ANTECEDENTS OF TECHNOLOGICAL CHANGE: THE INFLUENCE OF ENTREPRENEURIAL MOTIVATION AND STRATEGIC INTENTION[1]

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ABSTRACT

This study seeks to determine the influence of the underlying factors that facilitate the growth and implementation of new technologies within women-owned businesses. In our proposed model, market growth mediates the relationship between the individual antecedents (entrepreneurial intensity and opportunity costs) and technological change. Using the two-step approach for measurement analysis and structural equation modeling, results revealed that the process for entrepreneurs to implement new technological changes is influenced by their decision to expand their business. Entrepreneurial intensity and the entrepreneur's willingness to incur opportunity costs were key motivating factors that propel the entrepreneur to seek new growth strategies.

Antecedents of Technological Change: The Influence of Entrepreneurial Motivation and Strategic Intention

The process through which entrepreneurial firms plan and achieve technological changes often reflects a complex set of motivators and intentions that support this strategic path. Building on the pattern of growth literature developed by several researchers, this study seeks to determine the influence of the underlying factors that facilitate the growth and implementation of new technologies. There has been a lack of empirical work on the stages beyond start-up to examine the antecedents of growth intentions and technology change. This research investigates the process through which entrepreneurs implement new technologies in their firms. Technological innovation is the prime driver of economic progress. Schumpeter recognized it; entrepreneurs create many of the innovations that shape our lives in small businesses. One goal of organizations can be the fostering of high rates of innovation, since technical progress is a key factor in elevating the economic well being of a society.

Historically, successful firms have not taken advantage of technological advances that they themselves invented. Often, firms that seek out new markets in which they can capture the value that technological innovations create commercialize new products and services. Thus, the overall attempt is to seek both technological breakthroughs as well as capture new markets. Pursuing both goals is often a daunting task, especially with market forces demanding that the venture be effective in both arenas. More research is needed, therefore, to

identify how these two goals interact with one another. Are they compatible, synergistic, interactive, or independent of each other? This is a key research question to be investigated in this study.

Additionally, of research interest are the prime motivators leading entrepreneurs to pursue technological innovation and market growth. It might be expected that intense commitment to the success of the venture as well as the willingness to make substantial personal and professional sacrifices would characterize these entrepreneurs. Thus, a second research question is: Do entrepreneurs who adopt goals of technological innovation and market growth exhibit high levels of entrepreneurial intensity and commitment, and a willingness to make sacrifices by incurring opportunity costs? This study seeks to examine the nature of the relationship between these entrepreneurial predispositions and the aforementioned goals (see Figure 1).

Entrepreneurial Motivation and Commitment: Their Role in Post Start-Up Venture Growth

While commitment to the entrepreneurial endeavor can be described as the passion required for success of the enterprise, the degree of commitment exhibited by the entrepreneur is identified here as *entrepreneurial intensity*. It is characterized in this study as a single-minded focus to work towards the growth of the venture, often at the expense of other worthy goals. The difference between general personality traits and indicators of *entrepreneurial intensity* were

highlighted by Baum (1995) whose study indicated that while measures of general traits and personality were a poor indicator of venture growth, more specific applications of these traits such as "growth specific motivation" showed far stronger relationships with growth performance. Similarly, Montagno et al's (1986) investigation into the perceptions of entrepreneurial success characteristics found that self-motivation and determination were at the 'essential' end of the perceptual scale of success factors according to entrepreneurs themselves and their bankers alike.

There is a lack of empirical work on entrepreneurial motivation in the stages beyond start-up that contribute to sustained entrepreneurship (Bhave, 1994; Kuratko, Hornsby and Naffziger, 1997). Indeed, Davidsson and Wicklund (2001) specifically state that amongst the new directions for research of the entrepreneur at the individual level of analysis, "it is the study of what actions 'nascent entrepreneurs' take, and in what sequence, in order to get their business up and running…is perhaps the most promising development to be expected."

