



Market imperfections, opportunity and sustainable entrepreneurship

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Abstract

This research develops the argument that four types of market imperfections (i.e., inefficient firms, externalities, flawed pricing mechanisms and information asymmetries) at once contribute to environmental degradation *and* that they also provide significant *opportunities* for the creation of radical technologies and innovative business models. We show that these opportunities establish the foundations for an emerging model of *sustainable* entrepreneurship, one which enables founders to obtain entrepreneurial rents while simultaneously improving local and global social and environmental conditions. To advance this new field, we offer suggestions for a research agenda focusing on two areas: the relationship between market imperfections and entrepreneurial opportunities, and the emerging field of sustainable entrepreneurship.

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1. Executive summary

Few scientists today disagree with the notion that humans are severely degrading many of earth's ecosystems. And while debate continues on just how much human activities impact the environment (such as in the case of global climate change and the Kyoto Accord), industry is often viewed as one of the largest contributors to environmental degradation. Yet, industry also has the capacity to minimize its negative impact, as leading

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firms demonstrate; even more importantly, business may have the potential to reverse negative environmental trends by leading the world into the ‘next industrial revolution.’ In the last decade in particular, big business has increasingly taken on the mandate from policy makers and from public pressure to improve its environmental performance. The resulting plethora of corporate environmental and sustainability initiatives, programs, and management systems has fueled a growing body of scholarly literature on ‘corporate greening.’ This diverse, multi-disciplinary field examines the institutional contexts, antecedents, processes and economic and ecological consequences of firms’ environmental strategies. While fruitful, however, these developments are largely incremental in nature. It is our view that the real gains will be made by harnessing the innovative potential of entrepreneurship to resolve environmental challenges with innovative business solutions.

In this research we identify four market imperfections that have contributed to environmental degradation, explore their role as sources of entrepreneurial opportunity, and introduce a new breed of entrepreneurship. We aim to show that “sustainable entrepreneurship” has the potential to slow the degradation and even gradually improve the earth’s ecosystems. The necessary innovations are likely to come from entrepreneurs who are able to identify the opportunities to obtain entrepreneurial rents while simultaneously addressing environmental and social challenges and who thus venture toward the so-called triple bottom line.

This paper begins with a review of the literature on entrepreneurial opportunity. We then briefly summarize current knowledge on the major environmental challenges facing the earth and proceed to introduce and define sustainable entrepreneurship. Next, we provide the theoretical rationale for our argument that market imperfections are sources of opportunities. In the paper’s central section, we analyze four market imperfections which have contributed to environmental degradation: (1) firms are not perfectly efficient; (2) externalities exist, (3) pricing mechanisms work imperfectly, and (4) information is not perfectly distributed. We explore the types of entrepreneurial opportunity that are most likely to result from each of the four market imperfections, and use examples to illustrate innovative entrepreneurial solutions developed to address these imperfections. We culminate this section by summarizing our analysis in four premises. Finally, we close with suggestions to further advance research in two areas: the relationship between market imperfections and entrepreneurial opportunities, and the emerging field of sustainable entrepreneurship.

We believe that this paper begins to shed light on the potential for a new breed of entrepreneurial firm, one that is driven to contribute to a society which is sustainable, not just from an economic perspective, but from an environmental and social perspective as well. The field of sustainable entrepreneurship is in its infancy and it is our hope that this theoretical paper helps to both advance scholarly thought and to provide guidance to those entrepreneurs seeking to make triple bottom line impacts in their local and global communities.

“One of the most neglected questions in the entrepreneurship literature is where opportunities to create goods and services in the future come from”. (Venkataraman, 1997: 122)

This research explores the role that market imperfections play in the creation of entrepreneurial opportunities. Specifically, we suggest that market imperfections have on

one hand contributed to environmental degradation, and that on the other hand, they provide significant *opportunities* for the creation of radical technologies and innovative business models. Furthermore, we argue that these opportunities establish the foundations for an emerging model of entrepreneurship which enables founders to obtain entrepreneurial rents while simultaneously improving local and global social and environmental conditions. We posit that the current trend of global environmental degradation is associated with four types of market imperfections (namely inefficient firms, externalities, flawed pricing mechanisms, and imperfectly distributed information), which create entrepreneurial opportunities for the introduction of innovative technologies and business models in sectors as diverse as extractive, manufacturing, retail, transportation, construction and service.

Researchers have only just begun to explore the critical entrepreneurial question as to what factors contribute to the existence of entrepreneurial opportunities (Venkataraman, 1997; Sarasvathy et al., 2003). This research seeks to expand our understanding of how market failure may be used to explore sources of opportunities. For this research, we focus on the environmental arena to explore how market failures have generated entrepreneurial opportunities which, if exploited, have the potential to not only generate entrepreneurial rents, but also to simultaneously reduce the market imperfection, move markets towards equilibrium and improve global environmental conditions.

