Entrepreneurial Behavior in Agri-Food Supply Chains: The Role of Supply Chain Partners

By

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ABSTRACT
Technological innovation, globalization and market segmentation have led to increasingly complex agri-food supply chains and networks. At the same time, they have also created opportunities for entrepreneurial firms to create new wealth. The objective of this study is to investigate the differences in entrepreneurial performance between firms that discover and exploit new wealth creation opportunities within existing supply chains as opposed to those that decide establish the supply chain themselves. Using agent-based simulation, we find that supply chain partners can have a positive wealth effect for both firms that chose to align with them and those that do not.

KEYWORDS
Supply chains, entrepreneurship, agent-based simulation

Ross, R.B. Entrepreneurial Behavior in Agri-Food Chains: The Role of Supply Chain Partners. Paper accepted for presentation at the *19th Annual World Symposium of the International Food and Agribusiness Management Association*, Budapest, Hungary on June 20-21.

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Introduction

Technological innovation, globalization and market segmentation have together led to increasingly complex agri-food supply chains and networks, and uncertain agri-food markets. Both of these characteristics can strain an agri-food manager's ability to make fast and accurate decisions. However, as recent agribusiness scholars (Ross, 2008; Ross & Westgren, 2008; Roucan-Kane, Boehlje & Gray, 2008) have suggested, increased complexity and uncertainty also provide agri-food managers with significant opportunities to create new wealth by exercising entrepreneurial behavior. Specifically, Ross and Westgren (2008) highlight that following Austrian economic theory, markets in disequilibrium provide opportunities for exploitation of asymmetric information and other market frictions, the discovery of unique profit opportunities, and innovation (Hayek, 1945; Mises, 1963; Kirzner, 1979). We consider the above to be forms of entrepreneurship. In addition, the strategic entrepreneurship literature suggests that firms that adopt and develop capabilities for entrepreneurial behavior are more likely to prosper in the environments characterized by uncertainty, market segmentation, knowledge intensity, and hypercompetition (Bettis, et al., 1995; Hamel, *et al*., 1995; Alvarez, *et al*., 2000; Hitt, *et al.*, 2002, Ross, *2008*).

However, entrepreneurial opportunities are not often exploited in isolation. Instead, many entrepreneurial individuals or firms establish alliances with partner firms, both upstream and downstream, to exploit such opportunities. This is particularly true in the agri-food industry where the structure of the industry (i.e. multiple industry players, multiple governance structures and interfirm relationships,

commodity and niche markets, biological uncertainties, etc.) and length of supply chains often precludes individuals or firms from establishing the supply chain alone.

The presence of existing supply chains can have a significant impact on the performance of entrepreneurial firms. Entrepreneurial firms that utilize existing supply chains face lower costs associated with delivering (i.e. logistics, marketing, and procurement) value to end-users, and have advantages in information-sharing and learning. On the other hand, rent-sharing and agency costs in networks can reduce the economic returns available to entrepreneurial firms.

The objective of this study is to investigate the differences in entrepreneurial performance between firms that discover and exploit new wealth creation opportunities within existing supply chains in contrast to those that decide establish the supply chain themselves. Three specific research propositions will be addressed. The first two of these research propositions build on the work of Ross and Westgren (2008). In their study, Ross and Westgren examined the effect of various entrepreneurial capabilities on the performance of firms across various institutional landscapes in the agri-food system. The results of their study indicated that firms with developed capabilities for entrepreneurial alertness and efficiency outperformed those firms that did not in competitive environments characterized by market segmentation and uncertainty. However, the competitive environments used in the Ross and Westgren (2008) did not include the presence of other supply chain partners. As stated above, these players may have a significant impact on the dynamics of the competitive environment. This study addresses this missing element. In particular, we examine two propositions related to the affect of entrepreneurial alertness and efficiency in the entrepreneurial process given the presence of supply chain partners.

Furthermore, this paper also examines the role of supply chain partners in the entrepreneurial process. As indicated previously, entrepreneurial firms that utilize existing supply chains face lower costs associated with delivering (i.e. logistics, marketing, and procurement) value to end-users, and have advantages in information-sharing and learning. On the other hand, rent-sharing and agency costs in networks can reduce the economic returns available to entrepreneurial firms. To test these propositions, this paper develops an agent-based simulation model (ABM) to examine the differences in performance between firms that link to existing supply chains and those that do not to exploit entrepreneurial opportunities.

The conceptual frameworkfor our model is presented in the next section. In the third section, an agent-based model is developed and several experiments are defined to examine the stated research propositions. The results of these experiments are presented in the following section. Finally, we discuss several implications of this research and introduce future directions for research.

Entrepreneurial Theory

Entrepreneurship is a process in which firms search for, discover and exploit new profit opportunities by engaging in arbitrage or innovation activities (Ross, 2008). The literature on entrepreneurship suggests that several characteristics of the entrepreneurial firm affect the outcomes of this multi-step process: alertness to new opportunities (Kirzner, 1979; Shane, 2000), subjectivity and judgment (Knight, 1921; Foss & Klein, 2005), decisiveness /speed to market, and uncertainty-bearing (Knight, 1921), and aspirations (Ross and Westgren, 2008; Ross, 2008). For the purposes of this paper, we will focus only on entrepreneurial alertness. In addition, the ability of a firm to create wealth is also affected by the efficiency with which a firm exploits the profit opportunity. This includes both efficiency of the firm in the production process

as well as how it organizes the supply chain to deliver its product or service to customers. In our case, we consider two potential supply chain structures: direct-marking and partnership with existing supply chain partners (i.e. processors, retailers, etc.)

Alertness[1]. Alertness refers to a firm's ability to discovery and recognize potential profit opportunities. Following the Austrian economics paradigm, entrepreneurial discovery is related to the possession idiosyncratic information sets (Casson, 1997; Shane, 2000). According to Hayek (1945: pg. 519), "knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all separate individual [firms] possess." The possession of unique information by firms, therefore, is what allows firms to be alert to opportunities that others are not and to value goods and services at different prices than other market participates (Hayek, 1945; Kirzner, 1997; Shane, 2000).

A firm can obtain unique information from three different sources: prior knowledge (Shane, 2000), investment in new (specific) information (Fiet, 2002), and through interactions with its social network (Granovetter, 1973; Hoang, *et al*., 2003). Thus, each of these information sources can lead to the recognition of entrepreneurial opportunities they may not be seen by other firms.

Proposition 1: *Ceteris paribus*, firms with high levels of alertness will generate greater entrepreneurial returns and achieve greater survival rates that those with lower levels of alertness.