It could be presumed that entrepreneurial intensity would be positively related to growth intentions. However, factors such as socialization or self-efficacy can lead to conditions where even intensely motivated entrepreneurs may not be willing to grow the company. Alternatively, less committed, or intense, entrepreneurs may have strong growth intentions based on a unique product, competitive advantages, or joint alliances. Eggers and Smilor (199?) acknowledge that the entrepreneur's commitment may often conflict with their

need to maintain flexibility as part of the broader paradox of order vs. chaos facing entrepreneurs. Researchers have suggested that planned growth requires concentrated effort (Bracker, Keats and Pearson 1988; Lyles et al, 1993). Entrepreneurial intensity has been measured in several cross-cultural investigations (Pistrui et al, 1998; Welsch and Pistrui, 1993) and results showed it was related to growth intentions.

As in any complex undertaking, entrepreneurs must focus on survival and growth of their enterprises. This necessarily means that other obligations and activities will receive less attention. The priority choices and sacrifices made by entrepreneurs can take the form of individual opportunity cost decisions, in which entrepreneurs reject alternative, competing activities that vie for their time and consideration. For example, they give up secure jobs in other professions, and they forego higher salaries and promising careers in other industries. They may make sacrifices in their personal lives in order to pursue their dream of having an established, successful business. Thus, *opportunity costs*, as these sacrifices are termed in this study, become an important factor in the entrepreneurial growth process. Most, if not all, entrepreneurs suffer from a scarcity of resources, and therefore incur penalties in the pursuit of desired growth objectives. Reducing these opportunity costs may even be a prerequisite for entrepreneurship for some individuals. Amit and Cockburn (1995) found that individuals were more likely to undertake entrepreneurial activity when opportunity costs were lower. The present study seeks to examine the influence

of opportunity costs as an antecedent in the pursuit of technological change. We can compare the exploration of opportunity costs with Davidsson et al's (2001) call for "consideration of environmental factors fundamental to an understanding of the generation of and acting upon entrepreneurial activities"

Strategic Growth Intentions

Entrepreneurial growth intentions have been considered a differentiating factor between small business owners and entrepreneurs in previous research (Carland et al, 1984; Sexton and Bowman, 1986, Stewart et al, 1998). Krueger and Carsrud's (1993) application of a psychological model of planned intentions to the entrepreneurial process has illustrated that intentions are the best predictor of planned behavior both conceptually and empirically. Notably, the research indicates that "situational and individual differences are exogenous factors that influence entrepreneurship indirectly, not directly. The do so only in so far as they affect attitudes or the intentions-behavior relationship."

Moderate growth firms have been compared to the sample of *Inc*'s 500 fastest growing firms (Ginn and Sexton, 1990). Moore and Buttner (1997) described 'traditional' and 'modern' entrepreneurs, characterizing the former as small and slow growing. As Sexton and Bowman asserted, "…Growth is not inevitable. It does not occur of and by itself. It is a conscious decision made by some business owners and avoided by others…He/she can initiate the growth, foster it, nurture it, and prune it as desired" (1986: p. 330-331). Kolvereid (1992)

found that over sixty percent of entrepreneurs sampled wanted their firms to grow, while the rest did not aspire to do so. Ducheneaut (1995) found that 52% of small firms' owner-managers felt satisfied with the size of their firms, and that only 46% wished strongly to develop it if they had the opportunity. An earlier Swedish study found that nearly 40% of owner-managers did not prefer growth, even though they acknowledged market opportunities for growth existed.

Some entrepreneurs may thrive on rapid growth while others are uncomfortable with the crises and uncertainties that typically accompany such a strategy. Gundry and Welsch (in press) found that high-growth oriented entrepreneurs exhibited greater entrepreneurial intensity and willingness to incur opportunity costs than did lower-growth oriented entrepreneurs. One of the limits on an entrepreneur's growth intentions should be his or her tolerance to stress and discomfort (Bhide, 1996). Davidsson (1989) identified three primary reasons explaining the reluctance of small firm managers to grow: loss of control, deterioration of employee well-being, and increased vulnerability.

Entrepreneurial Technology and Innovation

In a review of theory surrounding the growth of technology-based firms, Autio (2001) comments that "we still lack a dedicated theory of the relationships between growth and technology in new firms. Most studies to date, true to the entrepreneurship research tradition, focus on the entrepreneur or management team, conventional product and market and industry variables without

attempting to develop a theoretical understanding of the influence of technology on new-firm growth." It is the intention of this paper to begin to address this theoretical gap.