While debate continues on the degree of impact human activities have on specific environmental issues (such as global climate change in the case of the Kyoto Accord), few scientists today disagree with the notion that humans are severely degrading many of earth's ecosystems. Industry and globalization are often viewed as the largest contributors to environmental degradation (e.g. protests at the 1999 WTO meetings in Seattle). Industry's role in weakening the natural environment is difficult to deny, yet industry also has discovered its capacity to reduce its negative impact. Even more importantly, industry has the potential to reverse negative environmental trends by leading the world into the 'next industrial revolution' (Hawken et al., 1999; Senge and Carstedt, 2001; Braungart and McDonough, 2002). In the last decade in particular, large businesses have increasingly taken on the mandate from policy makers and public pressure to improve or 'green' their environmental performance.² The result, a plethora of corporate environmental and sustainability initiatives, programs, and management systems, is fueling a growing body of scholarly literature on 'corporate greening'.³ This diverse, multi-disciplinary field

² Considerable advances have been made in reducing industry's environmental impact, particularly in the industrialized world, and large business increasingly accepts its important role. To illustrate: "Our commitment to corporate responsibility has to come from every level of Nike and be a part of every aspect of our business," states Dr. Conway, Nike Chair of Corporate Responsibility, quoted in Natrass and Altomare (2002). Eco-efficiency initiatives, for example, have successfully reduced resource requirements and ecological waste per unit of output; they have also generated millions of dollars of savings along the way. Similarly, ISO 14001 accreditation schemes are spreading Environmental Management Systems throughout global supply chains. However, as long as overall economic output increases more rapidly than impact reduction, absolute environmental impact continues to increase, resulting in continued degradation (Senge and Carstedt, 2001).

³ An indication of the growth of this domain of scholarly inquiry are recent Special Issues (Academy of Management Review, October 1995; Academy of Management Journal, August 2000); newly formed journals, e.g., Organization or Environment; Business Strategy and Environment; Corporate Environmental Strategy; and the growing number of edited volumes and individual journal articles on business, environment and sustainability.

examines the institutional contexts, antecedents, processes and economic and ecological consequences of firms' environmental strategies, and has, in its short history, generated important results.

Despite this growing scholarly interest in corporate greening, management research to date has failed to examine either the entrepreneurial aspects of business and environment in general, or the potential for entrepreneurial rents arising from environmental innovations in particular. This paper aims to draw attention to this neglected area of research; we do so, first, by exposing the economic and social significance of a new form of entrepreneurship which we refer to as sustainable entrepreneurship (see definition below). Second, taking a macro-perspective of the economic (and ecological) opportunities related to sustainable entrepreneurship, our analysis focuses specific attention on the *sources* of such opportunities, namely market imperfections.

Market economies, unlike their economic models, do not always lead to perfectly efficient allocation of goods and services. Rather, when any of the conditions for perfect markets (e.g. consumers and producers are price-takers; complete present and future markets exist; complete, perfect information exists, and externalities are absent), is violated, markets do not operate efficiently (Venkataraman, 1997; Yao, 1988; Dean and McMullen, 2002). Many of the environmental challenges faced today can be attributed in part to four types of market imperfections, or violations of perfect market assumptions: (1) firms are not perfectly efficient; (2) externalities exist, (3) pricing mechanisms work imperfectly, and (4) information is not perfectly distributed. Each of these market imperfections creates entrepreneurial opportunities, which, if identified and exploited, create entrepreneurial rents for the innovating firms, improve market performance, and introduce more sustainable interactions with the natural environment.

2. Entrepreneurial opportunities

In his seminal work establishing the domain of entrepreneurship research, Venkataraman (1997) stresses the need to deepen our understanding of entrepreneurial opportunities and their sources. Sarasvathy et al. (2003), drawing from classic works by Hayek (1945), Knight (1921), and Buchanan and Vanberg (1991) delineate three distinctive but not mutually exclusive views of entrepreneurial opportunity. The allocative view (tied to opportunity recognition) perceives opportunities to exist when there is potential to redistribute resources for the betterment of some without making others worse off (known as a Pareto improvement; see Dean and McMullen, 2002). The discovery view (tied to opportunity discovery) suggests that entrepreneurial opportunities arise from information asymmetries with respect to the true value of resources and the resulting value of the combination of those resources into outputs (Sarasvathy et al., 2003; Knight, 1921). The creative view (tied to opportunity creation) suggests that entrepreneurs seek to maximize the utility functions of multiple stakeholders and that opportunities can only truly be identified ex-post (Buchanan and Vanberg, 1991; Sarasvathy et al., 2003).

We do not intend to explore why some individuals identify opportunities when others do not. Rather, this research conceptually explores the role of market imperfections in generating entrepreneurial opportunities (in this case with respect to the natural

environment) and offers a theoretical foundation for introducing sustainability into the entrepreneurship domain.

To map the domain of *sustainable entrepreneurship*, our analysis starts with a broad definition of entrepreneurship. We then analyze each type of *market imperfection* with regard to the environment and, using examples for illustration, show that each market imperfection holds significant *opportunities* for entrepreneurial innovations. Lastly, we develop a research agenda for management scholars interested in further examining sustainable entrepreneurship.

3. Sustainability: an integral part of the entrepreneurship domain

In order to derive a conceptual definition of sustainable entrepreneurship, we briefly review current knowledge of human impact on the earth's ecosystems. We then examine the concept of sustainability and follow with a definition and discussion of sustainable entrepreneurship.

3.1. Human impact on the environment: climate change and ecosystems

Today, there is growing consensus in the scientific community that climate change is, if not caused, then certainly accelerated, by collective human activity (Bolin, 1997; IPCC, 2001). Global climate change is just one, albeit particularly large-in-scope, aspect of changes to and degradation of the eco-systems whose services sustain all life, including human economic endeavor, on earth.⁴ “Ecosystem services are the benefits human populations derive, directly or indirectly, from ecosystem functions” (Costanza et al., 1997). One recent survey of the challenges faced by five of earth's most critical ecosystems is a collaborative effort by the World Resources Institute, the World Bank, and the United Nations, the Pilot Analysis of Global Ecosystems (PAGE; World Resources Institute, 2000). Table 1 provides an overview and lists some of the challenges. The outlook for these ecosystems raises concern: each is suffering diminishing capacity due to human causes (such as deforestation, destruction of the rainforest and associated loss of biodiversity, pollution, and excessive consumption of freshwater), and the so-called ecosystem services associated with each (such as carbon sequestration, air purification, generation of fertile soil, filtering of freshwater) can be expected to suffer accordingly.

