compensate. Specialization reflects the "absence" of such turbulence.

Ex-industry diversification *(cross jumping)* – The third adaptive practiced studied is off-farm employment. Non-farm income is a particularly important source of household income for most types of US farms (Offutt, 2000). Agriculture Census data indicates that off-farm employment levels have been increasing at an average rate of approximately three percent per year over the last 25 years (NASS, 1999). Ex-industry diversification is measured as the percentage of farmers working more than 200 days off farm each year. It is hypothesized such a choice is motivated by forces different from those inducing within-industry incremental change. That is, an increase in non-business diversification could be as motivated by a pulling from the macro level of the environment, as a direct push from low munificence at the resource, sub-environment or task levels.

Radical Adaptation *(long jumping)*- Such adaptive strategies typically require a major reorganization of resources within the firm. This may involve leveraging core competencies and outside resources or simply de-assetation and exit from the industry. Industry exit reflects environmental selection against the firm as described by Hannan & Freeman, (1977) and Aldrich & Pfeffer, (1976). In terms of complexity theory, this selection is equivalent to the system 'dying' after ineffective adaptation at the point of bifurcation: failure to correct for the fundamental mismatch of organizational form and environmental context (Prigogine & Stengers, 1984; MacIntosh & MacLean, 1999). It is hypothesised that exit will increase with a pulling force from the macro and aggregate environment and decrease with the supportive nature of task, sub, and resource environments. The measure of exit (following Anderson & Tushmans' (2001) identification of exit as the termination of production and withdrawal from the industry) is derived from statistics tracking the decline in the number of farms within any one state (ERS, 1996).

Alternatively a long jump may entail architectural innovation, similar to Prahalad's (1993) opportunity gap approach. In agriculture the adoption of relationship management (one-to-one marketing) orientation by commodity firms, or the establishment of 'long-jump producer-owned ventures,' such as new generation cooperatives (NGC's[6]) have been identified as a form of long jumping (Goldsmith and Gow, 2001). NGC establishment involves a large investment of resources, commitments that are not necessarily reversible, and the acquisition of competencies that are not necessarily within the existing set of competencies of the producer. As investments of this type are irrecoverable (irreversible), irrespective of the performance of the venture, they can be likened to the complexity concept of entropy where firms import new "energy" and ideas as firms approach bifurcation. The 'new ideas', 'new products', and 'new markets' discussed by Cobia (1997) in relation to NGC's correspond to Prahalad's (1993) 'imaginative configurations' and requirement for a stretch of aspiration, and acquisition of new competencies. Data about NGC formation in the US since 1970 are

[6] New generation cooperatives are a relatively modern organizational form, unique to the US. These cooperatives are generally small (<200 producers), closed (meaning not everyone can be a member), require significant equity participation (for capitalizing the firm), commitment in terms of delivery obligations, not purely democratic, involve some form of integrative step (horizontal or vertical), and many times are formed as limited liability companies.

used as a proxy for agricultural radical innovation and originate from a data set compiled by Merritt et al (1999) and Merritt (2002).

Explanatory Variables[7]

Hostility – Previous theory measures hostility in terms of unexpected environmental changes and shocks (Covin & Slevin 1989; McArthur & Nystrom, 1991). In many respects, the operational measures adopted here are not unlike measures of concepts such as dynamism, malevolence, threat, turbulence, and instability used in previous studies. In a practical sense, the operational measures adopted here are similar to Dess and Beard's (1984) measures of dynamism (stability-instability, turbulence) that account for variability in the environment, and uncertainty of this variability. Dess and Beard (1984) found measures such as the variability of sales, margins, employment, and value added to be valid means of measuring dynamism. This practice to capture dynamism has since been followed by subsequent research (Shafman & Dean, 1991; Rasheed & Prescott, 1992; Goll & Rasheed, 1997).

The average change over two year periods[i] is used to study hostility's impact on organizational adaptation. The lagged measures capture the degree of short term turbulence of the environment. The independent variables are price, yield, net farm income, return on assets, and government payments (Table 3). Yield change represents the general 'hostility' of the physical environment (the resource pool level) and captures

[7] Summary statistics shown in Table 6.

the affects of weather patterns, weeds, pests, plant diseases, and other physical, biological, and climatic factors effecting the quantity and quality of production.