Just as growth intentions have been used to differentiate entrepreneurs from small business owners and managers, studies have also highlighted the acceptance of innovation as another important differentiator. Stewart et al's (1998) comparison of the three different groups indicate that entrepreneurs show a significantly greater propensity to embrace innovation than both managers and small business owners. "Given the relative significance of innovativeness in entrepreneurs, it would appear that creativity necessitates extended risk, because it entails coping with the potential outcomes that are associated with untried venues." Entrepreneurs alone appear able to embrace this coalition of creativity and risk taking. It is the contention of this paper, that the adoption of technology as a consequence of growth of the enterprise is a reflection of this potential to embrace innovation.

Despite common public perceptions to the contrary, studies in the UK and Finland have indicated that technologically advanced firms do not necessarily aspire to high growth (Autio and Lumme, 1998). Indeed the authors own findings are that the greater the degree of novelty of technology applied by the firm, the greater is the friction hindering its growth. The model proposed in this paper then asks, if not technology leading to growth, does growth lead to technology?

In a recent investigation into the role of technological adoption upon new venture growth, Baum (2000) concluded that the causes for adoption are dependant upon technology type. Product design technologies and marketing technologies were adopted early in the venture's life, whereas manufacturing technologies and management information systems adoption was often postponed until a critical level of growth had been obtained. Baum concluded that a critical level of growth was often necessary to justify the large investments required or where significant savings of scale could be achieved.

In broader terms, Arbaugh and Camp's (2000) review of the management of growth transitions acknowledges that "the innovation literature has identified the need for entrepreneurs, who desire their firms to grow, to innovate and to create a resource configuration that sustains a high level of growth over time." Unquestionably, the investment and adoption of technology is a key resource for today's entrepreneurs to configure, and as such its relationship with entrepreneurial growth transition is of fundamental importance.

Recently, Wiklund (1998) classified the growth literature into four theoretical perspectives: 1) Resource based perspective, is descriptive of the firm's internal strengths and resource integrations; 2) Motivation perspective, in which psychological theory is an important determinant of the direction, persistence and intensity of action and performance level reached; 3) Strategic Adaptation perspective, in which the fit between environmental demands and strategy have performance implications; and 4) Configuration perspective, in

which alignments of firm structure, strategy and environment contribute to a taxonomy. The approach adopted in the present study is most closely aligned with the Motivation perspective and provides a framework for examining the relationship between the psychological antecedents (entrepreneurial intensity and opportunity costs) of growth aspirations and technological innovations implemented by entrepreneurs.

The present study attempts to extend the research on strategic intentions by including a large sample of women entrepreneurs across several industrial sectors in established firms with significant sales. Thus, it follows recent research differentiating among women entrepreneurs whose businesses may be differentiated by size, industry, strategic intent and performance (National Foundation for Women Business Owners (NFWBO), 1994; Gundry and Welsch, in press). In a study published by the NFWBO, one out of five women entrepreneurs reported that maintaining the growth and competitive status of their firms was a significant challenge. Further, in their comprehensive review of research on women business owners, Starr and Yudkin (1996) stated that more work was needed to help define preconditions and strategies for growth in women-owned enterprises. Our study seeks to understand the technological change process adopted by women entrepreneurs as they expand the operations of their business. As shown in our proposed model and Figure 1, market growth mediates the relationship between the individual antecedents (entrepreneurial intensity and opportunity costs) and technological change.

METHOD

Participants

Eight-hundred thirty-two (832) women business owners responded to a survey developed by the authors in conjunction with the state's department of commerce and community affairs. The firms were randomly sampled by industrial sector from Dun's Marketing Database. The entrepreneurs who responded represented all industrial classifications, including: service (35%), wholesale trade (14%), construction (14%), retail trade (9%), manufacturing (9%), professional service (6%), finance/insurance (3%), transportation (3%), and agribusiness (1%). Forty-two percent of firms reported annual sales greater than $1 million; 12% had sales of $500,000 to $1 million; 18% had sales of $250,000 to $500,000; 20% had sales of $100,000 to $250,000; and 18% had sales less than $100,000 per year. More than 50% of the women entrepreneurs had been established in business over 10 years; 12% had been in business less than five years. Overall, most entrepreneurs were between the ages of 45-54 (33%), and 35-44 (31%). Nearly 10% were between 25-34 years of age, and 19% were between 55-64 years of age. Nearly 70 percent of the sample had at least a post-secondary education, while 20 percent had four-year college degrees and 21 percent have completed some post-graduate work. The average number of years of experience in the industry in which the firm operated was 16 years, and the average number of years of overall business experience was eighteen.