3.2. Sustainability

For decades, economic development and environmental protection was viewed as a zero-sum game of social wealth. The Brundtland report by the World Commission on Environment and Development (WCED), an independent body established by the United

⁴ Consisting of 2000 scientists from 100 countries, the Intergovernmental Panel on Climate Change (IPCC) concluded that the world will likely warm 1.5–4° the end of the 21st century, with parts of the US warming up by 6–8°. According to the IPCC, the continued warming of the earth is primarily due to the burning of fossil fuels, which significantly raises the levels of carbon emissions into the atmosphere.

Table 1
Critical Global Ecosystems (Adapted from World Resources Institute, 2000)

Ecosystem	General description	Challenges
Agricultural	Land surfaces devoted to agricultural purposes which account for \$1.3 trillion in output of food, feed, and fiber, 99% of calories consumed by humans.	Since 1950, 40% of agricultural land worldwide has been severely degraded through erosion, salinization, nutrient depletion, biological degradation, and pollution. The diminishing supply of quality water also continues to provide challenges.
Coastal	Land surfaces adjacent to continental and island boundaries which are home to 39% of the world's population and account for 95% of the marine fish caught for consumption.	Overfishing, destructive trawling techniques, and destruction of nursery habitats have diminished by 20% the stock of fish and shellfish. The use of synthetic chemicals and fertilizers in neighboring regions lead to pollution problems for coastal lands. Global warming also impacts coastal ecosystems through warming of ocean temperatures, changing storm frequency, and rising sea levels.
Forest	Land areas accounting for the largest source of wood products and millions of unique plant species, many used for medicinal purposes. Forests cover 25% of the earth's land surface.	Since 1989, more than 20% of global forest cover has been removed due to conversion to other land uses and logging. Deforestation has significant impacts on biodiversity in the form of loss of unique plant and animal species. Forests act as carbon sinks.
Freshwater	Water sources covering less than 1% of the earth's surface but are a primary source of water for drinking, domestic use, agriculture and industry, as well as an alternative source for fish.	Humans currently use more than 50% of all accessible fresh water runoff; by 2025 demand will reach 70%. Dams cause the loss of fisheries and biodiversity.
Grassland	Grasslands cover 40% of the earth's land surfaces and provide critical sources of protein and fiber from livestock. Primarily located in developing countries.	Roadbuilding, land conversion, and human induced fires have caused significant loss of grasslands and thus a loss of biodiversity.

Nations in the 1980s, changed that view when it coined the concept of sustainable development. Because of its simplicity and widespread acceptance, we adopt the WCED definition of sustainable development. Sustainability is defined as the ability to “meet the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

Today, the deeply held assumption that any advances in ecological sustainability require an inherent tradeoff in economic profitability is slowly giving way to a very different perspective; sustainability, namely the balancing of economic health, social equity and environmental resilience, serves as the integrative concept which offers a long-term perspective and provides opportunities for win–win solutions (Winn and Kirchgeorg, 2005). Firms applying the concept are often referred to as managing to the “triple bottom line” (Elkington, 1997).

Most scholarly work to date focuses on corporate greening, revolving around firm efforts to reduce their environmental impacts in the process of transforming material and

energy into salable products and services (e.g., reduced resource consumption and waste generation per unit of output). The literature on business and sustainability is comparatively slim (among the exceptions are the October 1995 issue of the Academy of Management Review; Hart, 1997; Hart and Milstein, 2003). Despite the progress made through corporate greening in practice, the changes achieved (1) are incremental only, (2) are necessary but not sufficient to reach economic, environmental and social sustainability, (3) do not fully resolve existing market imperfections, and (4) miss the most innovative and profitable opportunities to reach sustainability.

3.3. Sustainable entrepreneurship

Drawing on extant definitions of entrepreneurship, we propose a definition for the concept of “sustainable entrepreneurship”. While there are probably hundreds of definitions for entrepreneurship in the literature (see Bruyat and Julien, 2000 for a summary), we find Venkataraman’s (1997) definition of a multi-level domain for entrepreneurship research particularly appropriate. He broadly encompasses both the diverse contemporary research and early economic thought: “entrepreneurship as a scholarly field *seeks to understand how opportunities to bring into existence “future” goods and services are discovered, created, and exploited, by whom, and with what consequences*” (Venkataraman, 1997: 120; italics in original).

This definition is useful for several reasons. It focuses attention on opportunities and (1) their sources, (2) the agents of their exploitation, the entrepreneurs, and (3) the consequences of their exploitation. Furthermore, it pushes the field’s boundaries outward, placing entrepreneurship into its larger social context and allowing for the development of a structured, but broadly inclusive research agenda.

Our analysis suggests that market imperfections have contributed to many of the current ecological challenges and that knowledge of these challenges and subsequent market imperfections can lead to entrepreneurial innovations which help solve some of the environmental challenges. Here, we focus primarily on the *sources* of entrepreneurial opportunities, specifically those related to market imperfections linked to environmental degradation. While this paper only touches on the consequences of entrepreneurship, we do make a small, but significant modification to Venkataraman’s specification. Venkataraman suggests that the consequences of entrepreneurship can be economic, psychological, and social in nature. We agree and add a fourth category, environmental consequences, to the current list. Therefore, we define *sustainable entrepreneurship* as the examination of “how opportunities to bring into existence ‘future’ goods and services are discovered, created, and exploited, by whom, and with what economic, psychological, social, and *environmental* consequences.” We suggest that the addition of *environmental* consequences offers an expanded and significantly modified definition for the field of entrepreneurship.