Net farm income, and return on assets are two firm-level measures that reflect the current favorability (or hostility) of the sub environment. The two measures are valuable to account for costs of production; increases being reflective of sub- environmental hostility.

Crop prices (after appropriately weighting[ii]) are widely reported, thus highly visible, reflect the task environment in terms of the economic climate and market conditions. Also, consistent with Aldrich and Pfeffer (1976), temporal declines in government support are indicative of hostility. Government support has become a large and influential part of the environment itself in that payments to farmers have been capitalized into land prices on the basis that they positively contribute to expectations of future earnings (ERS, 2001). Any short term decline in the level of this support is thus perceived as an increase in the adversity of the aggregate environment.

Munificence – Previous studies of environmental munificence have generally empiricized munificence in terms of growth in sales (Yasai-Ardekani, 1989; McArthur & Nystrom, 1991). More comprehensive investigations of munificence used a variety of measures including; number of employees, value of shipments, firm concentration ration, and average market share (Dess & Beard, 1984; Shafman & Dean, 1991). The munificence model used in this study attempts to reflect the 'state' of the environment in terms of resource abundance or scarcity rather than indirect measures such as "rates of growth." These measures, made in relative terms (see Figure 3), more accurately reflect the 'state' nature of resource availability and the time dependent development of perceptions that condition behavior in response to munificence. Using relative ten year averages provides the ability to better capture the way in which the farm managers perceive the state of their resources base (Figure 4). This differentiates the measurement of munificence from that of hostility and previous research.

The most basic level of resources are captured by two variables: quality of the soil and weather, reflected in long term yield differences; and firm wealth, reflected in long term equity levels. High quality soils or elevated equity levels as resource pools potentially provide opportunity for a wider variety of adaptive strategies.

Long term trends in return on assets are used to reflect the sub-environment associated with firms themselves and their control of the resource pool. Higher prices, like demand growth as measured by Des & Beard (1984) and Shafman & Dean (1991), are a significant resource in the regional (task) environment. Castrogiovanni (1991) points to task resources as those affecting the firm and those firms with which it must interact.

The aggregate level is a higher order still reflecting resources available to not only the firms but the stakeholder community as well. Government payments, as noted above, have considerable effects on the expectations of crop producers and as such significantly influence the decision-making process. Consistent with the aggregate level, these resources are not entirely dedicated. They can not only reduced but more importantly redirected to other sectors and missions of the USDA, i.e. nutrition, conservation, and food safety.

Relative income and munificence of the ex-industry environment reflect the attraction/repulsion force of the greater macro environment. Relative income is the ratio of average net farm income per farm to average per capita income for the state. An adaptive response to low relative income would move resources to higher valued opportunities. Ceteris paribus, under conditions of low relative income a farm-firm would be expected to reduce investment in agriculture and either increase investment outside of agriculture or even exit.

Outside opportunities to redeploy capital may be limited at the same time relative income is low. The ex-industry macro environment is proxied by the number of metropolitan areas of population greater than 100,000 multiplied by the total number of people residing in those areas divided by the crop acres in the state. The variable serves as a proxy for the pool of off-farm or exit opportunities available to farm managers. At the same time, a high level of industrial activity associated with a significant metropolitan presence in the state could serve as valuable resource for farm businesses seeking to shorten the supply chain and serve end-users more directly through new generation cooperatives.

Results

Final presentation of results was not ready at the time of publication of this version. Results and discussion and an updated manuscript will be provided at the seminar. Appendices 1 and 2, which are attached, show the regression results.

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Figure 1. Castrogiovanni (1991) Taxonomy