Overview and Procedure

The variables of interest were assessed via a written, confidential instrument. These were: market growth and expansion intentions, technological innovations planned, the degree of entrepreneurial intensity, the willingness to incur opportunity costs, and demographic characteristics of the entrepreneurs and their firms. All items except demographic measures used a Likert-type five-point response format.

Entrepreneurial Intensity and Opportunity Costs

Entrepreneurial Intensity (EI) is the degree to which entrepreneurs are willing to exert maximum motivation and effort towards the success of their venture. The EI scale has been implemented in a variety of research studies in the United States, Central America, and Eastern Europe (Pistrui, Liao, and Welsch, 1998; Gundry and Welsch, in press) and consists of four items (e.g. "my business is the most important activity in my life") measured using a five-point Likert-type scale). *Opportunity Costs (OC)*, defined as the extent to which entrepreneurs are willing to incur personal and professional sacrifices for the sake of the venture was also measured using a Likert format for four items (e.g. "I would rather own my own business than pursue another promising career").

Market Growth Intentions and Technological Innovations

Based on the Typology developed by Miles and Snow (1978), strategic growth intentions were measured by items assessing the entrepreneurs' likelihood of adding a new product or service, expanding operations, selling to a new market, etc. using a Likert-type scale. These items are from the Implementable Attributes of Planned Growth (IAPG) scale developed by Pistrui (1999) that measures specific types of new combinations entrepreneurs plan to pursue.

Finally, the extent to which entrepreneurs had pursued technological innovations, including acquiring new computer equipment and updating computer systems was assessed.

Statistical Analysis

The data were analyzed using the two-step approach for measurement analysis and structural equation modeling, as recommended by Anderson and Gerbing (1988). Their approach separates the analysis of a measurement model representing the relationships between the individual indicators and latent variables from the analysis of the structural paths between the latent concepts.

In order to determine the structural relationships proposed in our model, a series of models were evaluated by comparing the change in chi-square associated with the restriction of certain paths to zero (Bentler & Bonett, 1980). Figure 2 shows the first model (Model A) which contains paths from the

antecedents to market growth and technological change and from market growth to technological change. From this *saturated* model, three nested models were evaluated: Model B, which restricted the paths from the antecedents to market growth; Model C, which restricted the paths from market growth to technological change; and finally, Model D, which restricted the paths from the antecedents to technological change. Significant changes in the chi-square of these models from Model A indicate support for the reinstatement of the restricted paths.

After completing these model analyses, the significance of the individual paths in the best-fitting model was assessed to demonstrate which structural paths showed which specific paths accounted for the significant change in chi-square and to determine if the change was positive or negative. Lisrel VIII (Joreskog & Sorbom, 1993) was utilized to compare the fit of all nested models to determine if the association between entrepreneurial antecedents and technological change is mediated by market growth.

RESULTS

Descriptive Statistics

The means, standard deviations, and internal reliabilities for the observed constructs are reported in Table 1. The reliabilities of the measures used were all over the .70 minimum established by Nunnally (1978).

Analyses of Nested Models

Before analyzing the nested models and the individual relationships, a test between the measurement model (an overall confirmatory factor analyses of the study's constructs) was compared to the null model, as recommended by Anderson and Gerbing (1988). The difference in chi-square values for the comparison was significant, indicating that the measurement model provided a significant improvement in fit (measurement model: Goodness-of-Fit Index (GFI) = .93; Comparative Fit Index (CFI) = .92; Tucker-Lewis Index (TLI) = .90). The CFI index is independent of the size of the sample and degrees of freedom (Marsh, Balla, & McDonald, 1988). Bentler and Bonett (1980) recommended that a value of .90 or higher on the CFI and TLI indicates an adequate fit of model to data.