By including consideration of the social benefits resulting from environmental initiatives (e.g. reduction of pollution increases quality of life and population health); of the economic benefits of successful venturing; and of entrepreneurship’s positive impact on social wealth, our analysis addresses each of the three aspects of sustainability: economic, social and environmental. Our primary focus, however, is on the economic and environmental components of sustainability.

We argue that market imperfections have led to significant opportunities for sustainable entrepreneurship. We do not focus on the ethical responsibility or “moral imperative” of entrepreneurs to engage in more sustainable business practices (for a thorough discussion of these topics see for example the Ruffin Series, volume 3 in *Ethics and Entrepreneurship*). Nor do we seek to discuss the emerging field of social entrepreneurship, which is oriented towards non-profit organizations with missions to make social change (Drayton, 2002). Rather we focus on the opportunities for achieving entrepreneurial rents through innovations which reverse or mitigate existing unsustainable conditions. The following section examines these market imperfections and resulting opportunities for sustainable entrepreneurship.

4. Market imperfections

In order for global commerce to shift towards a path of sustainability, several market imperfections must be addressed by market actors. Here we provide support for the thesis that imperfections associated with neoclassical economics assumptions of perfect markets have occurred with respect to the natural environment; second, we introduce four types of market imperfections in some detail, and third, we show that each provides opportunities for the creation of those profitable new ventures, whose products or services are focused on sustainability. Specifically, we examine violations of these assumptions: that (1) firms are perfectly efficient, (2) negative externalities are non-existent, (3) perfect pricing is present, and (4) perfect information exists. We relate each to the most appropriate view of entrepreneurial opportunity (Sarasvathy et al., 2003) and offer examples of sustainable entrepreneurship in action.

4.1. *Neoclassical economic theory and entrepreneurship*

Our intent here is not to enter the debate regarding the viability of neoclassical economic theory, but rather to explore how violations of its assumptions can provide a framework for understanding where entrepreneurial opportunities come from. To do so, we briefly summarize the foundation of neoclassical economic theory, and the current divergent views regarding the relevance and value of examining markets through a neoclassical economic lens. We conclude this section by introducing how one criticism of neoclassical economics, specifically its treatment (or lack thereof) of uncertainty, poses challenges for the theory’s ability to predict and explain the existence of entrepreneurial opportunities.

The origins of neoclassical economic theory derive from Walras (1871/1954), Jevons (1871) and Menger (1871/1951). At its core, neoclassical economics suggests that maximizing utility, primarily profits, is at the core of all economic activity. Neoclassical economists introduced the use of predictable supply curves for consumer goods and demand curves for factors of production. They rely on the aggregation of economic activity for modeling rational economic activities, which have an intrinsic movement towards the steady-state equilibrium (Whalen, 1987). A core premise of neoclassical economics is that economic actors seek to maximize their utility (von Neuman and

Morgenstern, 1947), with its underlying assumption that economic actors are rational and predictably make decisions based on all possible information.

Criticisms of the rational actor assumption have come from several sources. Psychologists (e.g. Simon, 1956; Tversky and Kahneman, 1981) have demonstrated that individuals have cognitive limits (i.e. bounded rationality) to their capacity to acquire and absorb disparate pieces of information. New institutional economists have suggested that neoclassical economics overlooks the existence not only of bounded rationality, but also of transaction costs and uncertainty (e.g. Coase, 1937; Williamson, 2000). Another significant shortcoming is its focus on the equilibrium state over time, causing its proponents to overlook the dynamic nature of markets in the short-term (Whalen, 1987). Furthermore, social embeddedness such as norms, customs, traditions and culture has been overlooked by neoclassical and new institutional economists (Williamson, 2000; Granovetter, 1985).

As we bring this debate to bear on the role of entrepreneurship in an economy, the works of Keynes (1936) and Knight (1921), in contrast to neoclassical economic doctrine, suggest that investment activity is inherently uncertain, and in some cases, the probability of various outcomes is largely unknowable. Knight (1921), among the first to explore uncertainty for economic actors, delineated three types of uncertainty including: (1) the distribution of future outcomes is known and probabilities can be calculated (associated with opportunity recognition); (2) the distribution of future outcomes exists but can only be identified over time through trial and error (associated with opportunity discovery); and (3) the distribution of future outcomes is unknown and unknowable (associated with opportunity creation). Entrepreneurs who identify and exploit these uncertainties will likely achieve entrepreneurial rents as the market compensates the entrepreneur for not only the opportunity cost of starting a new venture, but also for the risk involved (Venkataraman, 1997).

Entrepreneurial rents will only accrue to the entrepreneur until knowledge has disseminated in the market and competitors have had the opportunity to react. Four types of rents have been identified in the literature: monopoly rents, quasi rents, Ricardian rents, and entrepreneurial rents (Heeley, 1997). Entrepreneurial rents represent supernormal profits accrued by firms who introduce new combinations of resources to develop innovation in processes or products (Knight, 1921).

As the above discussion illustrates, neoclassical economics has its share of detractors and has several shortcomings in its ability to elaborate either normatively or descriptively on the existence and exploitation of entrepreneurial opportunities. Many scholars subscribing to neoclassical doctrine, however, suggest that by challenging and relaxing the underlying assumptions inherent in neoclassical economics, valuable insights regarding economic activity, and even entrepreneurial activity, can be gained (e.g. Ashton, 1989; Smith, 1962; Scapens, 1983). Thus, the further away a market is from perfect, the further is it away from equilibrium, and the more entrepreneurial the opportunities that exist. We do not question the usefulness of neoclassical economics but rather focus on its potential to use deviations from its principal components to help explain the pragmatic reality of diverse economic systems. The remainder of the paper seeks to accomplish just that by elucidating (1) how four market imperfections from a neoclassical economics perspective have contributed to environmental degradation, and (2) how

entrepreneurial opportunities have emerged which, if exploited, can simultaneously address the degradation, move dynamic markets towards equilibrium, and create entrepreneurial rents.