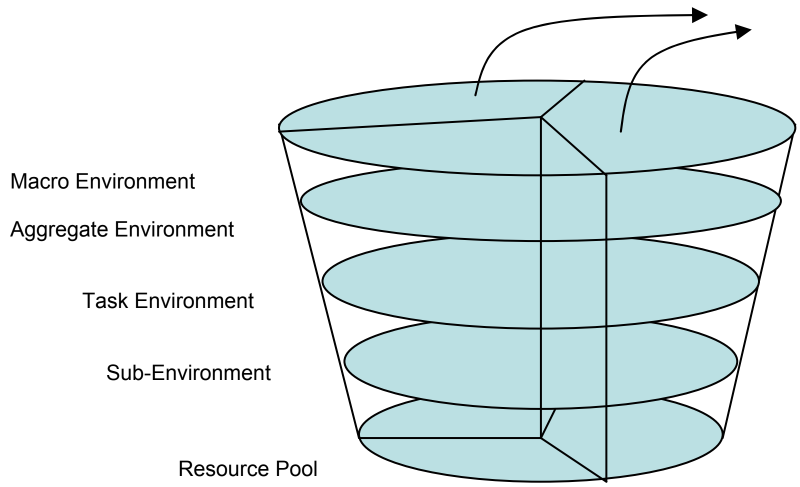
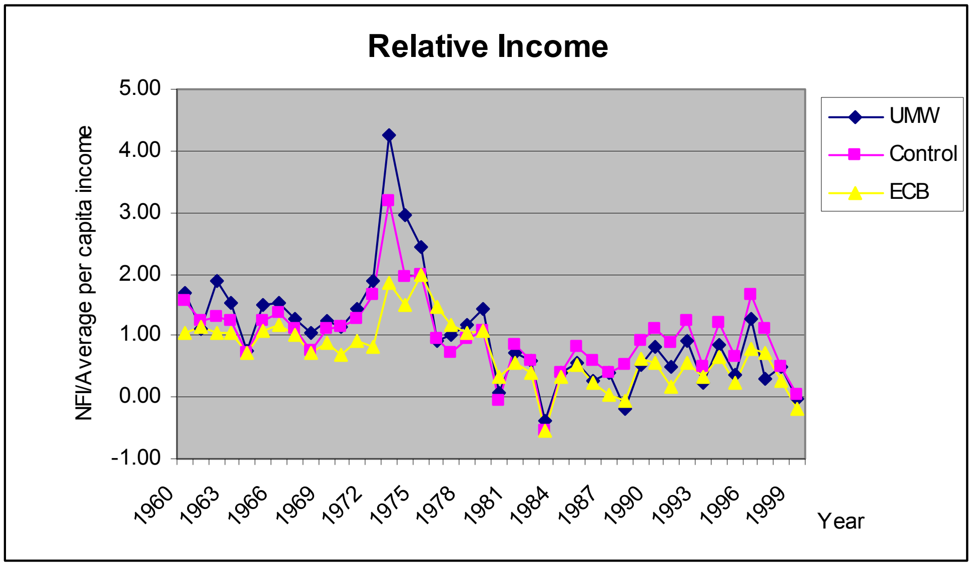
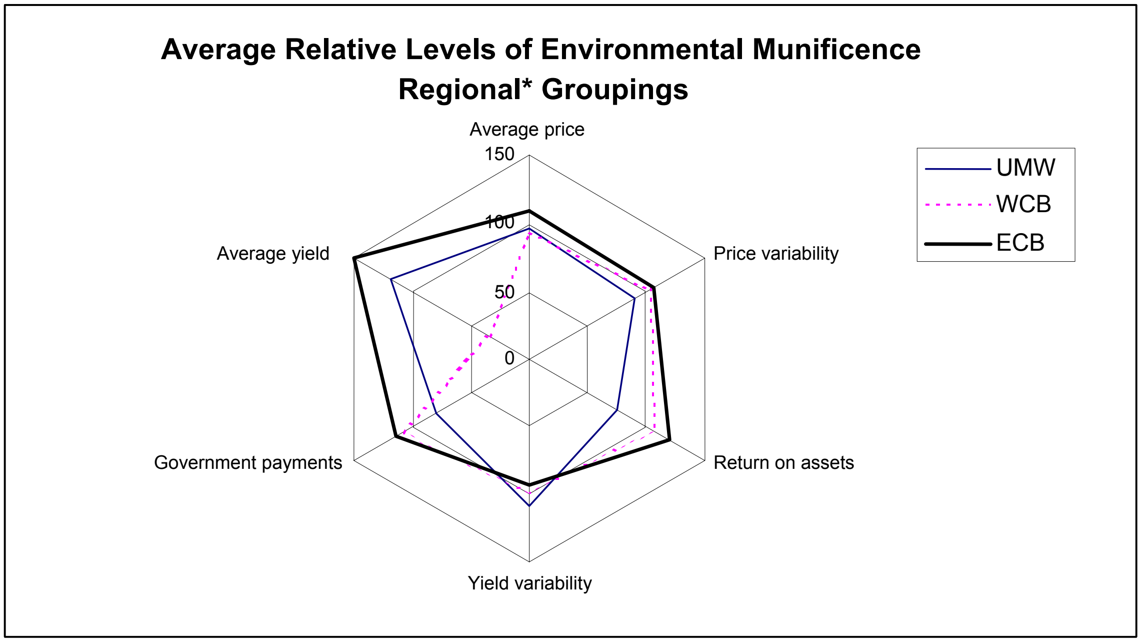