Extraction Theory

A necessary condition for firms to created wealth is that they must extract rents from the entrepreneurial opportunities that they discovery. Typically, this requires firms to

[1] For further discussion on the entrepreneurial capability of alertness see Ross, R.B. (2008) Modeling the Economic Returns to Entrepreneurial Behavior: Theory and Applications. Saarbrucken, Germany: VDM Verlag Dr, Muller.

engage in the production of a good or service that can be exchanged with other members of the economic community. Given these requirements, firm efficiency and supply chain structure are two factors that are likely to have a significant effect of the ability of a firm to create wealth.

Firm Efficiency. Wealth is created by the firm if the value they receive for their good or service is greater than sum of the costs they incur to produce it. Production requires that firms extract resources from their environment that can be combined and converted into the desired good or service. The rate at which a firm can convert these extracted resources into their chosen good or service provides a measure of firm efficiency or productivity. The more efficient a firm is, the fewer resources it needs to extract to produce one unit of good or service. Since it is costly to extract resources, firm efficiency can have a significant impact on the value a firm is able to create.

Proposition 2: *Ceteris paribus*, firms that can efficiently convert resources to revenues will generate greater entrepreneurial returns and achieve greater survival rates than those that are less efficient.

Supply Chain Effects. The presence of existing supply chains can also have a significant impact on the performance of entrepreneurial firms. Existing supply chains give entrepreneurial firms the option to align with partners to provide additional value to end users and to potentially appropriate greater rents from their entrepreneurial activities. Other benefits of aligning with supply chain partners include, but are not limited to: the exploitation of shared economies of scale, learning from partners and competitors, management of risk and sharing costs, facilitation of tacit collusion, and the management of uncertainty (Barney, 2002).

On the other hand, rent-sharing and agency costs in networks can also reduce the economic returns available to entrepreneurial firms. In particular, strategic alliances are often faced with issues of adverse selection, moral hazard and holdups that may not only increase the costs of the entrepreneurial venture, but cause it to fail as well (Barney, 2002).

Proposition 3: *Ceteris paribus*, entrepreneurial firms that form alliances with supply chain partners to exploit new profit opportunities will generate greater entrepreneurial returns and achieve greater survival rates than those that exploit new profit opportunities independently.

Methodology

This paper develops an agent-based simulation model (ABM) to examine the differences in performance between firms that link to existing supply chains and those that do not to exploit entrepreneurial opportunities. The basic setup of our simulation model follows the framework introduced by Ross (2008) where agents search for, discover and exploit strategies for new wealth creation on a strategic landscape However, in this model, two types of agents exist: firms (i.e. producers) and supply chain partners (i.e. input suppliers, first handlers, processors, retailers, etc.); if desired, these two types of agents may link together to exploit an entrepreneurial opportunities together. The advantage of the ABM approach is that it is able to capture the complex and dynamic nature of the entrepreneurial process. As Ilegen, et al. (2000) state, ABMs are a particularly useful simulation methodology for examining phenomena in a stochastic, dynamic and non-linear world. Furthermore, ABMs facilitate the modeling of heterogeneous agent attributes and behaviors, and are able to capture the consequences of individual agent-level decisions at the system-wide level. The term agent, in this respect, refers to a self-contained entity (i.e. person, firm, or any other

type of organization) that can control its own actions based on its perceptions of the operating environment (Gilbert, *et al*., 1999). In addition to being autonomous, agents also have the properties of being able to interact with other agents through a common language (i.e. rule set), to perceive and respond to changes in their environment, and to engage in goal-seeking behavior (Gilbert, *et al*., 1999).

The logic of the agent-based methodology is to simulate the individual behavior of each agent, allowing them to interact with other agents and their environment, to reveal emergent macro-level patterns of system behavior (Schelling, 1978; Axelrod, 1997). As various studies have shown, seemingly simple behavior rules for individual agents can lead to some very complex and unexpected outcomes to can have significant policy implications (Epstein, et al., 1995; Axelrod, 1997).

This model is explicit in the inclusion of multiple (simulated) agents (i.e. firms and supply chain partners) with simple behavioral rules of action and interaction, so as to elicit complex emergent outcomes. Moreover, we force agent behaviors into patterns of fixed and parametrically variable limits, so as to control the simulations in an experimental sense. This design ignores the theory-testing possibilities that exist if the simulation has an explicit gaming framework. We recommend Klabbers (2006) for a cogent discussion of theory testing in the gaming paradigm.

An Agent-Based Model of Entrepreneurial Behavior in Supply Chains

This study utilizes the agent-based framework to capture the dynamic interactions of heterogeneous agri-food producers as well as their movement across a strategic landscape. Furthermore, by adapting an agent-based model developed by Ross (2008), we are able to explore the effects of supply chain partners on the wealth creation process.

Following the Ross (2008) model, the base model is setup with a simulation landscape that is populated with strategies of varying levels of potential profitability given the available resource set as well as with firms that have varying capabilities to use those strategies effectively to create wealth. Behavioral rules are also defined for each firm to govern their internal processes along with their interactions with other firms and the environment. These behaviors are summarized as follows. All firms begin by extracting the limited rent-generating resources from their chosen strategic niches (randomly assigned). However, entrepreneurial firms will also periodically search out alternative strategic niches as their expectations for the future profitability in their current niche diminishes. An innovator will move to those alternative strategy spaces that they judge to offer the greatest expected opportunity for future profits. Interactions between firms occur when two firms occupy the same strategic niche. In this case, firms compete for the rent-generating resources of that niche. A full description of the simulation landscape and the various firm attributes (i.e. alertness and efficiency) as well as explicit explanation of firm behavior used in this model can be found in Ross (2008).

In addition to the model setup in the Ross (2008) model, the model presented in this paper adds several other features. In particular, in this paper, since we are concerned with the role of supply chain partners in the wealth creation process, the explicit existence of an additional set of agents (i.e. partners) and a firm's linkability to those agents are considered.

Additional Firm Attributes. This model assumes that in order to extract resources/profits, firms may be able to link to supply chain partners. By doing so, firms are able to decrease their costs of extraction by outsourcing part of the

extraction process to supply chain partners. Thus, an additional firm attribute for partner *linkability* is added to the Ross (2008) model. This attribute captures the firm's preference to distribute its products either directly (linkability = 0) to the consumer or via supply chain intermediaries (linkability = 1). ***Partner Attributes.*** In this simulation model, attributes are also defined for the new set of agents (i.e. partners). Furthermore, similar to the firm population, it is assumed that not all supply chain partners are created equal. The heterogeneity of partners is instituted by allowing partners to have varying levels of three attributes: region size, attraction, and power.

Region size refers to the landscape space or the number of strategies that the partner is able to serve. This region size is linked to the capabilities of the partner firm and the strategies that they employ. Although exogenous to this model, this notion of region size is consistent with the population ecology literature that categorizes partners that service a narrow set of strategic niches as specialists, and partners that are able to service a wide set of strategic niches as generalists (Hannan, *et al*., 1977).