4.2. Market imperfections and sustainable opportunities

For each of the four market imperfections examined next, we first introduce the market imperfection conceptually and link it to its role in environmental degradation. We then show how this market imperfection can lead to any of the three generic types of opportunities (Sarasvathy et al., 2003), offering examples of new ventures currently exploiting the newly created opportunity.

4.3. Market imperfection 1: inefficient firms

One key assumption of neoclassical economics is that firms are perfectly efficient in their resource allocation. While it is commonly accepted that perfect resource utilization is an unlikely expectation, the closer firms get to perfect efficiency, the better markets perform. Meanwhile, evidence is mounting that firms (and consumers) are only meeting a fraction of the potential efficiencies available from natural resources. For example, the waste generated when making a semiconductor chip amounts to over 100,000 times its weight (Hawken et al., 1999). Womack and Jones (1996) report that US industry acquires three-fifths of its aluminum from virgin ore, while Americans discard enough aluminum to replace its entire commercial aircraft fleet every 3 months. In making aluminum-based products, virgin ore requires twenty times the energy intensity of recycled aluminum. These examples illustrate how inefficient production processes, the lack of consumer appreciation for recycling, and the lack of strategic vision of industrial leaders lead to significant waste and inefficiency in our economic system.

Taking the perspective of transaction cost economics, Williamson (1991) stresses the primary importance of seeking efficiency gains through first order economizing in order to improve the performance of markets. First-order economizing seeks to reduce economic waste by maximizing efficiency (Williamson, 1991). While that view does not explicitly take into consideration the importance of efficiency gains in the use of natural capital, others show that economic waste and environmental waste can often be reduced simultaneously (Hawken et al., 1999). Popularized by DeSimone et al. (1997), the term “eco-efficiency” best exemplifies this convergent logic of the joint minimization of both environmental and economic waste for cost-savings, significant natural-resource efficiency improvements, and increased profits. An even more radical leap in efficiency improvements is proposed in the FACTOR 10 concept crafted by an international group of environmental and economic development experts in the Carnoules Declaration (1994). FACTOR 10 implores no less than a ten-fold increase in current resource productivity within 50 years as a solution to the growing pressure on natural resources. In a similar vein, Hawken (1993) makes a call for “radical resource productivity”.

Kirzner (1973), leveraging an Austrian economics perspective, suggests that opportunity identification and exploitation among entrepreneurs can actually bring markets closer to equilibrium through increased efficiency of resource allocation. We

argue that the growing recognition of the need for increased natural resource productivity coupled with improved functioning of markets, offers considerable entrepreneurial opportunities. These opportunities derive from the conversion to a cyclical economy (Kirchgeorg, 1999), in which dramatic improvements in efficiency of resource use depend on “recycling and recovery at every stage of the process” (www.factoriten.co.uk). In addition to greater resource efficiency within firms’ manufacturing processes, increased emphasis on technological and broader systems innovations, both along and beyond the traditional supply chain, generates considerable opportunities for efficient recovery of natural resources embedded in products at what used to be the ‘end of their product life’. The same holds for revamping services, whose provision and delivery generates similarly high levels of consumption of natural resources and concurrent waste.

Opportunities abound for firms to reduce environmental resource pressures and, moreover, to do so in a profitable manner (Hawken, 1993; Weizsäcker et al., 1995). In the context of the three distinctive views of entrepreneurial opportunity discussed earlier (Sarasvathy et al., 2003), opportunities relating to efficiency imperfections may cross all three (opportunity recognition, discovery and creation), but will commonly be “recognized” by combining known supply and demand elements of a market in more efficient ways.

A powerful design principle to spark entrepreneurial opportunity is biomimicry (Benyus, 1997), which suggests that large-scale advancements in sustainability could be made by designing industrial systems to imitate nature, where one creature’s waste is another’s food. While we are in the early stages of identifying innovation opportunities based on biomimicry, ecoparks offer a fascinating example. Ecoparks are similar to typical technology parks with one notable exception: waste elimination is a primary driver for the design and tenant selection process (DeSimone et al., 1997). “Eco-industrial parks offer firms the opportunity to cooperatively enhance both economic and environmental performance through increased efficiency, waste minimization, innovation and technology development, access to new markets, strategic planning, and attraction of financing and investment” (smart communities network; www.sustainable.doe.gov).

Hartberg, Austria is home to an ecopark which houses a center for applied research on environmental technologies and several companies whose products or processes are environmentally oriented. The primary objectives of that park are to foster environmental technology development, provide sustainable business and job opportunities for their community, and educate the public about the importance of sustainability. Additionally, the park seeks to minimize waste among the tenant firms by encouraging waste reuse and management, and to only use renewable energies to power the park. We are likely to see continued growth in ecoparks that seek out and foster entrepreneurial opportunities to leverage the waste of one company into a profitable opportunity for another firm. Another extension of the ‘waste equals food’ approach pertains to profitably converting industrial and consumer waste into new products and services. An example is Canadian-based Maxim Power, which captures methane gas from landfills and converts it into electricity to be purchased by local utilities.

Markets have been operating well below the perfect efficiency expected in an equilibrated neoclassical view of perfect markets. Innovating entrepreneurs who “discover” the potential to reduce that waste (e.g. through the creation of products with

recycled content or ecopark development) will assist markets in moving towards a sustainable trajectory.