After comparing the fits of these two models, nested model comparisons were conducted to determine if the relationship between the entrepreneurial antecedents and technological innovations were mediated by market growth. The results of the nested models analysis are reported in Table 2. Model A in Table 2 is the model in Figure 2. This model includes all of the mediating and direct effects of entrepreneurial antecedents, market growth, and technological innovations. As shown in the first row of Table 2, this *saturated* model had a χ^2 of 542.31, with 113 degrees of freedom (GFI=.93; CFI=.92; TLI=.90). Model B is almost identical to Model A, except that the effects of the entrepreneurial antecedents to market growth were omitted. As shown in Table 2, the chi-square

difference between these models was 73.89, which was significant ($p<.001$) at 2 degrees of freedom, indicating that the effects of the entrepreneurial antecedents on market growth made an important contribution to the overall fit of the model and should not be omitted.

Model C is almost identical to Model A except the effects of market growth to technological innovations were omitted. The chi-square difference between Model C and Model A was 137.20, which was significant ($p<.001$) at 1 degree of freedom, indicating that the effects of market growth to technological innovations should not be deleted from the model. Finally, Model D is the same as Model A, except that the effects of the entrepreneurial antecedents to technological innovations were omitted. This model was used to determine whether the relationship between entrepreneurial antecedents and technological innovations were fully or partially mediated by market growth. The chi-square difference between Model D and Model A was 3.89, and is not significant at two degrees of freedom. Therefore, the entrepreneurial antecedents, as a group, are fully mediated by market growth in determining technological innovations.

Significance of Individual Paths

The model comparisons discussed above were conducted to test the aggregate, not the individual relationships depicted in Figure 2. In examining the various relationships among the entrepreneurial antecedents to market growth, it appears that entrepreneurial intensity ($\beta=.26$) and opportunity costs (β

=.14) had a significant positive impact ($p<.001$) on market growth. Additionally, the relationship between market growth ($\beta=.55$) and technological change innovations was also significant ($p<.001$).

DISCUSSION

Because of the rapid acceleration of technology, entrepreneurs must find alternative ways to sustain their competitive edge through the introduction of new products/service, new processes, and new growth methods. This research represents one of the few large-scale studies of established women-owned enterprises embarking on technological innovations for the new millennium.

In our model, market growth mediates the relationship between the individual antecedents (entrepreneurial intensity and opportunity costs) and technological change. More specifically, results revealed that the association between individual antecedents and technological change is mediated by market growth. That is, the process for entrepreneurs to implement new technological changes within their firms is influenced by their decision to expand and grow their business. Entrepreneurial intensity and the entrepreneur's willingness to incur opportunity costs were found to be key motivating factors that propel the entrepreneur to seek new growth strategies in the market. These results extend the work on entrepreneurial motivation at more established venture stages (Bhave, 1994) and lend support to Wicklund's (1998) motivational perspective of entrepreneurial growth. Such motivations seem to induce entrepreneurs to put

aside some of their personal goals and incur significant sacrifices in pursuit of their venture's goals.

Study Limitations and Directions for Future Research

This study has several limitations. First, the relationship between the antecedent (entrepreneurial intensity and opportunity costs), market growth intentions, and technological innovations included common method variance. The measures used to tap each of these constructs were taken from one source (the owner of the business). These associations could, therefore, be attributed to a response bias on the part of the entrepreneur. Additionally, the study was cross-sectional and captured entrepreneurs' responses in various stages of their firm's life cycle. In future studies, it may be possible to control the life cycle stage in which respondents' firms are found, and investigate the relationship to growth intention and innovation. Thirdly, we have examined psychological antecedents to growth and innovation using the motivation perspective proposed by Wicklund (1998). Future research should consider the influence of other variables, such as resource integration, firm structure, and the nature of the external environment to further examine the perspectives outlined by Wicklund.