Partner *attraction* indicates the ability of a partner to attract a firm to form an alliance with it. Just as a firm must extract resources from the environment to generate profits, it is assumed that partners generate wealth by forming alliances with these firms. This alliance formation may take place either by persuading a firm using a strategy outside its service area to use a strategy within it, or by convincing firms already within its service area to enter/maintain an alliance. In our case, partners persuade firms to ally with them by increasing the 'perceived' value of the strategies

that it services. Note, however, that this perceived value is only available to linkable firms and partners may only form alliances with linkable firms.

Finally, partners have a 'realized' *power* to increase the value of strategies that it services for firms. This ability is captured in the partner power attribute. The power attribute decreases the costs of extraction for firms. For example, if a firm is affiliated with a partner that has a power of 2, the realized efficiency of the firm is doubled. This attribute, therefore, captures the decrease in costs associated with outsourcing some of the activities required for the firm to produce and distribute its product to consumers.

Partner-Partner Interactions. Supply chain partners do not interact directly. However, since their regions may overlap, they may interact indirectly through the apparent competition for firms. In this model, when agent firms occupy a strategy serviced by two potential partners, the firm chooses to ally with the partner with the greatest attraction level.

Firm-Partner Interactions. Firms that are linkable are able to interact with supply chain partners. This interaction occurs in two ways: 1) partners attract firms to supply chain alliances, and 2) partners and firms cooperate to improve the efficiency of the supply chain thereby decreasing the costs associated with meeting demand.

Firm Learning. This model also allows for firms to learn and improve their levels of alertness and efficiency over the course of the simulation time period. With respect to alertness, it is assumed that firms may increase their alertness level by learning about potential profit opportunities from other firms that are close (or connected) to them. That is, firms learn from their social networks. The gain to alertness from this type of learning is illustrated in Figure 1.

Firms may also learn from their experiences utilizing a specific strategy (i.e. niche) or from their experience in a specific alliance. This model captures both of these learning mechanisms. Both time spent in a specific strategic niche and time spent with a specific partner increase firm efficiency. The efficiency gain for each of these mechanisms is also illustrated in Figure 1.

Population Dynamics. Firms enter and leave the simulation environment according to a set decision rules. Initially, the simulation begins with 10 firms after which time 10 additional firms enter the simulation environment every 50 time units, beginning at T=25. Each grouping of firms represents a population cohort (only the results for cohort 1 are presented here). The removal of firms from the simulation occurs according to two criteria: 1) bankruptcy (i.e. firm wealth < 0)[2], or 2) lack of viable profit opportunities (i.e. the firm cannot find an alternative strategic niche that is expected to meet its aspirations for profits for six consecutive time periods).

Experiments. Simulation experiments were designed to determine the effect of supply chain partnership on firm performance. The parameters for each of the experiments are outlined in Table 1. For each experiment, we parametrically vary one firm attribute (i.e. alertness or efficiency) while keeping all others fixed at mid-range levels. At the same time, we also parametrically vary one or more partner attributes (i.e. region size, attraction, power) depending on the simulation design. In addition, model conditions were adjusted across experiments to allow for various organizational phenomena such as learning and partner alliances to determine their effect on the wealth creation process. Monte carlo simulations were conducted for each experiment consisting of 100 simulation runs. Upon execution of these

[2] Firms begin the simulation with an initial wealth endowment of 50 units.

experiments, the model results reveal several significant findings about the dynamics of firm strategy. These results are presented below[3].

Results

The results from the simulation experiments are presented in Tables 2 (AL Models) and 3 (EF models). The AL Models represent those models where firms have heterogeneous levels of alertness, and EF Models represent those models where firms have heterogeneous level of efficiency.

Firm Alertness Models

The firm alertness models (i.e. firm efficiency is held constant) point to several important findings about entrepreneurial behavior in supply chains.

Base AL Model. First, it is important to note the differences between the base AL and EF models. As Figure 2 shows, models which allow firm efficiency values to vary, on average, create more wealth over time per firm and cohort than do models where firm alertness is variable. However, such models also result in a greater number of firm deaths (i.e. bankruptcies) than alertness models. These two results together reflect the relative importance of firm efficiency in the wealth creation process. That is, firm efficiency has a greater effect on the survival and wealth creation ability of firms than firm alertness. That said, however, there is a strong positive relationship between a firm's level of alertness and its survival and wealth creation ability (see Figure 2).

AL Partner Attribute Models. The partner attribute models explore the effect of partner relationships on the wealth creation process. In particular, three partner attributes are considered: region size, attraction and power. The results of the

[3] Results are only presented for firms in the first cohort. However, later cohorts exhibited many of the same patterns.

simulation experiments highlight several expected and unexpected relationships. Expectedly, the results indicate that partner attributes have a greater effect on firms that are able to form alliances with partners (i.e. linkable firms) than those that are not (i.e. non-linkable firms).

As Table 2 reveals there is two notable differences between the AL_BASE model and the model in which partner region size is allowed to vary (i.e. AL_RS). The two differences are that both the number of years of partner affiliation among linkable firms and the number of contacts (both firm types) have decreased significantly. Further investigation is required to explain the sources of these results. However, with respect to firm survival and wealth creation, no significant differences between the AL_RS model and the AL_BASE model were found. This is not particularly surprising as both partner attraction and power were set to 1 in this experiment. Under these parameters, there are no benefits from partner alliance.

However, partner attraction has a significant effect on firm survival and wealth creation (see AL_Att model). When partner attraction is allowed to vary from 1, the simulation results reveal a significant negative effect on both of these measures among linkable firms (no effect on non-linkable firms). On the other hand, selection pressure based on firm alertness decreased for both linkable and non-linkable firms. With respect to linkable firms, this result may reflect a partner's ability to keep firms within the alliance and/or to attract firms to unprofitable niches.

The AL_Pwr experiment reveals an opposite effect. In allowing partner power to vary (holding attraction constant) across the partner population, both firm survival and wealth creation increase. Furthermore, there is a substantial difference between the performance of linkable and non-linkable firms, with the former outperforming the

latter over the simulation period. Also noteworthy is the finding that linkable firms stay in their partnerships longer under this scenario and that, although less than the AL_BASE model, selection pressure based on firm alertness is actually greater in the AL_Pwr model than in the AL_Att model. This final point appears counterintuitive to what we would expect, since alertness is associated with discovery and discovery is of less importance to firms in this model (linkable firms stay in their partnerships longer).

The AL_ALL model results reflect a combination of the results from the previous three models. However, it is significant to note that the negative effects of partner attraction have a greater impact of firm survivability than firm wealth creation. This is reflected in the comparison of the wealth created by the two different types of firms (i.e. linkable or non-linkable).

