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Results of Kauffman Dissertation Research Fellowship

Bounded Rationality and the Supply Side of Entrepreneurship:
Evaluating Technology Entrepreneurship Education for Economic Impact

In Five Summary Abstracts

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Abstract: *If entrepreneurship creates economic growth/jobs, then the "supply side" of entrepreneurship is important. Conventional wisdom says the supply of entrepreneurs in any society is fixed, yet millions is spent annually on Entrepreneurship Education (E-ed) to encourage entrepreneurship. This study reviewed the literature for the antecedents of E-activity, hypothesized and tested both a causal model of entrepreneurship and a theory of E-cognition, critiqued the extant E-ed evaluation research, and redressed its deficiencies in a methodologically robust controlled study of 4,000 alumni. The study found E-ed can work to create entrepreneurship under certain conditions. The economic theory/policy implications are also discussed.*

Introduction

Technopreneurial activity and Schumpeter's creative destruction, at the center of Romer's (1986, 1990) theorized endogenous growth alternative to neoclassical economics, is increasingly being accepted as the root source of economic productivity and growth (van Stel et al., 2005; Acs & Varga, 2005; Audretsch & Keilbach, 2007; Acs et al., 2009; Baumol, 2010). As a result, the "supply side" of entrepreneurship is becoming a topic of universal interest. Conventional wisdom has long presupposed that the supply of entrepreneurs in any society is a fixed commodity, limited to the number of unusual (even deviant) individuals born with anomalous personality characteristics. David Birch, author of the seminal research implying the enormity of the contribution of the small business sector to the overall economy, once said, "If you want to teach people to be entrepreneurs, you can't." (Aronsson, 2004, p. 289).

Nonetheless, based on the assumption that E-ed can increase the numbers of entrepreneurs and boost economic growth, national and local governments have invested significant resources into education as a supply-side economic development strategy. Likewise, on the demand side, the generation born as the industrial age transitioned into the information age, who watched with alarm as their parents' jobs moved overseas and their skills became obsolete, began to demand course offerings in entrepreneurship. Today, millions of dollars are spent every year on Entrepreneurship Education (E-ed) programs, courses, centers, workshops, and seminars, based on the assumption that E-ed works to generate entrepreneurship, new companies, and new jobs. But how much do we know about whether E-ed really works? E-ed appears to be one of those phenomena where action and intervention have raced far ahead of the theory, pedagogy, and research needed to justify and explain it.

This research study is the first empirical attempt to sort out the antecedent mechanisms, including E-ed, of entrepreneurship at the individual level of analysis, and isolate their impact on tangible, hard entrepreneurial outcomes including behaviors, activities, startups and other enterprising outcomes (such as intrapreneurship and social entrepreneurship). This study has contributed to the research in the field a number of ways. It is the first study to attempt the highest level (Step 6, Storey, 2000) empirical evaluation of E-ed, in a survey of 4,000 University alumni, and thus it sets an example for other entrepreneurship researchers at the individual level of analysis. Generally, the psychological research conducted in the field (usually by firm-level business school researchers) lacks appropriate control groups for comparison with entrepreneurs. (To-date researchers have tended to compare Entrepreneurs to managers (Busenitz & Barney, 1997) or they compare entrepreneurs to the general population (Gartner, 2001)).

The study is the first that I know of to show differences in E-outcomes between different E-ed pedagogies, and the first to identify the mechanisms behind *how* E-ed works, when it works. It demonstrates the strength of person x context research approaches and identifies personal mindsets and work-related predisposition variables as statistically significant predictors of E-outcomes. The study proposes and preliminarily tests several new, and promising, theoretical frameworks for better understanding "boundedly rational" entrepreneurs, their skillsets, and their mindsets.

Finally, the study is the first that I am aware of to utilize a pre-measure taken prior to when respondents became entrepreneurs (2 cohorts out of 3) to test for the influence of self-selection in E-ed (a concern of all other E-ed studies). Interestingly, some self-selection was found on personal characteristics but it was of no consequence. The study is the first to utilize a variety of dependent variables—categorical, ordinal, and continuous—to better take advantage of sophisticated statistical techniques like structural equation modeling (SEM). And it is the first study to demonstrate (through convergent validity) that entrepreneurship can be measured as a continuous metric along an entrepreneurial spectrum from enterprising behaviors (such as social entrepreneurship) to intrapreneurship to business entrepreneurship.

The research has produced comprehensive material for five research papers, each of which will be briefly summarized here:

I. Antecedents and Entrepreneurial Event Theory
II. Theory of Entrepreneurial Cognition
III. A Review and Methodological Critique of the E-ed Research Literature
IV. Does E-ed Work? A Longitudinal Outcome Study of Three University E-ed Programs
V. Research Implications for Economic Theory and Policy: The Supply Side of Entrepreneurship

I. Antecedents and Entrepreneurial Event Theory

An exhaustive review of the extant research suggested that E-ed may be just one of many antecedents of entrepreneurship. The literature review identified personal characteristics, cognitions and skillsets, and social context influences as critical antecedent variables.

It is now generally accepted that psychological variables including both predispositions and preferences may in fact represent critical antecedents of entrepreneurial behavior (Baum & Locke, 2004; Rauch & Frese, 2000). While early trait-based research focused on relatively stable personality traits (with mixed results), more recent research suggests that the psychology of entrepreneurs may derive less from hard-wired personality traits and more from personal values/beliefs, knowledge/skills/abilities (KSA's), and entrepreneurial experiences. The cognitive antecedents of entrepreneurship include motivation/initiative, intuition, creative cognition, and heuristics such as counterfactual thinking, risk attenuation, and failure management (the variable "setback response" in this study).

The immediate social and environmental context an individual finds him/herself in can influence entrepreneurial proclivities and activities. A sizeable body of literature exists on environmental attributes that encourage the geographic "clustering" of entrepreneurial ventures (Chrisman, et al., 2002). Recent literature on high-technology clustering has emphasized knowledge spillovers (Audretsch, et al., 2007) and the benefits of having access to specialized inputs, including university research and technology-proficient labor expertise (Almeida & Kogut, 1997). Social networks have been identified in supporting entrepreneurial ventures in the development of innovation, knowledge, skills, and procurement of capital, both formal and informal venture capital (Aldrich & Zimmer, 1986; Dubini & Aldrich, 1991; Fountain, 1998; Putnam, 2000; Baker & Nelson, 2005).

Family environments also influence entrepreneurial proclivities and activities. Researchers interested, for example, in how entrepreneurship is passed down through the generations have found that a number of variables including family businesses, values, parental role modeling, genetics, kinship ties, and social immobility (ethnicity, education, physical factors and even out-group discrimination) all help to promote ethnic and immigrant entrepreneurship (Portes & Zhou 1996).

At the individual level of analysis, mixed theorists are particularly interested in the cognitive and behavioral aspects of entrepreneurship and the interaction of individual aspects such as predispositions and values in varying environments. For example, Neufeldt found that self-directed-employment-oriented individuals had four cornerstone characteristics: self concept, know-how, resources, and the extent to which the context and social/policy environments were enabling. (Neufeldt, 2003).

According to this line of research it appears increasingly likely that personal mindsets and skillsets may be what primarily or exclusively distinguishes entrepreneurs—that they have unusual perceptive abilities allowing them to see opportunity in contexts others do not; they make and follow-through on judgments everyone else thinks are wrong (Casson, 2003); and they follow-through with talented execution. A thorough review of the literature suggested that entrepreneurial predispositions (for example, creative, proactive, independent, adaptive and persistent tendencies) supported by the cognitive talents, skills, and abilities that engender opportunity perception and actualization (such as alertness, leadership, management, risk attenuation, resourcefulness), personal learning and experiences, and contextual considerations including both physical and social (family, organizational, societal) environments may all play a significant part in explaining individuals' entrepreneurial behaviors.

In addition, the literature review identified the theories relevant to entrepreneurship by their association with the above variables and by their application in the research. Social Cognitive Career Theory (Lent, Brown, and Hackett, 1994) suggests that career goals/choices are related to self-efficacy beliefs and outcome expectations. The idea that individuals are motivated by self beliefs about their talents and abilities and their subsequent confidence in successful outcomes is derived from Bandura's agentic theory of human development. The influence of agency theory is evident in entrepreneurship education research. Two of the most common outcome variables in the limited number of E-ed evaluations that do exist are the psycho-social measures of entrepreneurial self-efficacy and entrepreneurial intentions. In addition, the theory has influenced E-ed teaching modalities.