Figure 2 – Relative Income[8]



[8] The upper Midwest states are defined as; North Dakota, South Dakota, and Minnesota; the Eastern corn belt as Illinois, Indiana, Ohio, and the control as Nebraska, Kansas, and Iowa.

Figure 3.



UMW = Upper Midwest (South Dakota, North Dakota, and Minnesota)
WCB = Western Cornbelt (Nebraska, Kansas, and Iowa)
ECB = Eastern Cornbelt (Illinois, Indiana, and Ohio)

Figure 4. Conceptual Framework

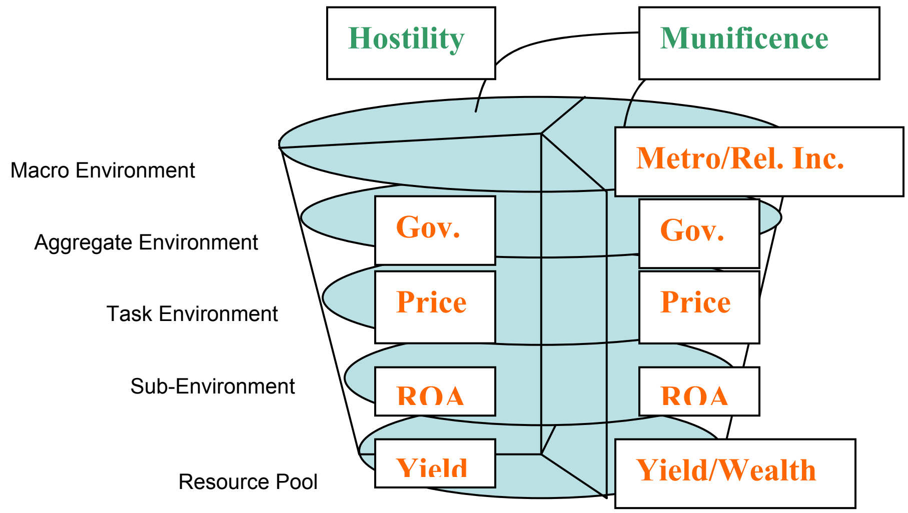


Table 1 – Summary Statistics by State (Average; 1960-2000)

	Illinois	Indiana	Iowa	Kansas	Minnesota	Nebraska	North Dakota	Ohio	South Dakota
Land in Farms (000 acres)	29,000	17,000	34,000	49,000	31,000	48,000	41,000	17,000	45,000
Farm Size	277	194	276	625	291	724	1053	167	1110
Specialization[a]	85	82	72	50	62	52	38	68	42
Price	3.34	3.22	3.09	2.83	3.06	2.60	2.94	3.37	2.68
Yield	75	73	81	40	64	74	30	65	42
Government Pmt per Acre	13.35	11.55	15.61	8.28	11.62	8.03	7.32	8.62	4.35
Return on Assets	2.43	2.64	3.10	2.35	3.73	3.10	2.05	2.98	3.71
Equity per Acre	1234	1061	584	376	688	715	290	1078	233
Debt/Equity	16	21	25	23	26	26	20	16	24
State Population	11496000	5515000	2848000	2421000	4216000	1576000	646000	10866000	698000
Relative Income	0.88	0.69	1.11	0.73	0.89	1.16	0.81	0.60	1.36
Off-farm Employment	38	20	26	26	21	16	12	39	14
Exit Rate	1.80	1.85	1.65	1.37	1.70	1.32	1.55	1.60	1.50

[a] % of total acres used in the production of corn, soy, and wheat.