AL Learning Models. With respect to the learning models (i.e. AL_ALL(L), AL_RS(L), AL_BASE(L)), the simulation results indicate the positive effect of learning on firm survivability and wealth creation for both types of firms. Learning, furthermore, reduces selection pressure based on firm alertness. The effect of learning is, however, greater for linkable firms than for non-linkable firms. This result may reflect the added efficiency benefits that a firm receives for staying with a partner over time as well as the alertness benefits received as firms cluster together in partner alliances (see Figure 1c).

Firm Efficiency Models

In comparison to the AL models, the simulation results for the EF models (i.e. firm alertness is held constant) highlight many of the same dynamic relationship as do the AL models.

Base EF Model. As shown in Figure 2, firm efficiency has a strong positive effect on wealth creation and survivability. In fact, firm efficiency tends to have a greater absolute effect on firm wealth creation and survivability than does firm alertness.

EF Partner Attribute Models. Similar to the AL_RS model, the EF_RS models varies only slightly from its base counterpart (i.e EF_BASE). However, as noted in the AL models, allowing the partner region sizes to vary results in a significant drop in the number of years that a linkable firm spends in a partner alliance as well as the number of contacts it develops. The result seems counterintuitive, as one would expect that an increased region size would increase the number of partner affiliation years and the number of contacts a firm has. Obviously, this is an area that needs further research.

The EF_Att simulation results also support the claim that partner attraction increases firm mortality, particularly among linkable firms, and decreases the average level of wealth created by all firms. In comparison to its AL counterpart though, the EF_Att model does not exhibit that same magnitude of firm mortality or losses in wealth creation as the AL model. The result may reflect the ability of efficient firms to better "weather the storm" in the short term than alert firms.

Partner power also has a similar effect on firm survivability and wealth creation as in the AL model. Firm wealth creation increases substantially for linkable firms and percentage of firms that are linkable at the end of the simulation time period has increased. However, unlike the AL model, average wealth creation among non-linkable firms has actually decreased and selection pressure based on firm efficiency has been reduced when compared to the BASE efficiency model. This latter result may indicate that with linkable firms preferring partner alliance (i.e. average number

of years that a firms is affiliated with a partner has risen from 49.85 in the BASE model to 75.64), there are greater opportunities for non-linkable to find valuable strategic niches. This finding is also evident in the AL_Pwr model as well. Also of note is that the number of contacts for both linkable and non-linkable firms has dramatically increased. Given that the level of firm mortality is the same in this model as in the EF_BASE model, it appears this simulation parameterize may have a clustering effect. This finding is also similarly found in the AL_Pwr model.

Finally, with respect to the model where all partner attributes are allowed to vary, the results indicate that the benefits of partner power on firm wealth creation and survivability are offset by the costs associated with partner attraction. As found in the AL_ALL model, the effects of the latter attribute again outweigh those of the former.

EF Learning Models. The learning models all increase average firm wealth creation above the EF_BASE model. Furthermore, with respect to the EF_ALL(L) and EF_BASE(L) models, firm mortality is also reduced and there is significantly less selection pressure based on firm efficiency, particularly for linkable firms. This latter result is again reflective of the fact that linkable firms also receive an efficiency gain for participating in partner alliances over time. In the EF_RS(L) model, however, partner attraction appears to continue to have a substantial effect on firm survivability. This result was also found in the AL model.

In summary, the simulation experiments reveal several interesting results that have consequences for agri-food managers interested in engaging in entrepreneurial behavior. The results of these experiments include:

1. Unexpected tradeoffs exist among entrepreneurial characteristics

2. Firms that have high linkability characteristics face lower rent dissipation from competitor firms in the market
3. Search behaviors for new opportunity are altered by the existence of existing chains
4. Wealth increases with a firm's alertness level, because it permits firms
    a. to find most valuable strategic niches; and
    b. to find supply chain partners with superior network linkages

Conclusion

As the results discussed above indicate, the use of existing supply chain networks to exploit entrepreneurial ventures can have a significant effect on firm performance. Furthermore, the results of the simulation experiments support the research propositions introduced in this study. Wealth and survivability both increased with a firm's level of alertness. This finding was true for both linkable and non-linkable firms. Though this finding is not particularly unexpected, it does indicate that firm alertness permits firms to find the most valuable strategic niches for all types of firms, and allows linkable firms to find supply chain partners with the advantageous network links. Likewise, firm efficiency was found to increase both wealth creation and survivability for both firms. Finally, and of particular interest to this study, the ability of a firm to align with strategic partners to appropriate the returns to entrepreneurial behavior (i.e. firm linkability) was shown to increase the overall wealth creation ability of entrepreneurial firms via lower rent dissipation from competitor firms in the market. This finding supports our third research proposition.

From an agri-food entrepreneur's perspective this latter finding signals the importance of aligning with existing agri-food supply chains to distribute their products. When taken in consideration with the increasing consolidated nature of the

agri-food industry[4], this finding is further emphasized. However, for the agri-food entrepreneur establishing a relationship or alliance with agri-food processors and retailers is easier said than done. One of the constraints to such relationships is the issue of legitimacy. Established processors, retailers and other potential supply chain partners are often hesitant to work with new ventures for various reasons, including: the perceived unpredictability of the entrepreneur to deliver consistent production quality and quantity over time. These concerns are amplified by the consequences of food contamination events. It is therefore, incumbent on the entrepreneur to alleviate these concerns and to try to establish themselves as a legitimate partner to the rest of the supply chain. Though this is not within the scope of the paper, the identification of firm-level strategies to establish legitimacy in this area is an important area of future research.

Though, in general, our research propositions were supported by the simulation experiments, several unexpected results were also evident. First, the presence of existing supply chains decreased the need for entrepreneurial abilities (i.e. alertness) both for linkable and non-linkable firms. For linkable firms this is not particularly surprising. As noted earlier, supply chain partners reduce rent dissipation via competition for competitor firms and thus reduce the frequency with which firms need to search for alternative profit opportunities. In the business environment, the reduction of rent dissipation is further associated with long-term contracts, exclusivity agreements, etc. However, for non-linkable firms this result appears counterintuitive. As noted by Ross (2008), spatial heterogeneity among strategic niches increases the

[4] Our model did not consider the increasing consolidated nature of the agri-food nature. However, the model could be adapted to accommodate this characteristic of the industry in two ways: 1) by allowing the region size of partners could be expanded to cover a wide range of the strategic landscape/market, and 2) by locking non-linkable firm agents out of strategies/markets that are currently serviced by partner firms. This is a area for future research.

need for firm alertness. One potential explanation for this finding is that with linkable firms attracted to supply chain alliances more viable strategic niches are available for non-linkable firms outside partner service regions. This result requires further attention.