The theory most important to informing the development of the study's testable "Bounded Rationality" correspondence model was the individual entrepreneur x situational context psychosocial perspective. From the antecedent research, I concluded that, while Shapero & Sokol's (1982) classic Entrepreneurial Event model was helpful, their "desirability and feasibility" constructs needed to be expanded to include the second half of the person x situation equation—the contextual element. The result was the theorized Bounded Rationality model of the entrepreneur. The

model also puts Schumpeter's assertion that all entrepreneurship is *local* squarely at the center of the entrepreneur construct. (See Figure 1).

The model presents a theoretically grounded model for expanding Shapero beyond the individual to include person x situation variables. The model is also informed by Lofquist and Dawis (1969) who hypothesized correspondence between a worker's wants, goals, and needs (Shapero's perceived desirability) and the perceived satisfaction of these wants/needs the worker receives from the workplace. Likewise, the theory requires correspondence between perceived feasibility (confidence in abilities and success) and the positive reinforcement of these abilities to in the workplace. If there is aligned correspondence both between a worker's intrinsic skills and a job's extrinsic skill requirements and a worker's intrinsic values and goals and a job's extrinsic fulfillment of these desires, an individual will stay engaged in the work context. When there is a discrepancy between a worker's needs or skills and the job's needs or skills, then the worker leaves willingly, is forced out unwillingly (the "Go" decision), or the environment must change. The E-Correspondence model itself is an antecedent mechanism for entrepreneurship, since, according to the Kauffman Foundation, the majority of entrepreneurs start their careers as employees, then leave their employer to start their own venture. The model builds on Shapero in suggesting that not only do entrepreneurial individuals require desirability and feasibility, they feel compelled to work in contexts that correspond to their values and goals (work personalities) as well as where their skills and abilities are vital and highly valued. The model explains why an individual with desirability and feasibility might *not* leave an employer to launch a venture, as well as why she would. They model hypothesizes that entrepreneurs place higher utility than other people on person-workplace fit variables (utilized in this study), and thus are more likely than others to choose a "Go" decision, leaving their current job in order to start their own venture. Or perhaps they are more sensitive to the feedback loops that influence both intrinsic and extrinsic motivation.

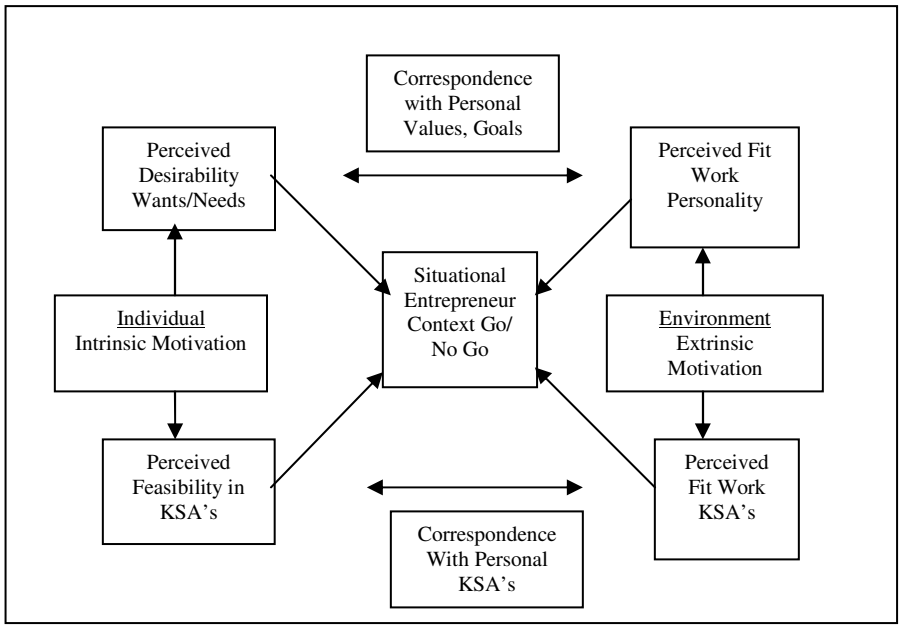

Figure 1. Bounded Rationality of the Entrepreneur:
Entrepreneurial Event in Context with Intrinsic/Extrinsic Correspondence Feedback
(Adapted from Shapero & Sokol; Lofquist & Dawis)

The above model parsimoniously fits the psycho-social antecedent research into a conceptualization of the Bounded Rationality of the Entrepreneur. The model depicts four kinds of entrepreneur x situation variable domains: intrinsic motivation (desire); perceived ability (self efficacy/feasibility), perceived personality workplace fit, and perceived ability workplace fit. Note that the personal characteristics and their fit in the workplace (the top half of the model) all have exogenous effects on entrepreneurial action (the center box). The bottom half of the model also operates exogenously on entrepreneurial action; however, E-ed operates exclusively through the lower left feasibility box (the endogenous mechanisms). (See Part IV for a discussion of how E-ed works through the endogenous feasibility mechanism).

Structural equation models comparing university alumni who became entrepreneurs against matched alumni who did not up to 14 years later (N=603), validated the Bounded Rationality typology. (See Part IV for detailed Study Methodology). While many correlational models of the entrepreneurial event exist, the Bounded Rationality model is the first to identify causal mechanisms that can predict entrepreneurship (entrepreneur group membership). The model's bounded rationality (endogenous) mechanism measures and research-based contextual (exogenous) factors held up well to

its first empirical test as a predictor of entrepreneurial production. The all-domain model fit was good: Model χ^2 (14,452) = 13.593, p=.480, CFI=1.000, TLI=1.002, RMSEA=.000. All paths were significant below the .05 level, and the R^2 of the Entrepreneurship DV variance explained was nearly 30%. The most parsimonious predictive model included three key cognition variables (Self Efficacy, Networks, and Skills), two key personal variables (Autonomy work-fit and Setback) and one key demographic/contextual variable (Parent Entrepreneur). The cognition variable Self Efficacy was the most important predictor of entrepreneurship with an R^2 of 51%. (See Parts II and IV for an in-depth discussion of endogenous E-cognition and Self Efficacy mechanisms). The exogenous variable Parent Entrepreneur equally impacted both networking and self efficacy (β =.09 and β =.08 respectively). The personal exogenous variables Autonomy work-fit and Setback risk attenuation strategies had direct effects and were, like Self Efficacy, direct and significant predictors of entrepreneurship (β =.13 and β =.10 respectively).

The SEM analysis is the first that I know of to demonstrate that personal characteristics can predict E-outcomes. The rationality of the entrepreneur is based both on endogenous perceptions of feasibility/self efficacy, but also on perceptions of "fit" in the work context, both with regard to values, goals, and work personality, as well as with perceptions about the efficacy of these knowledge, skills, and abilities (KSA's) in the workplace. Personal characteristics work to create hard E-outcomes both directly and through Self Efficacy. Personal predispositions and individual differences in outlook and perspective predict entrepreneurship, as do knowledge and skills preparation.

As for the "desirability" antecedents of entrepreneurship, correlational and qualitative analysis shed light on the motivational drivers of entrepreneurship that in turn influence the other predictors. It is notable that Achievement factors (these included goal-oriented behaviors—meet a challenge, obtain leadership, create and build a product or business, as well as dedicated perseverance and personal drive/work-ethic) were the most frequently sited factors behind *both* personal motivation to start a business *and* personal business success. Money, autonomy, and opportunity were the next most commonly sited motivators. Sixty percent of entrepreneurs were more motivated by internal stimulus (based on a personal talent, skill, ability or competitive advantage they believed they had) in starting their businesses, while 40% said they were externally motivated to start their businesses (as a response to a perceived market need). This result suggests that when it comes to Desirability, intrinsic motivation (like Achievement and Autonomy) may be stronger motivators than extrinsic motivation (like Opportunity and Money) when it comes to starting a business. The preference for intrinsic factors in attributions for business success is even more striking with 124 intrinsic mentions (74%) and 43 extrinsic (26%) mentions.