Table 2 – Strategic Response Variables

#	Response	Operational Calculation	Data Source
1	Size	Average farm size	NASS, (2001)
3	Specialization	Percentage of cropland acres used to produce corn, soy, wheat.	NASS, (2001)
3	Off-farm Employment	The percentage of producers working less than 200 days per year off farm)	USCB, (1990)
4	Exit	Average rate of farm number decline (%) from one year to the next.	NASS, (2001)
5	Innovation	Number of new generation cooperative organizations (NGC's) formed per acre of cropland	Merritt et al, (1999) and Merritt, (2002)

All data are for the period from 1963-1999

Table 3 – Explanatory Variables[a] (all models)

No.	Characteristic	Operational Calculation	Data Source
1	Price	Average weighted price/bushel of a basket corn/soy/wheat	NASS, (2001)
2	Price Volatility	Longitudinal standard deviation of price for each subject	NASS, (2001)
3	Soil Quality	Average weighted yield (bushels) of a basket of corn, soy, and wheat, per acre of cropland	NASS, (2001)
4	Weather	Longitudinal standard deviation of yield for each subject	NASS, (2001)
5	Net Farm Income	Average farm income (excluding direct government transfers) per acre of farmland[b]	ERS, (2000a)
6	Return on Assets	Net farm income/total value of farm assets	ERS, (2000a), ERS, (2000b)
7	Government Payments	Total direct government transfers per acre of total cropland	ERS, (2000a),
8	Metropolitan Areas	Number of metropolitan areas (of population greater than 100,000) multiplied by the cumulative population of those metropolitan areas, on a per acre of farmland basis	Lagmeyer, (2002), NASS, (2001)
9	Relative Income	Net farm income divided by per capita income	ERS, (2001a), BEA, (2001)
10	Equity	Average equity value per acre of total farmland (net worth/acre)	ERS, (2001b),

[a]Relevant munificence measures are expressed in terms of relative averages.
Relevant hostility measures are calculated on an average 2-year difference value.
[b] This net farm income measure does not allow for a return to management.

Table 4 – Summary Statistics for Munificence Variables

	MUNIFICENCE	Std.dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Price	0.22								
2	Price Variability	0.10	-0.86*							
3	Yield	15.82	0.37*	-0.08						
4	Yield Variability	2.54	0.11*	-0.27*	-0.64*					
5	Return on Assets	0.73	0.05	0.00	0.24*	-0.02				
6	Government Payments	1.81	0.52*	-0.30*	0.69*	-0.30*	0.08			
7	Metropolitan Areas	0.33	0.61*	-0.42*	0.32*	0.04	-0.10	0.09		
8	Relative Income	0.28	-0.42*	0.23*	-0.07	-0.07	0.48*	-0.13*	-0.63*	
9	Equity	236.98	0.69*	-0.43*	0.72*	-0.46*	-0.06	0.49*	0.63*	-0.42*

Mean VIF = 5.0 (Maximum VIF = 11.8)
Condition Index for model = 7.5
*p<.05

Table 5 – Summary Statistics for Hostility Variables[a]

	Variable	Mean	Std. Dev[b].	1	2	3	4
1	Price	0.04	11.64				
2	Yield	0.95	6.25	-0.56			
3	Net Farm Income	-0.08	-155.70	0.08*	0.42		
4	Return on Assets	-0.11	5.62	0.23	0.34	0.75	
5	Government	0.81	-10.89	-0.09*	-0.17	-0.60	-0.37

[a] These are mean difference values (i.e. they represent the average annual change over the 36-year period)
[b] This measure of variance has been standardized for the mean value of the variable.
Mean VIF = 2.44 (Maximum = 3.4)
Condition Index for model = 3.6
*p<.05