4.4. Market imperfection 2: externalities exist

Another simplifying assumption of economics is that of ‘exclusivity.’ It holds that one firm’s actions have no impact on the well-being of bystanders. Externalities exist when costs or benefits are not accurately reflected in the prices of products and services due to downstream (and, as we argue below, upstream) effects of a firm’s behavior (Browning and Zupan, 1999). Externalities may be negative or positive. A positive externality occurs when a third party benefits from the production or consumption of a good without incurring the full costs corresponding to the true value of the benefit received. For example, if a homeowner remodels her home and improves the landscaping around it, the neighbors receive benefits in the visual improvement of the neighborhood as well as potentially increased home values of nearby homes. Negative externalities, on the other hand, occur when a third party incurs the costs resulting from the production or consumption of products and services without receiving equivalent benefits.

Negative externalities with respect to the natural environment are abundant and may well represent one of the largest deviations from neoclassical economics assumptions, considering that collective firm actions have resulted in severe pollution and environmental degradation (Toman and Withagen, 2000). An entire discipline of economics, environmental economics, has emerged to explore how and when firms do or do not bear their share of environmental costs in conjunction with the benefits of rents. Negative externalities in the form of environmental degradation are observed not only in the country where a product is consumed, but also in the countries where resources are extracted and processed. With increasing globalization of trade, the geographic spread of externalities associated with a particular value chain is expanding.

Examples include ground water pollution from mining operations, runoffs from textile dyeing processes, or the toxification of land used for cotton farming. Beyond the more geographically confined impacts, such as fresh water pollution, acid rain, or smog, the global community is impacted by ozone layer depletion due to widespread use of chlorofluorocarbons (CFCs), by the metals and organic compounds found in fish due to the growing pollution of oceans, and by loss of biodiversity due to habitat encroachment and pollution, to name a few. In addition to the deterioration of ecosystem services that clean air, filter and purify drinking water, etc., the rapid depletion of natural resources “further compromises the ability of future generations to meet their own needs” (WCED, 1987). Other examples for such intergenerational, i.e., temporally distributed, externalities are the effects of climate modification or species extinction on future generations.

Substituting current practices with technologies and supply chain services that minimize, nullify, or even improve on earlier negative externalities generates opportunities for new ventures and may even generate positive environmental externalities (e.g., remediation of polluted ecosystems enables regenerative ecological capacity which may result in increased species diversity and greater resilience). While examples of all three types of opportunity identification might be found in addressing negative externalities, opportunity “discovery” and “creation” appear the most likely. This is the case because

entrepreneurs addressing negative externalities are less likely to have quality information regarding the supply or demand side of the equation and because opportunity creation is likely to result from a collaborative process amongst several stakeholders.

Innovative firms able to recognize and create opportunities to reverse existing negative environmental externalities (e.g., air pollution) can generate triple bottom line results as they produce social benefits (by improving the air surrounding communities breath) and environmental benefits (improved ecosystem functioning), and do so profitably (by tapping into markets for cleaner air).

The U.S. Environmental Protection Agency (EPA) estimates that about 220 million tons of discarded computers and other technologies end up in landfills in the U.S. every year. This electronic waste (e-waste) generates many potential health threats through soil and groundwater contamination due to the toxic properties of discarded metals (i.e. lead, mercury and cadmium). Fifty percent of computers sent to landfills due to “obsolescence” are still in working order (Silicon Valley Toxics Coalition, svtc.org) and provide forward thinking companies *opportunities* to find triple bottom line solutions. An example of an e-waste reduction company is Hackett Electronics in California; founded in 1989, Hackett Electronics provides jobs for 30 employees and generates revenues from the reclamation, refurbishing and resale of obsolete or previously damaged computer related electronic components.

While significant negative externalities have contributed to an unsustainable trajectory of world markets, entrepreneurs who discover and create opportunities for environmentally benign energy sources (such as biomass, fuel cells and e-waste reduction), or who create opportunities (through creating new emissions trading markets), achieve two results: (1) they facilitate the reduction of negative externalities, moving markets towards a more sustainable trajectory, and (2) they expand the overall pool of entrepreneurial opportunities (discussed further in the “Future Research” section below).

4.5. Market imperfection 3: flawed pricing mechanisms

In a perfectly competitive market, the prices of all products and services in an industry are determined by equating the demand for a good with its supply. The resulting price is known as the market clearing price or equilibrium price. Conventional economics theory assumes that natural resources are infinitely plentiful and that they have a market value that accurately reflects supply and demand. The reality, however, is that many natural resources are exhaustible (Kurz and Salvadori, 1997), undervalued and underpriced.

Exhaustible or non-renewable resources are those that do not regenerate naturally, or will not regenerate within a period of time relevant to current and forthcoming generations (Kurz and Salvadori, 1997). They include both resources used as inputs, such as oil or natural gas, as well as eco-system services needed for wastes to be absorbed and recycled, such as wetlands or forests. The free market economy has failed to adequately account for the true value of exhaustible natural resources (Hawken et al., 1999). Many ecosystem services (such as clean air and water, renewable energy sources, and a regulated climate) are undervalued or not priced at all. A more sustainable economic system would be one that assigns an appropriate dollar value to natural capital. Such an economic system recognizes that the world’s natural capital provides both services and products and, as such, has a net worth (McGuinty, 2002). A study by 13 researchers comprising ecologists,

economists, and geologists at various universities estimated the current value of ecological services used by those inhabiting the earth to be near \$33 trillion annually (Costanza et al., 1997), which is nearly double the gross national product of the world's nations combined (\$18 trillion at the time of the study).