This study raises several questions. First, if market growth aspirations mediate the pursuit of technological innovations, what effect does fluctuation in market conditions have on entrepreneurial strategic behavior. For example, do entrepreneurs engaged in e-commerce ventures, in which the pursuit of

innovation is a core business value, exhibit high strategic market growth intentions? Future research should include e-commerce enterprises to investigate these relationships. Moreover, more work should also investigate other factors that may influence the decision-making process of e-commerce-based entrepreneurs in incorporating core and emerging technologies such as electronic data interchange (EDI), databases, data communications, electronic fund transfers (EFTs), and security-related technologies. Selection and integration of the correct technology for any e-commerce business employs capital and organizational efficiency and serves as a foundation for building the business (Davis & Meyer, 1998). To this end, the work of Baum (2000) and this study should be developed to understand the interactions between technology adoption, stages of firm development and growth expectations.

Additionally, as entrepreneurs carve out their competitive niche in their industries, more research should also focus further on the process of how their attitudes and beliefs influence major changes in their organization's overall strategies and short-term functional objectives. That is, additional work should examine how the organization's strategic orientation can affect the advancement and implementation of innovative solutions and methods essential to entrepreneurial success. This study offers support for the process by which entrepreneurial beliefs can serve as a critical antecedent of market growth intentions, and demonstrates how the direction of these intentions can serve as a motivating force in determining technological innovations. As more

entrepreneurs strive for a measurable strategic advantage in their industries, one of the keys to success may reside in the visionary focus of the entrepreneur in aligning the firm's strategy and intentions with its innovative prowess, thereby introducing revolutionary new ideas into the venture itself and into their respective industries.

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Figure 1
Proposed Model of Study

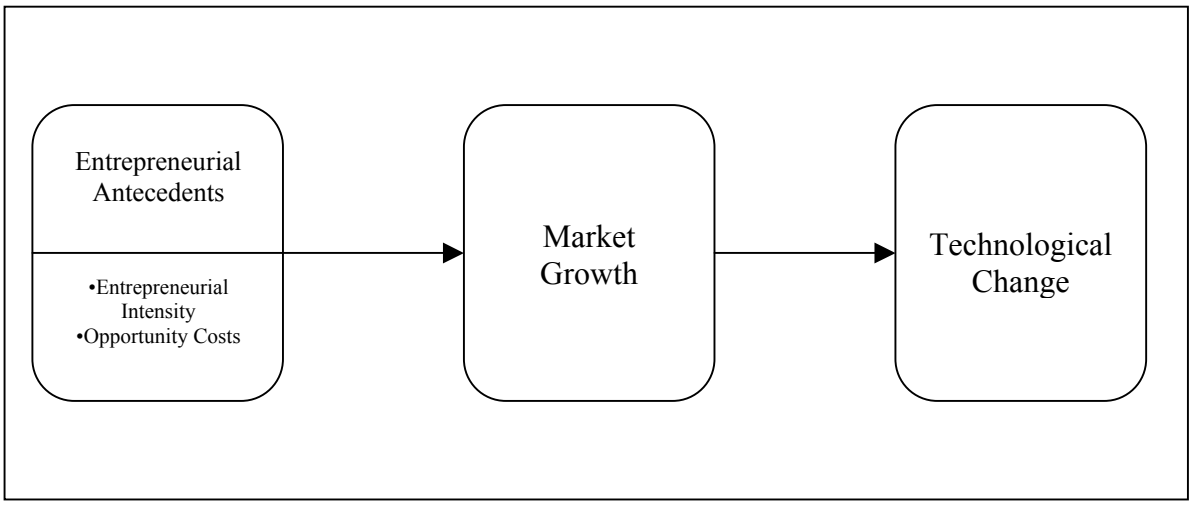
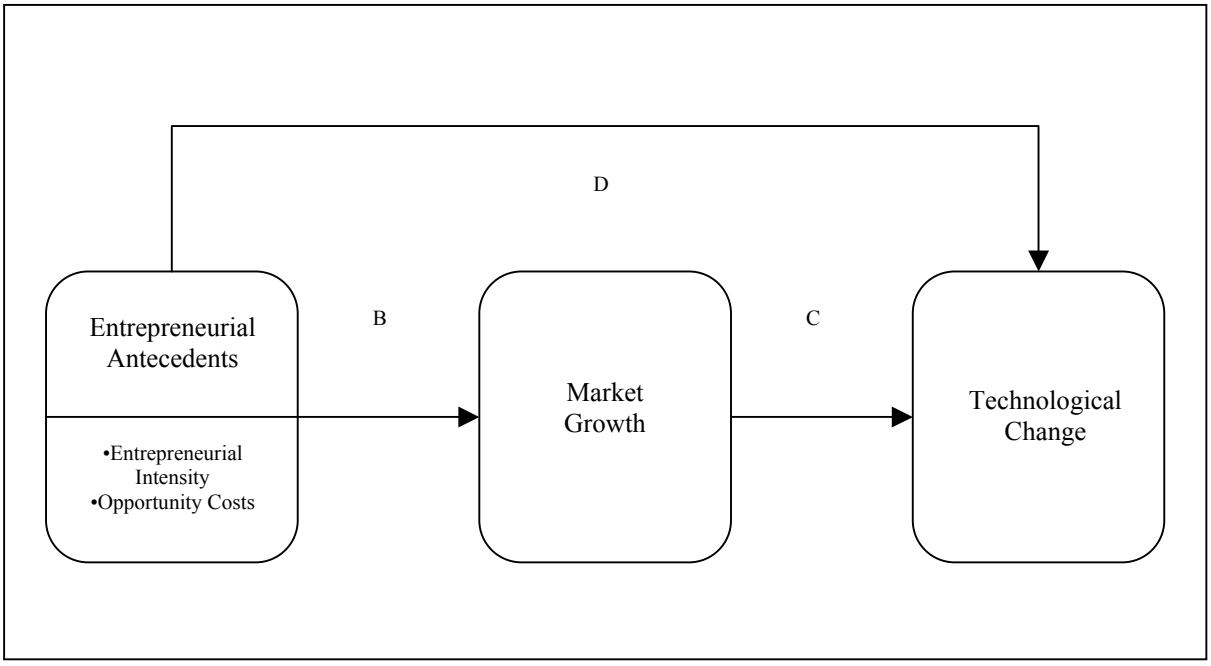