While the intrinsic/extrinsic measure utilized in this study is only a single measure (albeit bolstered by the qualitative results), it is a first step toward operationalization of the entrepreneurship effectuation construct (Sarasvathy, 2001); respondents had to indicate whether they relied more upon personal characteristics, KSA's/other inputs at hand in creating their businesses, or whether they acted more in response to perceived external causes/market conditions. The importance of intrinsic motivations to entrepreneurial "desirability" calls for additional research into the individual/personal characteristics of entrepreneurs, which unfortunately have been under-researched by psychologists. Further research will need to be conducted to confirm these findings that intrinsic motivators may be more important than extrinsic motivators in the creation of entrepreneurial ventures, and to test the psychometrics involved.

The highly statistically significant (p<.000) goodness of fit of the Bounded Rationality typology to Structural Equation Modeling, as well as the correlational intrinsic/extrinsic data presented in the current study, suggest that this bounded rationality E-correspondence model holds promise in explaining entrepreneurial behaviors at the individual level of analysis. If entrepreneurship is a dynamic person x situation phenomenon, as this study empirically suggests, it is critical to the field that researchers not leave individual differences out of the equation. The two most important individual difference predictors found were individual attitudes about failure and risk attenuation and needs for personal autonomy.

Additional research needs to be done to rigorously test the model and confirm that work personality and workplace fit play a significant role in creating entrepreneurs, and to determine whether this "Correspondence" conceptualization can withstand the rigor of multiple studies in diverse contexts and environments.

II. Theory of Entrepreneurial Cognition

Unfortunately, the Bounded Rationality typology pays short-shrift to Entrepreneurial Cognition, which was identified in the literature as an important antecedent domain. (The correspondence model lumps E-cognition into Sokol's "black box" of Feasability/skills and abilities, See Figure 1).

The review of the theoretical research suggests that to the degree Entrepreneurship Education (E-ed) can create self efficacy it may support entrepreneurial activity. Tacit knowledge and skills play a part in all theories of E-ed, from formulating "expert" scripts, to cognitive "alertness" to satisficing on inputs under conditions of uncertainty, little information, and few resources. Tacit knowledge is experiential, often new knowledge that has not yet been written down. It can even include the psychological conscious and subconscious modes of knowing (intuition), (Polanyi, 1967; Honig, 2004). Tacit knowledge is central to Knowledge Spillover Theory (Audretsch et al., 2007) which attributes the clustering of entrepreneurial activity around universities to be a direct result of tacit knowledge spillovers. Social

Networking Theory is the theory of how tacit knowledge spills over. While a vast research shows that entrepreneurs use social networks to competitive advantage, (Aldrich & Zimmer, 1986; Fountain, 1998; Cohen & Fields, 1999; Davidsson & Honig, 2003; Greve & Salaff, 2003), these networks can be inter or extra organizational.

Given the importance of tacit knowledge to the numerous cognitive and social strategies that entrepreneurs use expertly under conditions of bounded rationality, a specific, overarching theory of human entrepreneurial cognition (how entrepreneurs think) would be most helpful in developing efficacious E-ed interventions.

Input-Output (IO) Knowledge Theory, derived from the Knowledge-Based Theory of the Firm (Spender, 1996), (itself a derivative of the Resource-Based Theory of the Firm) is a logical place to start. IO Knowledge Theory has a focus on specific inputs and their corresponding outputs. It differs from Structural Knowledge Theory, which is general knowledge about the variables of a system and their causal relations—this knowledge is anything but tacit in that its recorded/codified. The research surrounding the two classifications (IO vs. Structural) is a robust and controversial topic among cognitive psychologists (Medin & Shaffer, 1978; Nosofsky, 1984; Nosofsky, Palmeri, & McKinley, 1994; Allan, 1993; Anderson & Sheu, 1995). Conventional management scholarship suggests that structural knowledge is the preferred focus for firms and other complex systems, while IO is the purview of simple relationships or small systems (hence its application in micro electronics).

Recent developments in electronics and systems theory, where controlling dynamic systems under conditions of uncertainty are of paramount importance, suggest that IO may offer an interesting model for a theory of entrepreneurial cognition. The individual entrepreneur, who is founder, opportunity, and firm all in one, as well as the primary resource of the firm, clearly appears to be a suitable "small systems" candidate. Further, entrepreneurs and the embryonic ventures they create also fit well the definition of controlled action-taking in a dynamic, uncertain environment in an attempt to produce a successful outcome.

IO Systems researchers have empirically proven that when uncertainty is high and factual/structural knowledge is low or unavailable, IO cognitive strategies (manipulating the number of inputs if that's the only strategy available, for example) to control dynamic systems outcomes can be as effective performance-wise as when structural information about a system is known or knowable.

IO Knowledge Theory is relevant to entrepreneurial cognition because, under conditions of uncertainty, with low levels of resources, and not even a clear idea of final outcomes, entrepreneurs employ, and expertly apply, a large number of varying cognitive input strategies according to this review of the research. Entrepreneurs utilize cognitive strategies including tacit knowledge, and experience-based "expert" scripts to make decisions. The cognitive heuristic techniques they employ (representativeness, counterfactual thinking, planning fallacies, attribution biases, etc.) are also input approaches (or substitutes). Other input (IO) strategies include "bricolage" resourcefulness, which relies upon inputs-at-hand resource acquisition activity, (Baker & Nelson, 2005). Entrepreneurs "effectuate," employing the means, or inputs, close at hand in making decisions, rather than acting on the basis of end-states (Sarasvathy, 2001). Like Sarasvathy, Hans Joas' (1996) theorizes that entrepreneurs have the ability to make decisions even in the absence of pre-existing concrete goals by means of idiosyncratic inputs and path-dependency. Perhaps what all of these input-oriented cognitive strategies have in common is they are used by entrepreneurs, consistent with I/O theory, to attenuate risk under conditions of uncertainty.

One of the more interesting results of the study was support for the idea that entrepreneurs creatively manipulate inputs as a risk management strategy. SEM results showed entrepreneurs could be predictably distinguished from non-entrepreneurs on the way they perceived major setbacks and failures. Entrepreneurs were not distinguishable on tenacity and persistence (contrary to correlational research findings). While non-entrepreneurs were more likely to try again, harder, entrepreneurs predictably had a more creative response to a setback input. They learned from the new information, and adjusted as necessary to capitalize on the situation. The entrepreneur's motivational preference for intrinsic resources (effectuation was used by 60% of entrepreneurs, See Part I) and their "learn and pivot" response to setbacks conforms to the definitional creative aspects of entrepreneurial cognition.

Another way to look at risk mitigation is to turn it around and talk about perceived "control." IO knowledge theory postulates that entrepreneurial cognition involves talented management of inputs (resources and information at-hand) as a strategy to better manage uncertainty and control risk. IO knowledge theory suggests that entrepreneurs are particularly adept with inputs, both perceiving them more acutely than others (Kirzner's (1985) "alertness" to opportunity), and processing them and responding to them in creative ways. These input management strategies include bricolage (Baker & Nelson, 2005), as well as "effectuation" —which focuses not on desired end-results but on the given set of inputs and focuses on selecting among the possible effects that can be created with that set of inputs (Sarasvathy, 2001).

Bricolage, effectuation, expert schema, scripts, heuristics, self belief/efficacy and setback competence are all techniques to enhance perceived control. Having a robust social support network is a critical component to enhancing perceived control as well. In sum, entrepreneurs are not necessarily risk takers; they are risk attenuators, (even if this attenuation is only in their own mind).

Exploratory analysis was conducted to further test the overall goodness of fit of IO as a theory of E-cognition grounding Sokol's "black box" of feasibility. Overall, goodness of fit was suggested by the Critical Analysis self assessment pre-post measure correlation. If entrepreneurs are talented input perceptors, managers, and interpreters, you might expect them to self-assess high on the basis of this talent.

The significance of the Critical Analysis measure on the dichotomous Startup DV was tested via binary logistic regression (N=593). Sure enough, the odds of high self-assessed abilities in critical analysis skills were 67% higher for entrepreneurs than for non-entrepreneurs. (Exp(B)=1.667; p=.001).

Similarly, the significance of a related IO variable, self-assessment of Coping with Change was also tested against the dichotomous Startup DV via binary logistic regression, (N=593). Again, in support of the IO cognition theory, odds of high self-assessed input-associated abilities "coping with change" were 56% higher for entrepreneurs than for non-entrepreneurs. (Exp(B) = 1.559; p=.001).