With regards to the methodological approach, this study suggests that ABSMs are an appropriate tool for analyzing entrepreneurial behavior in supply chains. This type of methodology permits the investigation of complex interactions among entrepreneurial characteristics within and between firms, while highlighting performance outcomes. Models that assume equilibrium conditions or homogeneity of variables on the other hand would not be able to adequately capture the dynamics and complexity of entrepreneurial firm behaviors.

Finally, it is apparent that the characteristics that reflect an entrepreneur's ability to link to, and share rents with, supply chain partners require more investigation. In particular, the question of why supply partners reduce the entrepreneurial capabilities needed by non-linkable firms to create wealth and survive should be to be addressed. Furthermore, if this is the case, do industries characterized by long supply chains naturally have fewer entrepreneurial ventures? This study suggests this might be the case, but further research is needed in this area.

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Tables and Figures

Table 1–Model Parameters for Simulation Experiments.

	FIRMS						PARTNER		
EXPERIMENT	AL	EF	LINKABILITY	LEARN AL	LEARN EF	LEARN JD	REGIONSIZE	ATTRACTION	POWER
BASE EXPERIMENTS									
AL_BASE	Uniform(0,10)	5	NO	N/A	N/A	N/A	10	1	1
EF_BASE	5	X	NO	N/A	N/A	N/A	10	1	1
PARTNER ATTRIBUTE MODELS									
AL_RS	Uniform(0,10)	5	YES	N/A	N/A	N/A	Uniform(5,15)	1	1
EF_RS	5	Uniform(0,10)	YES	N/A	N/A	N/A	Uniform(5,15)	1	1
AL_ATT	Uniform(0,10)	MID	YES	N/A	N/A	N/A	10	Uniform(1,10)	1
EF_ATT	5	Uniform(0,10)	YES	N/A	N/A	N/A	10	Uniform(1,10)	1
AL_PWR	Uniform(0,10)	5	YES	N/A	N/A	N/A	10	1	Uniform(1,10)
EF_PWR	5	Uniform(0,10)	YES	N/A	N/A	N/A	10	1	Uniform(1,10)
AL_ALL	Uniform(0,10)	5	YES	N/A	N/A	N/A	Uniform(5,15)	Uniform(1,10)	Uniform(1,10)
EF_ALL	5	Uniform(0,10)	YES	N/A	N/A	N/A	Uniform(5,15)	Uniform(1,10)	Uniform(1,10)
LEARNING + PARTNER ATTRIBUTE MODELS									
AL_ALL(L)	Uniform(0,10)	5	YES	YES	YES	YES	Uniform(5,15)	Uniform(1,10)	Uniform(1,10)
EF_ALL(L)	5	Uniform(0,10)	YES	YES	YES	YES	Uniform(5,15)	Uniform(1,10)	Uniform(1,10)
AL_RS(L)	Uniform(0,10)	5	YES	YES	YES	YES	Uniform(5,15)	1	1
EF_RS(L)	5	Uniform(0,10)	YES	YES	YES	YES	Uniform(5,15)	1	1
AL_BASE(L)	Uniform(0,10)	5	YES	YES	YES	YES	10	1	1
EF_BASE(L)	5	Uniform(0,10)	YES	YES	YES	YES	10	1	1

Table 2 - Experimental Results from AL models.