Appendix 1 – Temporal Model Results

HOSTILITY	**(1) NGC**	**(2) Size**	**(3) Specialization**	**(4) Off Farm**	**(5) Exit**
Price	0.01	-0.42	0.18	**-1.36**	-0.41
	(0.09)	(1.68)	(1.40)	**(3.10)****	(1.62)
Yield	-0.01	-0.01	0.01	0.04	-0.01
	(0.88)	(0.65)	(0.47)	(1.25)	(0.53)
Net farm income	0.00	0.01	**0.01**	**0.04**	0.01
	(0.14)	(0.59)	**(2.02)***	**(1.98)***	(0.39)
Return on assets	0.01	**-0.22**	**-0.22**	**-0.96**	-0.22
	(0.18)	**(1.97)**	**(3.81)****	**(4.91)****	(1.96)
Government Payments	0.02	**-0.06**	**-0.03**	0.06	**-0.06**
	(1.23)	**(2.54)***	**(2.41)***	(1.43)	**(2.50)***
R-squared	0.01	0.06	0.08	0.21	0.06

Those numbers in parenthesis represent the absolute value of the t statistics
** Significant at 1%

Appendix 2 – "State" Results

MUNIFICENCE	NGC	Size	Specialization	Off Farm	Exit
Price	0.13	-451.07	35.14	-1.59	0.09
	(1.65)	(7.24)**	(7.62)**	(0.38)	(0.48)
Price Variability	0.10	-363.99	46.03	8.27	0.21
	(0.94)	(4.28)**	(7.31)**	(1.46)	(0.87)
Yield	-2.E-03	-11.55	0.65	0.06	2.E-03
	(2.36)	(20.35)**	(15.49)**	(1.67)	(1.25)
Yield Variability	-3.E-03	-14.09	2.15	0.65	0.01
	(0.99)	(5.91)**	(12.17)**	(4.06)**	(1.82)
Return on Assets	0.06	-100.83	-1.75	2.39	0.04
	(6.96)**	(15.55)**	(3.64)**	(5.54)**	(2.24)
Government Payments	0.01	-21.14	0.05	0.47	0.02
	(2.43)	(5.46)**	(0.17)	(1.81)	(2.15)
Metropolitan Areas	-0.09	66.53	-8.08	11.41	0.16
	(3.66)**	(3.33)**	(5.47)**	(8.58)**	(2.83)**
Relative Income	-0.12	514.97	-0.44	-16.44	-0.02
	(4.89)**	(25.42)**	(0.29)	(12.19)**	(0.30)
Equity	-1.E-04	-0.04	0.03	0.01	0.03
	(2.17)	(0.92)	(9.12)**	(3.73)**	(1.15)
R-squared	0.32	0.96	0.92	0.83	0.35

Those numbers in parenthesis represent the absolute value of the t statistics
** Significant at 1%

Endnotes

[i] The two-year lagged period is adopted only after having first found that the one and three year lagged periods were less desirable predictors of strategic response (that is, after having modeled them against the dependent variables). Also, the measures are deliberately not detrended on the basis that the holistic impact of both variability and trend (cumulative for the various response variables) is an important component of the model as determinants of strategic change. Had the study focused on a more micro-analysis of organizational adaptation (e.g. one specific strategic response), then detrending would be an appropriate if not necessary part of the analytical process. Future research efforts may attempt to distinguish between the specific influence of the trend and the year to year variability. Though it is recognized that both affect strategic response, for the sake of comprehensiveness and parsimony, the effects are not separately analyzed in this investigation.

[ii] Yield is weighted for the proportion of crop type grown. Careful consideration was given to the weighting scheme used (alternatives included weighting relative to the average yield for the population, and no weighting at all). It was found that there is little variation between these indexes (analysis of pair-wise correlation coefficients showed that all relationships were significant at the 0.0001 level), such that potential effects (of differing alternative weighting schemes) on model results are minimal. Thus, a weighting scheme by crop area was selected for its ability to more accurately reflect changes observed at the farm level. This was made on the assumption that firstly, deviation of percentage yield variability across the three major crops is minimal, and secondly farmers are more perceptive to the variability in their own yields than they are to those of neighboring farms, or state or population averages. The same rationale is made for the weighting of price. Again it was found that alternative schemes produce indexes of very high covariance and thus have minimal effect on regression results (this is likely attributable to the high degree of competition both within and between markets for crop products and the relatively high degree of substitutability of crop products (especially in feed markets) in the case of price, and similar effects of rainfall, sunshine hours etc. on all crop types produced in relation to yields). The degree to which risk is endogenized or exogenized by this means of indexing yield and price for the three crop products is an interesting topic for further research.