Finally, the Autonomy E-cognition variable "Ability to Plan and Carry out Projects Independently" was assessed via binary logistic regression against the dichotomous Startup DV (N=593). The odds of high self-assessment on ability to plan/execute was 74% higher for entrepreneurs than for non-entrepreneurs, (Exp(B) = 1.738; p=.000).

Given that entrepreneurial skillsets and mindsets are best developed and applied together, future research supporting the development of a theory of Entrepreneurial Cognition is critical. Today, E-cognition researchers are faced with a situation very similar to that faced by Gartner in the 1990s, where a number of disparate lines of research, from entrepreneurial heuristics to expert entrepreneurial scripts, (Mitchell et al., 2002; Smith et al., 2009) beg for coherence. This exploratory evidence suggests that IO Knowledge Theory presents a promising perspective and further study should be undertaken to probe its suitability as an overarching theory of entrepreneurial cognition.

III. A Review and Methodological Critique of the E-ed Research Literature

Entrepreneurship education is increasingly of interest to policymakers who want to promote economic growth and create jobs. According to the Global Entrepreneurship Monitor a lack of education is one of the major barriers to entrepreneurship. However, what do we really know about the outcomes and economic benefits of entrepreneurship education (E-ed)? Does E-ed really work as a driver of economic growth?

E-ed offerings at the university level have surged in the past decade, with over 90% of accredited institutions now offering entrepreneurship courses. According to one report the number of students enrolled in E-ed courses at U.S. universities has increased by 1600 per cent over the past ten years! But this supply may still fall short of the overwhelming demand; (nearly 70% of US high-schoolers are interested in starting a business according to a 1994 Gallup poll). Increasingly significant public resources are being invested premised on the assumption that successful new entrepreneurs can be "made."

The Empirical Case for E-ed: As far back as 1997 Gorman et al. concluded, based on their exhaustive review of the literature, that "the utilization of basic quasi-experimental controls and more careful descriptions of the programs and the research samples would result in substantial progress in the field, as would a more comprehensive and systematic review of the literature (p. 72)". How well has the field responded? My comprehensive and detailed review of the extant empirical research critiqued the quantity, coverage and quality of the research and the extent to which it can answer the question: "Does E-ed really work?" My review examined studies of university-based E-ed that were published from 1998-2010 (plus relevant studies from outside that time frame) that were identified by: 1) searching the EDGAR/CELCEE/ERPN databases; 2) major search engines; and, 3) by reviewing the major entrepreneurship journals. In order to exclude the large number of inferentially worthless monitoring studies that Storey (2000) identified in his paper, I limited my review to studies that attempted to use some minimal counterfactual comparison including pretest-posttest or comparison group designs; (another preferred condition, validated psychometrics, were rarely reported and thus dropped from the criteria in order to allow for at least a dozen reviews). Given the results of previous reviews, it came as no surprise that the number of studies that met this criterion was relatively small. Specifically, I was able to identify only 12 studies that *attempted* one or all of the above. With respect to outcome measures examined, 5 of the studies attempted to examine E-ed effects on psychosocial outcome measures while the remaining 7 examined effects on the kind of objective outcomes that policymakers are more likely to be interested in.

Psychosocial Outcome Studies--While the studies that examine psychosocial outcomes might not provide a basis for truly answering the policymaker's question, "Does E-ed really work?", they do have the potential to help us begin to answer the more refined question: "*If E-ed works,* how does it work?". Based on the studies reviewed, there appears to be modest support for a Social Cognitive Theory-based hypothesis that E-ed can affect entrepreneurial self efficacy. Support for entrepreneurial intentions was weak, however. While the field still puts great stock in a strong theoretical case for the link between entrepreneurial intentions and entrepreneurial acts, in fact I found surprisingly limited empirical support for this assumption, which is the underlying assumption common to much of the psycho-social E-ed evaluation research.

For instance, DeTienne and Chandler showed *lower* intentions after E-ed in comparison with controls—suggesting that E-ed in the form of opportunity identification skill-building may be a cognitive skill that is unrelated to entrepreneurial intent and subsequent activity. But while Zhao et al.'s (2005) study appears to support a connection

between E-ed and intentions (mediated by entrepreneurial self-efficacy); Cooper's et al.'s (2006) study suggests only a transient effect. Potentially, the objective outcome studies that also included psychosocial measures could contribute to this question and begin to also look at objective outcomes. Unfortunately, none of these studies used the kind of robust statistical methodology (e.g., SEM) that might help clear up the linkage between E-ed interventions-psychosocial mediators-objective outcomes. These shortcomings plus well-grounded concerns about the internal validity of inferentially weak pretest-posttest designs used in most of the 5 studies appear to leave us where we started. *If E-ed works,* how does it work? The answer provided by the psychosocial outcome studies collectively appears to be: we really do not know.

Objective Outcome Studies--Seven of the 12 viable studies included in my review attempted to evaluate the impact of E-ed on hard outcomes, including the kind that policymakers and economic developers care about--business start ups, serial entrepreneurial activity, time to start up, and various personal and business economic measures. Encouragingly, these studies also included a diverse set of interventions and populations and relatively long follow up periods. While three of these studies examined the technically trained engineering populations that are most likely to contribute to technopreneurial outcomes, two of these studies (Ohland et al, 2004; Thursby & Thursby, 2009) only looked at academic outcomes. Interestingly, only Charney et al. (2000) appeared to try to measure outcomes that captured technology-driven entrepreneurial activity.

Regardless, evidence from the three more robust hard outcome studies is consistently positive. Kolvereid et al. (1997), Charney et al. (2000) and Menzies et al. (2002) all found that E-ed majors produced more business start ups and other markers of entrepreneurial success than students in their respective comparison groups. Taken at face value, these results appear to suggest that E-ed is an effective vehicle for promoting economic development goals. While these results should be encouraging to those who believe in the value of E-ed, my optimism in this regard needs to be tempered because of the inferential weakness of the designs used in these studies.

Because the posttest-only comparison group design used in these three outcome studies is considered to have relatively poor internal validity, the ability to confidently assert a cause-effect relationship is compromised. Encouragingly, most of the investigators attempted to strengthen the inferential power of the basic design by using various matching strategies to create a comparison group and/or using demographic predictors as covariates. However, the benefit of these steps appears to be mitigated by two other factors. First, in most instances the value of these steps was negated by other problems including apparent flaws in the way the matching was done and huge discrepancies in response rates between the two conditions, apparently often caused by a misguided desire to "get as much data as possible from our treatment group." Second, the version of posttest-only design used in all of these studies, individuals who seek treatment versus a group who did not, (as opposed to a comparison of two naturally assembled collectives), is considered a weak sister to an already weak basic design.

The major concern with this design is selection biases. The salience of this concern is vividly illustrated by the findings of two of the reviewed studies: Chen et al.'s (1998) found that individuals enrolled in an E-ed course had significantly higher entrepreneurial intentions than comparison group members *before* their training began; and, Zhao et al. (2005) found that intentions before training is the strongest single predictor of intentions after training. Since none of the three best objective outcome studies included pretest scores on critical entrepreneurial precursors already identified, (or, if none, even hypothesized in the empirical research--like entrepreneurial experiences (prior courses, parent entrepreneur, for example), demographics (age, gender, etc.), entrepreneurial skillsets and mindsets) that could be used as covariates (see discussion below), there is no way to confidently know whether E-ed training produced these positive findings or whether these effects are simply due to the most motivated nascent entrepreneurs finding their way into training (or perhaps a combination of these factors). Thus, although the findings of this set of studies are generally positive, when trying to answer the question, "Does E-ed really work?" we are once again left with the same answer: we really do not know.

A Research Prescription: My review underscored how diverse E-ed pedagogy and the target populations it is applied to are. While no single pedagogical approach has emerged as best for teaching entrepreneurship, there appears to be a growing consensus that a more hands-on approach is more effective, especially for technopreneurial education. The dilemma continues to be figuring out what pedagogical methods to use for which population and for what end (Hills, 2004).