As governments, citizens, and companies begin to recognize the true value of the earth's declining natural resources, the market will more likely reflect the actual value and price of these natural resources. This may come in the form of economic incentives (e.g., taxation for land owners that recognizes the economic value of its natural resources and thus provides incentives to retain the land in its current state) and economic penalties (e.g., taxation on firms for extracting natural resources from the earth), the removal of so-called 'perverse' subsidies (e.g., subsidizing environmentally damaging agricultural practices) (Bazerman and Hoffman, 1997) or merely a shifting of the supply curve inward to reflect real stocks of natural resources.

As we move closer to the ideal of perfectly pricing natural resources, that is, as we value and price natural resources more accurately, we will likely see demand for the use of nonrenewable factors of production decline, while demand for more renewable factors increases. It is our contention that renewable factors of production (for example geothermal, biodiesel, wind, solar, recyclable materials) are currently undervalued in the marketplace because nonrenewables have been priced as if they were nonexhaustible. Once nonrenewables begin their ascent towards their true equilibrium price, markets will open up for alternatives. Even the anticipation of more accurate pricing generates opportunities, and can spark new venture creation, since entrepreneurial opportunities can be generated by either anticipating a shift in the supply curve of a natural resource or by identifying a demand curve for a new technology which previously did not exist or which was not price competitive with existing technologies at their prior equilibrium price (Kirzner, 1997; Casarosa, 1981).

Given that demand for alternatives to the over-utilization of natural resources can not be easily predicted ex-ante and that supply of alternative technologies to harness renewable resources (such as wind, water, hydroelectric, or solar) are not widely commercially available, entrepreneurs addressing this market imperfection are likely to do so through opportunity "creation" (i.e. creating new markets).

The concept of disruptive technology (Christensen, 1997) offers examples. Disruptive technologies are initially technically inferior to those in mainstream markets, used in less demanding applications or sold to customers normally not inclined to buy high end products; they tend to represent opportunities missed by established firms focused on profitable growth through technological advancement (Christensen, 1997). Disruptive technologies provide opportunities for innovative entrepreneurs to enter a market under the radar screen of established players, enabling them to build market share to the point where they can become a challenge to established firms.

Disruptive technologies may first be introduced to the four billion people at the bottom of the economic pyramid to engage emerging markets in profitable, environmentally sound innovations (Hart and Christensen, 2002; Kirchgeorg et al., in press). For example, 2 billion people in the world have no access to reliable energy. Some innovative, entrepreneurial companies are looking at ways to utilize renewable energy sources to provide basic, clean energy to the bottom of the pyramid. An example is Iowa Thin Film Technologies, which has developed a solar photovoltaic cell based on a modified, low-end semiconductor circuit

with potential for use in third world countries without established power grids (Hart and Christensen, 2002). The company may then be able to perfect the technology for use in the developed world, where renewable energy alternatives encounter difficulties competing with established electric and coal powered energies. As prices for non-renewable fossil-fuel energy sources increasingly reflect the long term decrease in supply, the full costs of extraction, and the costs of greenhouse gas emissions in an increasingly carbon-constrained world, then the disruptive, renewable energy technologies developed for the bottom of the pyramid are likely to become increasingly competitive in first-world countries.

As was the case with the first two market imperfections, violations of the perfect pricing assumption have contributed towards an unsustainable trajectory in leading markets. At the same time, those innovative entrepreneurs (including those developing bottom of the pyramid solutions) who spot current and future trends to “create” entrepreneurial opportunities that bring to bear the full cost of products and services can find triple bottom line solutions that displace underpriced, unsustainable technologies.

4.6. Market imperfection 4: imperfectly distributed information

The perfect competition assumption of neoclassical economics finally suggests that market omniscience is universally present in free markets (Kirzner, 2000) and that in free markets, suppliers and buyers have perfect information about prices, products and the market. In reality, however, no actor in the economy is omniscient, and even if a firm or individual were capable of acquiring perfect information about respective markets, bounded rationality would limit their capability to process the information and develop the “perfect” strategic decision (Simon, 1956; Williamson, 1985). Such information asymmetry is a primary cause of market failure (Akerlof, 1970) and is also a main driver of entrepreneurial opportunities (Kirzner, 1973; Sarasvathy et al., 2003; Venkataraman, 1997). It occurs when individuals possess different information with respect to resources, markets and opportunities. Information asymmetry has been researched at great length with respect to the relationship between entrepreneurs and investors; it has been suggested that entrepreneurs contain specialized information about themselves and the opportunity (Cohen and Dean, 2005; Stuart et al., 1999) and have psychological and financial incentives to engage in opportunistic behavior (Shane and Cable, 2002).

Little entrepreneurship research, however, has explored the contexts in which information asymmetries are most likely to occur, or the conditions under which asymmetries lead to entrepreneurial opportunities. Entrepreneurs capitalizing on information asymmetries in the marketplace are most likely to engage in opportunity ‘discovery’ by leveraging informational advantages and complementary resources (Sarasvathy et al., 2003; Venkataraman, 1997).

One example of imperfect information is that very few consumers actually know how much energy they use in their homes, what the costs and benefits are of different energy solutions (e.g. photovoltaics), or what rates of return to expect for energy efficient home enhancements (e.g. double paned windows, improved insulation) (Hawken et al., 1999). This lack of knowledge on the part of the consumer creates a market imperfection leading consumers to make uninformed buying decisions, often at the cost of both the environment and their pocketbooks.

It is this imperfect information which generates entrepreneurial opportunities (Kirzner, 2000); in fact, the poorer the information is, the greater the number and scope of entrepreneurial opportunities. A direct example of business opportunities relating to the information gap stems from firms that certify whether products and services meet a particular set of environmental criteria. TerraChoice Environmental Services, a Canadian company, has introduced several environmental rating products and services including a comprehensive assessment of environmentally oriented products and services (Environmental Choice Program), a rating system for hotels committed to environmental performance (HAC Green Leaf), a golf course rating system (GreenLinks) and a system for environmental ratings for boat marinas (Clean Marine Green Leaf). Another company, Power Measurement, is helping corporate and government clients save millions of dollars through the introduction of digital power recording instruments which enable their clients to measure and manage their power usage in real time. Without this information, companies remain in the dark on how to effectively reduce their energy use.