Figure 2
Proposed Model Relationships and Analyses (Model A)



Note: Theoretical relationships between the antecedents, market growth, and technological change and the nested models utilized to assess the significance of those relationships. The path labeled B represents the paths restricted to zero in Model B; the path labeled C represents the path restricted to zero in Model C; and the path labeled D represents the paths restricted to zero in model D. For each of the nested models, if restriction of the paths to zero causes a significant difference in chi-square, then support is shown for reinstating those path(s) in the full model.

Table 1
Descriptive Statistics, Correlations, and Internal Consistency Reliabilities

Variable	Mean	SD	1	2	3	4
1. Entrepreneurial Intensity	3.95	0.86	(.81)			
2. Opportunity Costs	2.01	0.56	.41**	(.75)		
3. Market Growth	3.59	1.10	.27**	.20**	(.85)	
4. Technological Change	3.48	1.17	.20**	.12**	.46**	(.81)

Internal consistency reliabilities (Cronbach's Alpha) are provided along the diagonal, in parentheses.

**p<.001

Table 2
Model Analysis and Comparisons

		Goodness of Fit					Chi-Square Difference[a]				
Model	Interpretation	χ^2	df	GFI	CFI	TLI	χ^2	df	ΔGFI	ΔCFI	ΔTLI
A	Full Model (i.e., mediating and direct effects)	542.31***	113	.93	.92	.90	___	___	___	___	___
B	Full Model without Individual Antecedents→Market Growth	616.20***	115	.92	.91	.89	73.89***	2	.01	.01	.01
C	Full Model without Market Growth→Technological Change	679.51***	114	.91	.89	.87	137.20***	1	.02	.03	.03
D	Full Model without Individual Antecedents→Technological Change	546.20***	115	.93	.92	.90	3.89	2	.00	.00	.00
	Measurement Model	542.31***	113	.93	.92	.90	___	___	___	___	___

[a]Difference scores were calculated from a chi-square of 542.31 with 113 df.
Goodness of Fit Index (GFI); Comparative Fit Index (CFI); Tucker-Lewis Index (TLI)

**p<.001