Simulation	Firm	Age	Wealth	Years Affiliated	# of Firm Contacts	Avg. Alertness	Avg. Efficiency	# of Linked Firms	% of Firms Linked	Years Affiliated (Linked Firms)	Years Affiliated (Non-linked Firms)	Avg. Wealth (Linked Fims)	Avg. Wealth (Non-linked Fims)	Avg. # of Contact (Linked Firms)	Avg. # of Contact (Non-linked Firms)	Avg. Alertness (Linked Firms)	Avg. Alertness (Non-linked Firms)	Avg. Efficiency (Linked Firms)	Avg. Efficiency (Non-linked firms)
AL_BASE	1,000.00	-	500.00	-	-	5.68	5.00	503.00	0.50	-	-	50.00	50.00	-	-	5.74	5.63	5.00	5.00
	952.00	49.47	2,449.08	5.10	1.86	5.91	5.00	482.00	0.51	10.07	-	256.64	257.89	1.89	1.83	5.93	5.89	5.00	5.00
	898.00	99.52	4,277.16	12.58	2.87	6.19	5.00	455.00	0.51	24.83	-	475.80	476.81	2.94	2.80	6.20	6.17	5.00	5.00
	855.00	149.51	5,901.29	20.20	3.72	6.40	5.00	427.00	0.50	40.45	-	690.19	690.23	3.94	3.50	6.48	6.32	5.00	5.00
	813.00	199.50	7,203.81	27.43	4.38	6.60	5.00	409.00	0.50	54.52	-	884.98	887.19	4.49	4.27	6.65	6.55	5.00	5.00
AL_RS	1,000.00	-	500.00	-	-	5.45	5.00	498.00	0.50	-	-	50.00	50.00	-	-	5.47	5.42	5.00	5.00
	942.00	49.55	2,415.92	1.87	1.85	5.70	5.00	472.00	0.50	3.72	-	255.70	257.24	1.86	1.83	5.71	5.70	5.00	5.00
	890.00	99.46	4,222.57	5.12	2.77	5.96	5.00	443.00	0.50	10.28	-	473.99	474.90	2.74	2.80	6.00	5.92	5.00	5.00
	851.00	149.43	5,854.68	8.50	3.53	6.15	5.00	428.00	0.50	16.90	-	686.68	689.29	3.61	3.44	6.14	6.16	5.00	5.00
	798.00	199.54	7,046.73	11.21	4.26	6.39	5.00	400.00	0.50	22.37	-	881.15	884.96	4.27	4.26	6.40	6.38	5.00	5.00
AL_Att	1,000.00	-	500.00	-	-	5.45	5.00	497.00	0.50	-	-	50.00	50.00	-	-	5.50	5.40	5.00	5.00
	784.00	49.56	2,003.90	1.92	1.63	5.61	5.00	312.00	0.40	4.82	-	252.73	257.50	1.67	1.61	5.53	5.67	5.00	5.00
	688.00	99.51	3,253.88	4.59	2.36	5.86	5.00	241.00	0.35	13.10	-	464.68	477.40	2.72	2.16	5.80	5.89	5.00	5.00
	605.00	149.47	4,159.04	7.15	2.76	5.99	5.00	174.00	0.29	24.84	-	669.72	694.60	3.02	2.65	5.86	6.04	5.00	5.00
	518.00	199.51	4,621.21	6.26	3.15	6.16	5.00	112.00	0.22	28.96	-	865.65	899.43	3.46	3.07	5.71	6.28	5.00	5.00
AL_Pwr	1,000.00	-	500.00	-	-	5.41	5.00	488.00	0.49	-	-	50.00	50.00	-	-	5.31	5.50	5.00	5.00
	927.00	49.56	2,686.90	5.28	1.84	5.74	5.00	450.00	0.49	10.88	-	324.36	257.29	1.88	1.81	5.67	5.81	5.00	5.00
	877.00	99.56	5,007.49	15.24	2.95	5.99	5.00	426.00	0.49	31.37	-	669.07	478.33	3.21	2.72	5.90	6.07	5.00	5.00
	850.00	149.52	7,340.67	27.91	4.09	6.11	5.00	413.00	0.49	57.44	-	1,044.68	692.48	4.72	3.49	6.01	6.20	5.00	5.00
	806.00	199.52	9,395.79	43.71	5.44	6.30	5.00	394.00	0.49	89.42	-	1,449.50	894.36	6.12	4.80	6.20	6.40	5.00	5.00
AL_All	1,000.00	-	500.00	-	-	5.47	5.00	497.00	0.50	-	-	50.00	50.00	-	-	5.61	5.33	5.00	5.00
	860.00	49.47	2,323.49	2.32	1.76	5.57	5.00	384.00	0.45	5.21	-	287.70	256.03	1.68	1.82	5.57	5.57	5.00	5.00
	780.00	99.59	4,034.20	6.83	2.57	5.71	5.00	323.00	0.41	16.50	-	574.28	476.86	2.54	2.59	5.65	5.75	5.00	5.00
	702.00	149.52	5,410.87	12.89	3.21	5.90	5.00	269.00	0.38	33.63	-	896.74	692.53	3.63	2.94	5.78	5.97	5.00	5.00
	631.00	199.42	6,452.12	20.51	4.24	6.09	5.00	224.00	0.35	57.79	-	1,252.90	895.73	5.17	3.73	5.89	6.20	5.00	5.00
AL_All(L)	1,000.00	-	500.00	-	-	5.57	5.00	510.00	0.51	-	-	50.00	50.00	-	-	5.61	5.52	5.00	5.00
	989.00	49.47	3,128.13	3.49	1.85	5.61	5.00	503.00	0.51	6.86	-	326.88	305.33	1.82	1.88	5.67	5.55	5.00	5.00
	985.00	99.49	6,047.74	10.28	3.03	5.63	5.00	501.00	0.51	20.21	-	647.57	579.22	3.23	2.82	5.69	5.57	5.00	5.00
	976.00	149.60	8,901.90	18.31	4.06	5.67	5.00	497.00	0.51	35.96	-	975.87	845.89	4.44	3.66	5.72	5.62	5.00	5.00
	961.00	199.45	11,422.18	26.02	5.20	5.73	5.00	490.00	0.51	51.03	-	1,282.60	1,090.75	5.70	4.68	5.78	5.68	5.00	5.00
AL_RS(L)	1,000.00	-	500.00	-	-	5.49	5.00	494.00	0.49	-	-	50.00	50.00	-	-	5.44	5.53	5.00	5.00
	882.00	49.47	2,819.38	2.67	1.73	5.49	5.00	390.00	0.44	6.03	-	337.55	305.48	1.84	1.64	5.28	5.66	5.00	5.00
	822.00	99.63	5,125.34	7.85	2.53	5.50	5.00	335.00	0.41	19.27	-	682.74	582.79	2.85	2.31	5.20	5.70	5.00	5.00
	787.00	149.55	7,331.63	15.09	3.78	5.51	5.00	301.00	0.38	39.45	-	1,058.00	853.30	4.31	3.45	5.18	5.71	5.00	5.00
	742.00	199.46	9,132.68	23.12	4.91	5.54	5.00	256.00	0.35	67.02	-	1,462.93	1,108.55	6.13	4.27	5.22	5.71	5.00	5.00
AL_BASE(L)	1,000.00	-	500.00	-	-	5.39	5.00	507.00	0.51	-	-	50.00	50.00	-	-	5.38	5.41	5.00	5.00
	981.00	49.53	3,162.17	5.34	1.88	5.48	5.00	500.00	0.51	10.47	-	337.08	307.02	2.00	1.77	5.44	5.51	5.00	5.00
	968.00	99.55	6,174.30	15.99	3.11	5.54	5.00	490.00	0.51	31.59	-	690.34	584.02	3.51	2.69	5.53	5.54	5.00	5.00
	963.00	149.50	9,232.31	28.89	4.51	5.56	5.00	488.00	0.51	57.01	-	1,059.68	854.96	5.25	3.74	5.55	5.57	5.00	5.00
	956.00	199.47	12,091.91	42.77	5.84	5.59	5.00	486.00	0.51	84.13	-	1,417.58	1,106.91	6.84	4.80	5.57	5.61	5.00	5.00

Table 3 - Experimental Results from EF models.