Fortunately, the strategy for beginning to address the complexities of E-ed research is clearer. First, we need a larger pool of methodologically adequate E-ed studies. Perhaps the most pressing need is for researchers to use more inferentially powerful quasi-experimental research designs. For instance, only one study included both pre-measures and a defensible comparison group. In addition, well designed case studies would also be useful to help identify potentially important mediators. We need more quantitative research that simultaneously examines the role of promising mediators like entrepreneurial self efficacy, cognitive skills and knowledge, values and attitudes, social networks, and other contextual variables on policy relevant outcomes, and that tests their utility with powerful statistical tools like structural equation modeling. Clearly, there is also a need for the development of better, more psychometrically sound measures to support these efforts. For instance, given recent findings that many entrepreneurs begin to start new ventures in their 40's

and 50's, we need to engage in longitudinal studies of E-ed programs. In summary, while E-ed appears to be a promising tool for promoting local and national economic development, its value will remain unknown until the E-ed research community responds to the challenge to conduct higher quality and more sophisticated outcome evaluations.

IV. Does E-ed Work? A Longitudinal Outcome Study of Three University E-ed Programs

My comprehensive review of the empirical literature concluded that while E-ed appears to be a promising tool for promoting local and national economic development, its value will remain unknown until the E-ed research community responds to the challenge to conduct higher quality and more sophisticated methodological evaluations. This research study's methodological design attempts to address the empirical shortcomings highlighted in Part III. Specifically, the study:

- Incorporates a defensible comparison group, premeasures, and addresses other methodological concerns;
- examines a diverse set of objective E-ed relevant outcome measures over a long follow-up period;
- evaluates three kinds of E-ed programs;
- examines outcomes for both undergraduate and graduate students;
- contributes to theory by testing a causal model of entrepreneurship involving the identification of mediating and/or moderating antecedent mechanisms (personal and contextual) associated with a continuum of entrepreneurial behaviors.

The study attempted a robust pre-test-post-test quasi-experimental design methodology (Shadish et al, 2002), using matched comparison groups and powerful structural equation modeling (SEM) statistical techniques in an attempt to disentangle the effects of E-ed from the effects of other known and suspected personal, cognitive, and contextual antecedents (See Part I) on a variety of E-outcomes (business entrepreneurship, product development, intrapreneurship and social entrepreneurship).

Setting: The research setting was a major state university with a prominent engineering program in the Southeastern U.S. Two university undergraduate E-ed programs (engineering (U-Eng) and business(U-Biz) with differing pedagogical approaches were evaluated, as well as one graduate business E-ed program (G-Biz).

Design: The study employed a longitudinal quasi-experimental matched comparison group design. The study evaluated differences in entrepreneurial outcomes between alumni who received E-ed and a matched control group who did not up to 14 years later. Several research designs were employed because of the unique availability of some pretest data for the undergraduate group. For undergraduates, the study employed a pretest-post-test quasi-experimental design (Shadish et al, 2002). For graduates, the study employed a post-test only control group design. Shadish et al. (2002) advises researchers to decrease the odds of selection biases introduced by insufficient pre-testing by forming treatment and control groups through matching or stratifying on likely correlates of the post-test (in this case gender, major, year graduated, GPA, age, race, and type of degree). Optimal matching, (where populations being matched overlap completely on stable and reliably measured matching variables), and where additional variables are employed to prevent undermatching create greater equivalence between treatment and control groups.

Instrumentation: Data collection involved surveys (both email and mail) of 4,000 business and engineering alumni, including 2,000 who had taking E-ed since the early 1990s, and 2,000 matched controls. Complete responses were received from 603 respondents. Group equivalency was confirmed through a rigorous battery of tests. The survey instrument was pre-tested by a small group of local entrepreneurs, alumni, and faculty experts. All scales were thoroughly validated by psychometric analysis. Specific measures included entrepreneurial courses respondents had taken, background data, local context, career histories and entrepreneurial intentions, activities, and accomplishments and to self-assess along two dimensions, personality and cognitive self-efficacy in general and in entrepreneurial tasks. Pre-measures included general entrepreneurship skills and abilities (speaking, writing, analytical, self-confidence, and the ability to plan and carry out projects independently). Dependent variables included psychosocial measures typically found in similar studies (entrepreneurial intentions) as well as measures only available to longitudinal studies: 1) startups, 2) new product/service and intrapreneurship; and, 3) social entrepreneurship outcomes.

Results: In answering the question, does E-ed work? Logistic regression found that those who took E-ed were significantly more likely (at the $p<.05$ level) to become entrepreneurs than their matched controls. The odds ratio (Exp(B)) of 1.725 means that, overall, the odds of starting a business were 73% higher for treatment group members compared to their matched controls (Exp(B)=1.725; p=.005).

At the program levels, though, the results were mixed. The odds of starting a business for UEng group members was 84% higher than their matched controls (Exp(B)=1.843; p=.047). UBiz group members' odds were 29% higher, but this difference was not significant (Exp(B)=1.287; p=.482). The odds of GBiz group members creating a a new product or service, in comparison with their matched controls, were 2.2 times more likely (Exp(B)=2.236; p=.028).

While there were no significant impacts of E-ed on the Art and Social Entrepreneurship DV's, there were significant Intrapreneurship outcomes with similar group effects; UEng and GBiz had significant differences between their treatments and matched controls on new product/service creation (although the GBiz group significance dropped to the 10% level), while UBiz showed no differences.

In terms of answering the question, "How does E-ed work?" Entrepreneurship is a dynamic system, influenced by social cognition, psycho cognition, individual differences and circumstance. In a complex system, you must study the component with the largest variance first to affect the output of the system, (Jenkins, 1981). Recall from Part I that Self Efficacy was the most important psycho-social mechanism for creating E-outcomes. Not only must students perceive that they have the knowledge, skills, and abilities to launch a business, they also must perceive that they have the ability to succeed. The measure of the first aspect of "feasibility"—know-how—was the BizSkills variable. (See Inside Sokol's Black Box of Feasibility, Figure 2). This variable, which asked respondents to self-assess on E-specific business skills, was the most significant predictor of E-Self Efficacy, and it also impacted Social Networks. However, while BizSkills was an important indirect variable in the SEM analysis, it had no direct effect on E-outcomes. Business know-how was not sufficient, in and of itself, to catalyze entrepreneurship.

Interestingly, the model also found no significant path between E-ed and Self Efficacy. Group (E-ed) did, however, have a small direct effect on the E-outcomes (β =.10, p=.012). Primarily, E-ed worked to create the Self Efficacy that produces E-outcomes indirectly *through* the Social Skills/Networking variable. Thus the endogenous variable most important to the successful E-ed programs, in that it mediated the relationship between group and E-self efficacy, was Networking. This Network measure asked respondents if they knew someone or knew how to find someone who could accomplish a number of tasks specific to starting a business.

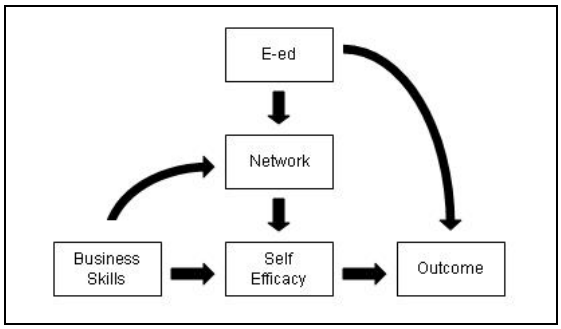

Figure 2. Path Analysis: Inside Sokol's "Black Box" of Feasibility: E-ed Endogenous Mechanisms on E-Outcomes

In answering the question "does E-ed work to create entrepreneurship?" this research study found that not all types of E-ed succeed in producing new business startups as well as new products and services. The study found no difference between the alumni of the UBiz courses and their matched controls on any of the DV's *or* on Self Efficacy. Thus, despite having taken E-ed, the UBiz treatment group did not differ in their entrepreneurial abilities from their matched controls. The opposite was the case for the UEng and GBiz alumni, where the differences between treatment and their matched controls on Self Efficacy and both the Startup and New Product/Service DV's were statistically significant. *Group still had a significant impact, even when controlling for all study covariates.* While each of the programs catered to different groups of students, it is also true that the two predictive E-ed programs took a higher-dosage, team-based, more highly robust andragogical approach to E-ed while the non-predictive UBiz course utilized more traditional teacher-directed pedagogy, albeit with some andragogical components.

Andragogy is concerned with "relevance"--what are students most interested in learning that can immediately be applied in their day-to-day lives? Andragogical learning involves problem-based curricula, rather than content-based assignments. Andragogy, as opposed to pedagogy, is experiential, where students learn by doing (and being allowed to fail). Thus, andragogy is the ideal educational modality when it comes to teaching a subject that involves *tacit* knowledge and bounded rationality.