Simulation	Firm	Age	Wealth	Years Affiliated	# of Firm Contacts	Avg. Alertness	Avg. Efficiency	# of Linked Firms	% of Firms Linked	Years Affiliated (Linked Firms)	Years Affiliated (Non-linked Firms)	Avg. Wealth (Linked Fims)	Avg. Wealth (Non-linked Fims)	Avg. # of Contact (Linked Firms)	Avg. # of Contact (Non-linked Firms)	Avg. Alertness (Linked Firms)	Avg. Alertness (Non-linked Firms)	Avg. Efficiency (Linked Firms)	Avg. Efficiency (Non-linked firms)
EF_BASE	1,000.00	-	500.00	-	-	5.00	5.46	462.00	0.46	-	-	50.00	50.00	-	-	5.00	5.00	5.32	5.57
	887.00	49.53	2,345.19	2.01	1.82	5.00	4.90	414.00	0.47	4.31	-	269.77	259.70	1.87	1.78	5.00	5.00	4.80	4.99
	798.00	99.57	4,343.28	4.18	2.49	5.00	4.45	377.00	0.47	8.85	-	548.29	540.67	2.48	2.49	5.00	5.00	4.40	4.49
	798.00	149.53	6,305.87	6.83	3.43	5.00	4.45	377.00	0.47	14.46	-	795.03	785.89	3.55	3.33	5.00	5.00	4.40	4.49
	785.00	199.42	8,064.51	8.90	4.15	5.00	4.41	372.00	0.47	18.78	-	1,029.98	1,024.93	4.26	4.06	5.00	5.00	4.37	4.45
EF_RS	1,000.00	-	500.00	-	-	5.00	5.44	484.00	0.48	-	-	50.00	50.00	-	-	5.00	5.00	5.38	5.51
	740.00	49.49	1,990.16	1.68	1.52	5.00	4.84	280.00	0.38	4.45	-	280.02	262.20	1.51	1.52	5.00	5.00	4.61	4.98
	632.00	99.47	3,449.55	3.38	2.04	5.00	4.44	215.00	0.34	9.95	-	567.30	534.74	1.98	2.07	5.00	5.00	4.22	4.56
	591.00	149.49	4,764.59	5.11	2.75	5.00	4.39	175.00	0.30	17.26	-	873.11	778.04	2.89	2.69	5.00	5.00	3.98	4.56
	556.00	199.46	5,913.00	6.55	3.08	5.00	4.32	142.00	0.26	25.63	-	1,227.71	1,007.16	3.11	3.07	5.00	5.00	3.63	4.55
EF_Att	1,000.00	-	500.00	-	-	5.00	5.69	496.00	0.50	-	-	50.00	50.00	-	-	5.00	5.00	5.72	5.65
	877.00	49.51	2,543.15	5.62	1.76	5.00	5.11	437.00	0.50	11.28	-	325.66	254.55	1.77	1.76	5.00	5.00	5.17	5.04
	812.00	99.48	4,897.17	14.97	2.75	5.00	4.79	418.00	0.51	29.08	-	675.97	525.79	2.87	2.62	5.00	5.00	5.00	4.58
	807.00	149.42	7,316.02	26.12	3.84	5.00	4.78	415.00	0.51	50.80	-	1,038.75	766.64	4.03	3.65	5.00	5.00	4.99	4.56
	799.00	199.46	9,673.23	39.00	5.02	5.00	4.77	412.00	0.52	75.64	-	1,411.72	996.63	5.35	4.67	5.00	5.00	4.98	4.55
EF_Pwr	1,000.00	-	500.00	-	-	5.00	5.60	525.00	0.53	-	-	50.00	50.00	-	-	5.00	5.00	5.67	5.52
	811.00	49.48	2,190.25	2.33	1.61	5.00	5.07	389.00	0.48	4.85	-	280.77	260.20	1.60	1.61	5.00	5.00	5.17	4.98
	713.00	99.54	4,009.50	6.55	2.22	5.00	4.67	334.00	0.47	13.98	-	592.94	535.38	2.26	2.18	5.00	5.00	4.83	4.52
	677.00	149.52	5,669.32	10.99	2.94	5.00	4.59	302.00	0.45	24.64	-	903.84	783.93	3.08	2.83	5.00	5.00	4.72	4.49
	643.00	199.64	7,104.59	15.48	3.89	5.00	4.52	272.00	0.42	36.60	-	1,217.19	1,022.60	4.13	3.72	5.00	5.00	4.61	4.45
EF_All	1,000.00	-	500.00	-	-	5.00	5.44	483.00	0.48	-	-	50.00	50.00	-	-	5.00	5.00	5.40	5.48
	914.00	49.50	2,815.33	2.68	1.80	5.00	5.01	446.00	0.49	5.49	-	314.83	301.54	1.77	1.84	5.00	5.00	5.02	5.01
	896.00	99.46	5,384.85	7.57	2.77	5.00	4.93	437.00	0.49	15.53	-	623.97	579.11	2.88	2.66	5.00	5.00	4.94	4.93
	868.00	149.52	7,934.79	13.61	3.80	5.00	4.80	433.00	0.50	27.28	-	936.97	891.42	4.06	3.53	5.00	5.00	4.90	4.71
	839.00	199.51	10,247.32	18.83	4.23	5.00	4.66	424.00	0.51	37.26	-	1,235.08	1,207.37	4.48	3.98	5.00	5.00	4.82	4.50
EF_All(L)	1,000.00	-	500.00	-	-	5.00	5.40	509.00	0.51	-	-	50.00	50.00	-	-	5.00	5.00	5.44	5.36
	827.00	49.53	2,702.29	2.80	1.66	5.00	4.93	381.00	0.46	6.08	-	343.85	312.16	1.75	1.59	5.00	5.00	4.97	4.90
	777.00	99.47	5,078.76	9.36	2.50	5.00	4.86	335.00	0.43	21.71	-	729.50	596.14	2.73	2.33	5.00	5.00	4.87	4.86
	722.00	149.49	7,438.55	18.68	3.63	5.00	4.68	304.00	0.42	44.37	-	1,176.40	923.99	4.30	3.14	5.00	5.00	4.75	4.62
	678.00	199.45	9,631.37	30.41	4.84	5.00	4.54	278.00	0.41	74.16	-	1,654.97	1,257.64	6.20	3.90	5.00	5.00	4.70	4.43
EF_RS(L)	1,000.00	-	500.00	-	-	5.00	5.54	496.00	0.50	-	-	50.00	50.00	-	-	5.00	5.00	5.56	5.51
	925.00	49.61	2,836.42	5.89	1.74	5.00	5.18	462.00	0.50	11.80	-	314.17	299.13	1.86	1.62	5.00	5.00	5.25	5.11
	917.00	99.52	5,534.14	15.14	2.85	5.00	5.15	461.00	0.50	30.12	-	634.61	572.05	3.13	2.57	5.00	5.00	5.24	5.05
	886.00	149.54	8,231.53	26.48	4.09	5.00	5.01	456.00	0.51	51.46	-	972.38	883.13	4.66	3.47	5.00	5.00	5.20	4.82
	861.00	199.56	10,810.40	38.73	4.98	5.00	4.90	451.00	0.52	73.95	-	1,307.41	1,198.53	5.56	4.33	5.00	5.00	5.15	4.61
EF_BASE(L)	1,000.00	-	500.00	-	-	5.00	5.43	476.00	0.48	-	-	50.00	50.00	-	-	5.00	5.00	5.58	5.30
	897.00	49.45	2,350.94	4.56	1.73	5.00	4.92	423.00	0.47	9.66	-	254.98	268.44	1.74	1.72	5.00	5.00	5.04	4.81
	813.00	99.51	4,352.23	10.65	2.52	5.00	4.50	384.00	0.47	22.55	-	518.60	550.31	2.52	2.52	5.00	5.00	4.64	4.38
	809.00	149.53	6,312.95	16.64	3.48	5.00	4.48	380.00	0.47	35.43	-	757.69	800.40	3.72	3.27	5.00	5.00	4.61	4.38
	799.00	199.54	8,047.95	23.34	4.31	5.00	4.48	374.00	0.47	49.85	-	983.74	1,027.95	4.52	4.12	5.00	5.00	4.56	4.40