Recall that tacit knowledge is different from explicit (rational and codified) knowledge which is usually both searchable and knowable. Tacit knowledge is the implicit knowledge associated with experience. The andragogical approaches utilized by the two successful E-ed programs were strikingly similar in that both involved real-world simulations. (The UBiz pedagogy was somewhat less andragogical in that it focused on inculcating entrepreneurial mindsets, business cases, and business planning, as opposed to a prototype and/or business startup deliverable). UEng and GBiz student teams identified problems, ideated solutions, created new technologies, and prototyped new products and services. In particular, the UEng alumni excelled in terms of the latter outcome against their fellow (matched) engineers. This alone is a highly significant finding of the study (not found elsewhere) in that it suggests that like business courses, an engineering education does not in itself drive new product development—it's the andragogical E-ed component that helps transform engineers into the supply-side producers of technology innovation.

In both successful courses the potential existed that the student companies could continue beyond the conclusion of the class, thus making the courses exceptionally relevant to students and motivating them to engage at higher levels than they would an ordinary class. (Students routinely complained that 3-4 credit hours were insufficient for the time and effort they put into the class).

Under extreme time pressures with little more than tacit knowledge to work with, students had no choice but to employ a high level of social networking skills. They conducted primary market research, made weekly customer development calls, raised real money, and met with countless experts. Interestingly, according to the SEM analysis, the success of both programs primarily stems from the latter (most tacit) aspect. Recall that the Network variable was the endogenous mechanism that tied E-ed indirectly to Self Efficacy—the most important predictor of Entrepreneurial production.

While constructivist approaches to E-ed may be more effective than case-based lecture approaches, as many scholars suppose, the specific curricula may not matter much as long as students engage in *authentic* learning-embedded-in-local-context, where the line between class exercise and student-become-CEO is blurred, if not absent. This type of experience provides invaluable tacit learning that enhances perceived self-efficacy by boosting confidence in feasibility: both know-how (entrepreneurial psycho-social skillsets and mindsets) and know-who (support networks).

The andragogical approach providing authentic learning experiences either outright or via simulations also validates emerging research suggesting that entrepreneurial cognition is developed by replacing "novice" entrepreneurial schemata with "expert" mental schemata. Schemata is defined by Gioia as "built up repertoires of tacit knowledge." (Vaghely, 2010). When individuals have the expert schemata developed as part of an andragogical simulation, for example, they have the mental frameworks in place that easily allow for new product/service/company innovation. They catalog new information and formulate cognitive scripts, which are the automatic responses that experienced entrepreneurs can draw upon to make decisions under conditions of uncertainty.

V. Research Implications for Economic Theory and Policy: The Supply Side of Entrepreneurship

If you know the *antecedents and predictive factors* of entrepreneurship, you have a place to start in terms of proposing strategies and policy approaches for catalyzing entrepreneurial job creation. A conclusion that can be drawn from the research is that entrepreneurship is a multi-faceted, complex phenomenon. Individuals are the raw material of entrepreneurship, but a number of coincident contextual factors must also be present and available; entrepreneurship is "local" as Schumpeter first proposed. Firm creation requires human and capital resources and these are most commonly bootstrapped and leveraged from within the entrepreneur's immediate network. These findings reinforce the Schumpeterian notion that the ideas and opportunities that drive entrepreneurship are both subjective and contextual, as evidenced by the spatial clusters of innovation that we see today. An opportunity that is likely to be successfully commercialized is a *realizable* opportunity, requiring the juxtaposition of a small number of individuals, with a matching set of favorable circumstances, background, and knowledge.

Economic theory has only just begun to examine the optimization of entrepreneurship in order to realize the latest research illustrating the extraordinary positive economic externalities it provides. Economist William Baumol, in his seminal work on the economics of entrepreneurship, attributes 90% of US GDP growth to innovation spillovers, which account for half the growth rate of GDP over time. Innovative entrepreneurship produces spillovers even to those who were uninvolved. There are two kinds of spillovers: Creative Destruction, (inventors benefit and obsolete inventors bear the brunt of the costs); and, Spillovers from Dissemination (societal benefits unrealized by the inventor). While a great deal of attention is paid to negative externalities of productive innovation (environmental damage from manufacturing, for example), very little attention is paid to the positive externalities because positive externalities only appear with the Schumpeterian dynamic economic perspective.

The "essential fact" of capitalism, Schumpeter wrote, is creative destruction, "a form or method of economic change that not only is, but never can be, stationary... The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumer goods, the new methods of production or transportation, the new markets, and the new forms of industrial organization that capitalist enterprise creates" (Schumpeter, 1962).

In the knowable, predictable, rational world of classic economic theory, there is no place for the entrepreneurial dynamic. Classical theory assumes economy-wide R&D is near optimality, the supply of entrepreneurs is static, and externalities are primarily negative, (environmental damage, for example). But in the real world, renewal via creative destruction is not an exogenous factor, as classical theory suggests, but an endogenous 4th factor of production as Romer/Baumol propose, with both negative and positive externalities (spillovers), the latter of which account for the near miraculous increases in living standards over the last century. If this is the result when entrepreneurship happens organically, in societies where the rules are structured around established businesses, what would be the impact if the rules were restructured around startups? What if the supply of entrepreneurs is *elastic*? In the aggregate, then, a demand-supply curve right-shift to a whole new production possibility frontier is achievable. This would require policymakers to return from a preoccupation with distribution, redistribution, and demand, and concentrate again on the means of production.

My research concludes that with the right combination of policy and education, it is at least theoretically possible to optimize the number of innovative entrepreneurs in a free market economy. As a psycho-social phenomenon, to the degree that social structure and government policy promote entrepreneurial skillsets and mindsets, and create supportive environments, entrepreneurship will grow.

The unfortunate part is, there is no *operationalization* of a theory of entrepreneurship in Economics—no measurable outcome that can be optimized. When entrepreneurship is viewed as a firm-level construct it's impossible to measure because of the heterogeneity of output at the firm level (Baumol, 2010). This is true if operationalization is viewed temporally. At their earliest stage firms are *not* collectives but individuals. Thus there is no "demand" for their supply. It is the individual him/herself who demands to pursue self-employment aspirations. Entrepreneurship economic theory is not only stymied by lack of a demand curve—it suffers from associated level of analysis problems. The origin of the entrepreneurial act occurs at the point when the individual IS the firm—which may at that point in time exist only as a mental projection of the entrepreneur; or, it may exist on paper but consist of the individual alone.

At the individual level of analysis, at the point of entrepreneurial creation, when the individual and his firm are one and the same, the discipline of Psychology allows for operationalization of individual innovation and enterprising outcomes. In this controlled study, I found that entrepreneurship, as measured by entrepreneurial outcome behaviors (creation of new products, new companies, new enterprises) *is* variable under certain conditions. If the rate of entrepreneurship in market economies that do nothing to encourage it is around 5% of the population, levels can only increase substantially with targeted, evidence-based policy. (In this study, alumni of graduate and undergraduate E-ed courses started companies at rates of 30% and 25% respectively compared to 16% for their matched controls). Optimal levels of entrepreneurship at the macro-economic level can thus be achieved by creating conditions conducive for expanding the production possibility frontiers of individual entrepreneurs.

As a fourth factor of production (Romer's endogenous engine) the individual entrepreneur is the "strange attractor" core that catalyses the ever-higher orders of self organization common to every dynamic system. Austrian economics (in theory), and the collapse of command and control economies like the Soviet Union (in practice), confirm the utility of self-organizing market economies to wealth building and productivity-lead economic growth.

Supply Theories—Self organizing economies grow in response to individuals engaging in I/O, taking risk, and expending resources before they know what they will get in return because the market/demand exists only in their imagination. Creative destruction requires innovators to produce without waiting for demand to clamour for a new invention. Consistent with Say's Law (that supply will create its own demand), Baumol's entrepreneur takes a loss up front on the costs of creating supply, holding out hope that these sunk costs will be repaid later with monopoly profits.

As a factor of production, however, distinguishing the productive entrepreneur from the destructive entrepreneur is essential because only the *productive* entrepreneurial function will kick-start the system into higher productive order. The destructive entrepreneurial catalyst can only lead to dysfunction and chaos (Baumol, 2010). Thus the *supply* of entrepreneurs differs from the supply of labor (which may be exogenous) because it is endogenous to the system. A greater supply of entrepreneurs is always beneficial but *only* if that involves a greater supply of *productive*, not *destructive* entrepreneurs.

Baumol's theory that the supply of entrepreneurs in any society is roughly fixed (say at 5%) is based on history. Supply varies depending on whether a society's entrepreneurs choose to allocate their efforts to productive entrepreneurship or whether they instead seek careers in unproductive rent-seeking or organized crime. Interesting, then, that Baumol considers entrepreneurial psychology to be the "shadowy entity" behind Adam Smith's invisible hand, just as Keynes once observed "the state of confidence is a matter to which practical men always pay the closest and most anxious attention," and Kirtzner found the psychology of opportunity perception at the source of Schumpeter's creative destruction. Baumol's psychology is determined by a society's structure of payoffs —"the exercise of entrepreneurship can sometimes be unproductive or even destructive, and whether it takes one of these directions, or another that is more benign, depends heavily on the structure of payoffs in the economy—the rules of the game." (Baumol, p. 156). Baumol ascribes this willingness to play the entrepreneurial game to individual differences in entrepreneurial talent and entrepreneurial motivation, and in particular to two psychological constructs, one intrinsic and the other extrinsic: 1) Entrepreneurial over-optimism 2) Rewards such as wealth, power, and prestige. He asks, "Is entrepreneurship the Imaginative Pursuit of Position?" (Baumol, p. 162).

In terms of construct #1 (over-optimism), the empirical research presented in Parts I-IV shows that the supply of entrepreneurs is not dependent on Keynes' Animal Spirits, or Baumol's "Over-optimism and sheer miscalculation of odds."[*] Entrepreneurs are no more spirited, optimistic, or miscalculating than the average person; and in fact leaders in any field can have these same characteristics. They simply have a different way of handling risk calculation and failure than most people (See Part II).

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[*] Because the economic profits of entrepreneurship are "distinctly negative," according to Baumol, entrepreneurs have to hope that they will recover their sunk costs with a run of monopoly pricing that can occur when their product is first brought to market and before competitors enter the market with matched offerings of their own. The vast majority of the benefits of innovation do NOT go to the inventor, but are lost to spillovers, thus producing a disincentive to invent.

This study suggests that mastery of cognitive IO strategies for risk attenuation may be the key to entrepreneurial cognition and thus the source of entrepreneurial talent. Furthermore, while talent is as important in entrepreneurship as it is in any profession, IO is the only theory that accommodates situational variables like "coincidence" and "luck" (which many successful entrepreneurs attribute at least some of their success to) as inputs. The implication of this finding is that the supply of entrepreneurs may be directly impacted by educational strategies that include teaching entrepreneurial mindsets and skillsets in primary and secondary curricula, as well as at adult levels, (higher education and continuing education/workforce development), as discussed below.

As for construct #2, are entrepreneurs more highly motivated than the average person by wealth, power, and prestige, as Baumol suggests? This study shows that while entrepreneurs *are* motivated by extrinsic factors like wealth, position, and power, they are motivated by intrinsic values (such as work ethic and self sufficiency) more. In fact it may be the unproductive/destructive entrepreneurs, the rent-seekers and corrupt government officials who may be more likely to be motivated by money. The motives of a society's ne'er-do-wells, petty criminals, and shady characters are fairly straightforward (achieving the spoils of work without the work), while the motives of productive entrepreneurs in any society are less well understood (Baumol, 2010). This study suggests that, in fact, entrepreneurs are more willing to work and work harder than non-entrepreneurs (See Part I). Support for this idea, that destructive entrepreneurs and productive entrepreneurs are different sorts of people altogether, with *dissimilar* motivations, is supported by research showing that innovative entrepreneurs receive *lower* financial returns than corporate employees with similar experience and effort.

Education Policy Implications—If wealth is not the defining motivational characteristic of productive entrepreneurs, then perhaps Baumol's "clever" aspect is a key entrepreneurial distinction? Expert information processing theory models (Mitchell et al., 2002) hint that education may be a key predictor of entrepreneurism. But, as Baumol points out, if increased levels of education are correlated with entrepreneurship, why do countries such as Russia, with large numbers of well-educated scientists and engineers, produce so little entrepreneurship? The explanation, as this research suggests, is that it takes more than education. The execution of entrepreneurial ideas and opportunities is hard to do, and it takes the convergence of a number of aligned endogenous and exogenous variables—individual skillsets, mindsets, and a conducive environmental context. In fact this research suggests that, because entrepreneurship is typically taught in business schools, there is an inordinate focus by business researchers on weakly correlated inputs (like management, finance, and accounting). Business skills had no direct effect on entrepreneurship and do not, in and of themselves, create entrepreneurs. They impact entrepreneurship indirectly, along with social network skills, through self efficacy (See Part IV).

If E-ed is to influence Romer's 4th factor of production, it needs to be customized to individuals who have a tacit work preference and entrepreneurial bounded rationality. Educators must understand the psycho-social-cognitive factors that determine and influence the bounds of rationality. If internal motivation most often drives entrepreneurship (as this study suggests) the andragogical approach makes good use of this mindset. Students know that, at the end of the course, student-turned-CEO is a distinct, credible possibility. This idea that their economic future depends on themselves (perceived control) gives relevance to their education and makes them highly internally motivated to make it happen.

Students should be explicitly taught resourcefulness/social networking skills, and IO risk-attenuation techniques, for example. Interestingly, the two E-ed programs studied do this via "iteration" (just as real startups do) (Blank, 2006). Students learn something, they apply it, they learn something new, they go back and "iterate" the new information into their previous work. As a result many students completely change course several times throughout the semester. Students gain practice in entrepreneurial setback strategies as they begin to learn that this kind of "failure" is tolerated and even encouraged.

Technopreneurs may need even more of these abilities than small business entrepreneurs in that high-tech startups typically involve not only sophisticated cognition/technical expertise (skillsets) but also the personal values, work habits, beliefs (mindsets) and the social skills required to raise large amounts of money, build an organization, and put together a winning team. The creation of new entrepreneurs (high-tech, high-growth companies in particular), may not be as simple as boosting the numbers of college graduates with academic credentials in entrepreneurship. Just as new doctors and dentists need practitioner "internships," entrepreneurs may also need boundary-spanning affective experiences across three psycho-social-cognitive domains in order to develop the tacit knowledge and intangible skills (such as IO's input-oriented strategies of risk attenuation) required of successful entrepreneurs.

An entrepreneurial "eco-system" approach to education should not ignore individual differences; and education modalities must take into consideration the local environments where the education takes place. Curricula must align with students' individual values, goals, and predispositions. It must be relevant, and grounded in local networks. One way to deal with this variation is to employ andragogical approaches that embed the entrepreneur in local context, instill tacit knowledge and entrepreneurial mindsets, while also facilitating the development of each student's entrepreneurial network. The broader network access provided by multi-disciplinary faculty may thus better support student E-teams, and better embed them into local E-ecosystems.

To the degree students are introduced to entrepreneurial concepts early, (as early as elementary school, even), socialization for entrepreneurial careers can begin. Today few K-12 students know that "making their own job" is even

an option for them. Students are socialized to graduate from high school, go to college, and get a job from an employer, even if this may not be the best fit for many self-starters. Even earlier, in elementary school, students could be recognized for their creativity and inventiveness with the simple addition of this rubric in the grading of student projects. Just as students are currently taught life skills such as character education and conflict resolution, K-12 students could be taught risk mitigation skills; they could be rewarded for initiative taking, independent effort, and even allowed to fail. Teaching students to think creatively will help them to perceive mistakes and failure as an opportunity for learning. Spatial relations is another important talent tied to creativity that should be encouraged in American youth if we are to retain our nation's edge in innovation, technology, engineering, and entrepreneurship.

Economic Policy Implications—While education policies are clearly critical to a well-developed supply side of entrepreneurial talent, this research suggests that the today's conventional demand-driven policy approaches may be precisely the wrong approach. Most economists agree with Adam Smith's view "the extent of the division of labor…is determined by the extent of the market." The profession of entrepreneurship is thus market-driven and exogenous, they believe. Instead of recognizing entrepreneurship as an endogenous factor of production, classical economists suppose entrepreneurial activity is best stimulated exogenously on the demand side—by markets or aggregate demand (with its exogenous tastes and technologies), and the money supply—under the mistaken belief that all of these define the opportunities of the entrepreneur and thus the supply of entrepreneurial actors in the economy. Nevermind that opportunities are the subjective and local perceptions and creations of intrinsically motivated entrepreneurs.