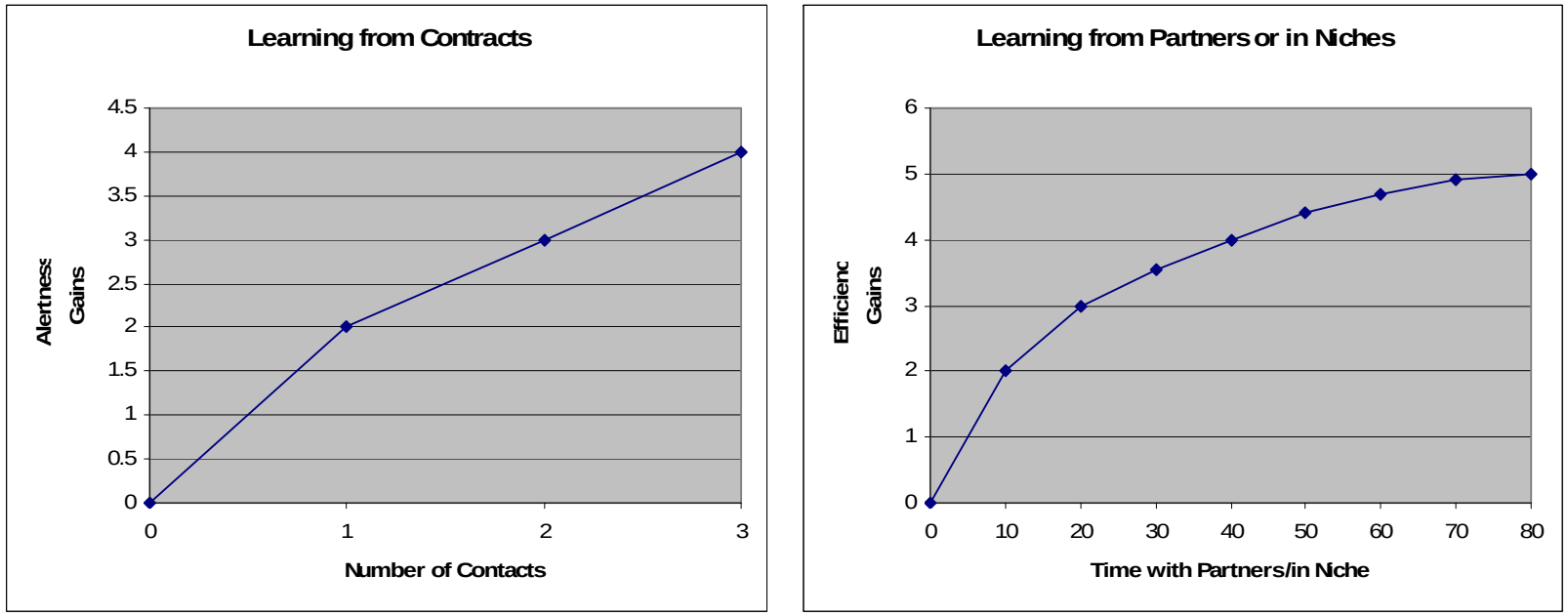

Figure 1 - Alertness and Efficiency Gains from Learning

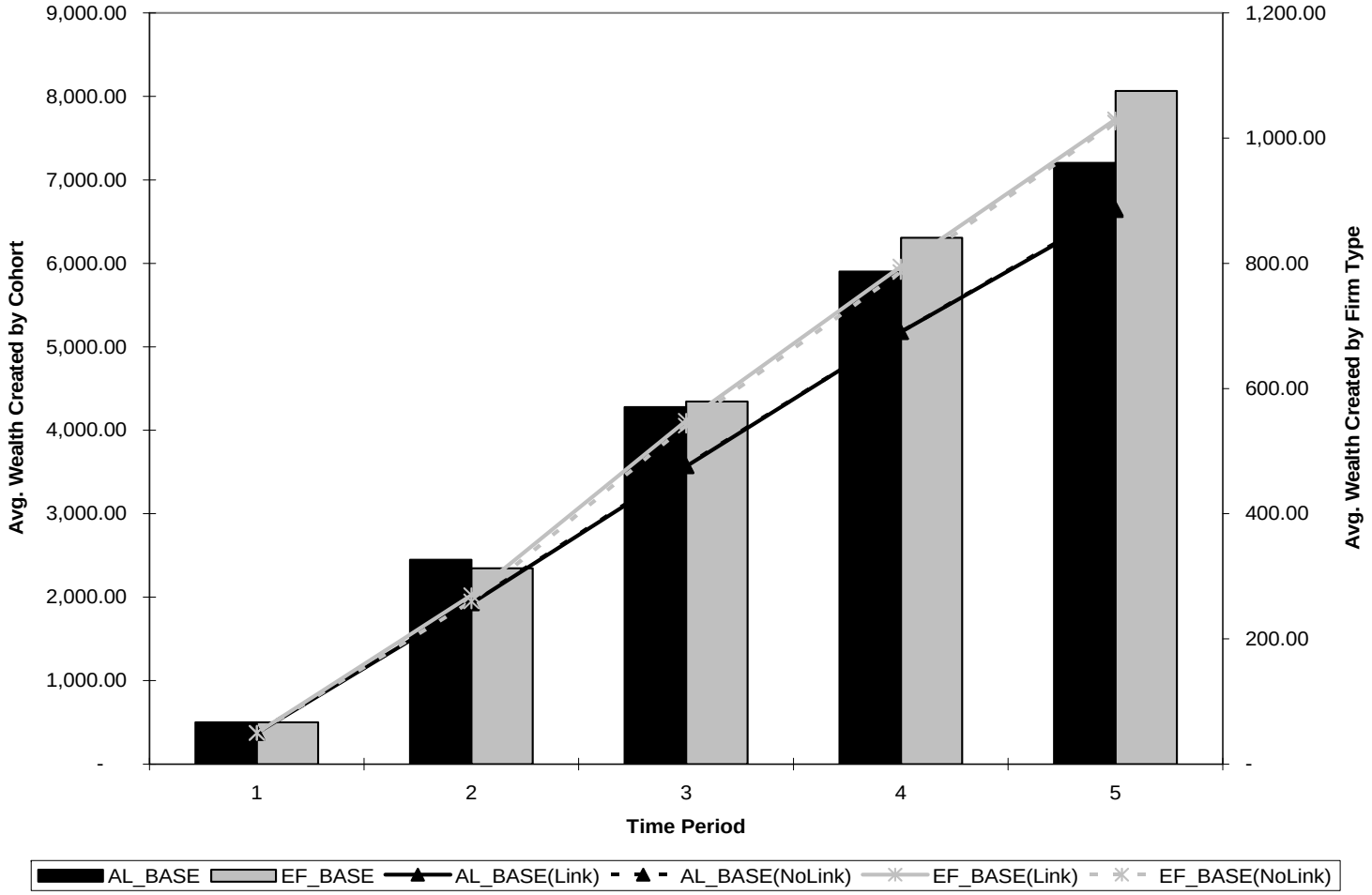

Figure 2 - Results of AL and EF BASE Simulation Experiments