Interestingly, while government efforts to control economies through demand policies (fiscal stimulus, borrowing, spending) are "Keynesian" economics, Keynes himself made the individual investor the central figure in economics—"the goal of the economy is to cultivate his skills and ensure his inducement to invest" (Gilder, 1981). A renewed focus by economic policymakers on the policies that incentivize individual entrepreneurs to *invest* their human and capital resources into productive entrepreneurial endeavors is consistent with Keynes' observation that *the productivity of the investment side of the savings side is the key*.

If productivity of the entrepreneur's investment is the key; recall that individuals with tacit knowledge make superior decisions for the investment of their personal labor. This is consistent with principals of moral hazard, a psychological heuristic explained by prospect theory: people value their own money more than they value what it could buy because their own money is tied to the expenditure of time and effort getting it (Tversky & Kahneman, 1981). Thus the supply of innovative entrepreneurs and their investment in aggregate depends on whether societal rules encourage or discourage that investment of time and effort. This research study suggests not only what influences and encourages entrepreneurial investment, it also suggests what defeats and undermines it. In essence, the forces that are most threatening and destructive of entrepreneurship are the same forces that threaten all self-organizing systems. Self organizing systems bubble up naturally and organically, from bottom to top, and as such they require little process energy, operating with Occam's razor-like parsimony. This is the opposite of highly centralized, command and control, hierarchical, and legalistic systems. Hierarchies, whether they are command and control totalitarian governments, classes, administrations, guilds, or castes that prevent upward mobility also inhibit highly productive self organizing networks, which are the critical ingredients of productive innovation and entrepreneurship. Interestingly, the threat posed by bureaucratic hierarchies to inhibiting entrepreneurial production was one of the key empirical findings of this study (See Part I). This result supports research that finds large corporations to be very good at imitation and incremental innovation, but very poor at radical innovation.

Rent seeking bureaucracies impose transaction costs that serve as a drag on innovation, productivity, and economic growth. The externalities of hierarchal Process Societies often materialize as aggregative fallacies or "unintended consequences" but these unintended consequences can produce such bad consequences that they require additional bureaucracy (processes, rules, regulations) to offset them. In fact, process societies have negative externalities that can be as destructive as those of unregulated business (environmental destruction in the old USSR and China, for example). Among the negative externalities is the loss to society of the positive externalities (the knowledge spillovers) of private innovation and entrepreneurial activity. With excessive bureaucracy, the unproductively or unhappily employed rent seeker may nonetheless forgo entrepreneurial opportunity if the opportunity cost is high, (for instance if she can take bribes).

Just as venture capitalists invest actively and locally, policies which empower individuals, at the grassroots level, who have the specialized knowledge to know what niche/what need they can best serve in their own communities, know best how to invest productively. Government can also invest productively, but this suggests that those investments should be *in* the individual entrepreneurs who have invested their own resources (time money, etc.), who are steeped in an idea niche known only to them, when knowledge about an idea/solution to a tricky unsolved problem is tacit and local.

Consistent with this perspective, then, the most effective policy approach to entrepreneurial job creation is very different from current practice. Participant Stakeholder Theory, with its focus on investing in the development of willingly participative individuals' capacity, rather than growing institutional capacity, offers a promising approach for limiting the moral hazard that plagues the corporate welfare approaches to stimulating firm formation, growth, and job creation. Stakeholder policies are productive, grassroots investments that incentivize/reward individual participant-

stakeholders with "skin in the game." The Thrift Savings Plan (TSP) is an example of a federal participant-stakeholder policy (Rideout, 2005). Federal employees are incentived to participate (save for retirement) with federal matching dollars. In the aggregate (4.5 million participants), the $300 billion investment in private markets has had extraordinary macroeconomic multiplier effects. At the micro-economic level, spillovers have also been substantial in that participants can access the funds (borrow and pay themselves back with interest) for self investment (education) and wealth-building activities (buy a home or start a business). They can even access them to prevent the loss of an equity asset (their home, for example) in the event of a medical emergency. Significantly, because the $300 billion was in private hands, it was not available (as Social Security surplus revenues were, for example) to fund wealth sumps (TARP/other political exigencies). Other federal, state, and local policies to help capitalize small business in the U.S. and elsewhere could include small business grant and loan programs, tax laws, tax abatements and incentives, and policies that would encourage and support bootstrap firm capitalization. Examples could also include student loan deferrals, matching grants, tax incentives for seed (friends and family) investments, and tax deferrals on profits during the initial years of firm establishment.

The participant stakeholder approach, because it maximizes grassroots investments, empowering individuals, devolves economic control of resources from hierarchies to workers/producers. An approach that "helps individuals help themselves" facilitates self-service so it also facilitates self-government (empowerment).

Stakeholder policy empowers spontaneous self-organization because self organizing facilitative networks typically scale up in systems that devolve power and responsibility, saving on transaction costs, and flattening government. Likewise, new technologies, because they reduce process/bureaucratic inefficiencies also help to minimize transaction costs, which further contributes to the upward spiralling economic growth produced by self organizing economics.

While private network formations occur organically and spontaneously, state sponsored/organized networks, typically created by government from the top down, are less efficient because of moral hazard and their potential for political corruption. However, whether limited government is or is not the result, government *size* is not as important as government *productivity*. A nation with a very small government in terms of dollars taxed, borrowed, and spent, may nonetheless be more productive than a country with a leviathan government, if they can effectively devolve government investment in the productive capacity of Romer's endogenous individuals in order to make them and their self organizing networks more competitive. Even the smallest undeveloped country could become self-sufficient and prosperous, this suggests, with a laser-like focus on encouraging investment and work. Thus it's not volume of resources in play (Keynes' wealth sumps) but it's their impact on growing the capacity of businesses and workers to create, invent, and execute. Economies can be made more productive *both* by investing in the productive, self-organizing activity of individuals (increase their supply of entrepreneurs), but also by substituting this investment for that in unproductive rent-seeking bureaucracies (whether private or public).

As long as a public sector is productive, a regulatory state is not necessarily a problem, because, by definition productive rulemaking increases market competitiveness. Thus it is prescriptive (companies can choose how to achieve the standard) and limited in terms of micro-management and number of rules, and the delays and efficiency costs that prevent productive private activity are minimized as a result.

To summarize, then, this research calls for renewed scholarly focus on the entrepreneur-in-context, the endogenous 4th factor engine of economic growth in free market economies. This will require the cross-disciplinary application of social science and econometric tools of modeling and analysis, and collaborations between economists, psychologists, sociologists and systems theorists. If in fact the supply of entrepreneurs is elastic and responsive to policymaking (educational and economic) then we have only begun to witness the tip of the iceberg in what could become a virtual explosion as the innovative entrepreneurs among us choose to realize their highest potential. In an increasingly networked, "flatter" world, participant stakeholder theory and policy is one promising approach for fomenting the self-organizing behaviors that encourage innovation and entrepreneurship and flattening the hierarchies that suppress it.

As workers achieve ever higher levels of education they become more autonomous and self-sufficient, allowing for the further devolution of governmental authority. More educated, autonomous workers, likewise make more efficient decisions, allow for flattened hierarchies, and the elimination of middle managers. Cost savings due to declining process inefficiencies (reduced bureaucracies; fewer administrative rulemakers, union bosses, procedure-writers, lawyers, arbitrators, and other rent-seekers) lead to flatter organizations and a flatter, more equitable/less elitist world. At the level of governments, devolution (flatter, smaller, and closer to the grassroots public agencies) leads to the disbursement of power—whether financial or political—and further enhances positive economic externalities both by reduced transaction/process costs and increased positive externalities of entrepreneurship and innovation. Higher levels of general education leads to the autonomous workers who create, innovate, and start small businesses that can better compete on the basis of the tacit knowledge advantage these entrepreneurs hold.

If productive self-organizing economics is the door to global prosperity, then education is the key. Ever higher levels of education for all of humanity will undermine tendencies for ever-increasing hierarchies and dehumanizing

economies of scale, counterindicating Karl Marx's assertion that over the course of history the lifeblood of corporations, Taylorite divisions of labor, will inevitably implode capitalism from within.

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