The persistence of imperfect information across markets has contributed significantly to unsustainable production and consumption patterns. On the other hand, our examples illustrate how innovative entrepreneurs can develop solutions that help lead markets towards sustainability. As the collective knowledge of environmental degradation caused by unsustainable practices continues to grow, we are likely to see increasing pressure from policy makers, consumer groups, environmental activists, employees and others for firms to introduce innovative solutions to these problems in the hopes of stopping or even reversing environmental degradation patterns. In summary, entrepreneurial rents are available to ventures “discovering” opportunities that reduce information asymmetry with respect to environmental degradation.

In this section, we outlined our main arguments about market imperfections, environmental degradation and related entrepreneurial opportunities. Below, we articulate our arguments as four premises on the relationships between market imperfections and sustainable entrepreneurship. These premises are to serve as a first step toward developing propositions and testable hypotheses that further specify the relationship between market imperfections and the identification and exploitation of sustainable entrepreneurial opportunities.

Premise 1: *Significant and pervasive market imperfections related to efficiencies, externalities, pricing and information exist across multiple industries with respect to environmental concerns.*

Premise 2: *The existence of these pervasive natural-environment-related market imperfections generates numerous entrepreneurial opportunities (through identification, discovery and creation) in the marketplace.*

Premise 3: *The massive changes occurring in the natural environment, and a growing attention to, and understanding of, these changes redefine the institutional and natural environment of firms and their markets, thus generating additional opportunities in the marketplace.*

Premise 4: *Entrepreneurs identifying (recognizing, discovering and creating) and exploiting market imperfections with respect to the natural environment have the potential to achieve entrepreneurial rents.*

5. Future research directions

Below, we explore avenues for future research. Our suggestions focus on the continued study of the role of market imperfections for entrepreneurship on one hand, and on expanding the emerging field of sustainable entrepreneurship on the other hand.

5.1. Market imperfections

To date very little entrepreneurship research has explored how *externalities* (positive or negative) contribute to (or detract from) opportunity identification, exploitation and subsequent firm performance. For example, first movers in an industry may actually suffer from the resulting positive externality of identifying and exploiting an opportunity. This occurs because once an opportunity has been shown to be profitable, others will follow suit and the resulting diffusion of information regarding the opportunity benefits imitators who likely enter the market and compete away the entrepreneurial rents (Saravathy et al., 2003; Schumpeter, 1934). Recent research into network externalities has demonstrated the usefulness of the construct for entrepreneurship. Specifically, Bygrave and Minniti (2000) found that as concentrations of new ventures form in a geographic region, benefits accrue to other local ventures (current and future). This network externality was also confirmed in Neck et al. (2004) who found that as new and established technology ventures moved into a specific region (Boulder, Colorado), the supporting infrastructure for entrepreneurship (e.g. venture capital, entrepreneurial legal and tax advisors) increased, which then helped to spawn more growth in new venture activity.

Rather than being a ‘zero-sum’ game whereby one actor wins and another loses, *collaborative efforts* may actually generate positive externalities in terms of an expanded pool of entrepreneurial opportunities. For example, when an entrepreneur engages in opportunity “creation”, new industries may emerge. By creating markets where none existed, entrepreneurs may endogenously create opportunities not only for themselves but for others that follow. “Ends emerge endogenously within a process of interactive human action (based on heterogeneous preferences and expectations) striving to imagine and create a better world” (Saravathy et al., 2003, p. 155). One of the most important sources of entrepreneurial opportunities is the role of other entrepreneurs in a marketplace (Holcombe, 2003). Thus research should be conducted to identify under what contexts opportunities can be created through endogenous sources such as positive externalities.

Another stream of research, drawing on recent work on entrepreneurial cognitions, might examine the role of contextual variables like demographic factors, country of origin, or prior work experience affecting entrepreneurs in *identifying and exploiting* sustainable entrepreneurship opportunities. Transaction cognition theory, for example, suggests that entrepreneurs leverage a set of unique cognitions to create value deriving from market imperfections (Mitchell et al., 2003). Studies on the influence of different types of founders’ transaction cognitions (planning, promise, and competition) could increase our understanding of opportunity identification by founders of sustainable ventures.

In this paper, we focused on the role of market imperfections in leading to environmental degradation, and subsequently, to sustainable entrepreneurial opportunities. This leads to the broader question affecting entrepreneurship research in general, namely:

do market imperfections also create opportunities for traditional (as opposed to sustainable) new ventures, and if so, under what conditions?

Furthermore, in the face of rapidly changing technological, social and natural environments and global competition, it is important to look at other factors beyond market imperfections that can generate new opportunities. More broadly, what is the role of shifting institutional conditions (Lawrence et al., 2001) in changing the institutional landscape of entrepreneurial opportunities? Possible avenues could be to explore the role that government regulation and deregulation, changes in demographics and trends, or increased disposable income (e.g. China) play in generating entrepreneurial opportunities.

5.2. Sustainable entrepreneurship

While the determinants of new venture performance and survival constitute important research domains, the entrepreneurship field needs to go beyond the traditional strategic management focus, and include in its studies an examination of the *implications new venture creation has for social wealth* (Venkataraman, 1997). Finding the appropriate theoretical and operational dependent variable to adequately capture the role of new venture creation for social wealth creation is a formidable challenge. We argue that an appropriate dependent variable for sustainable ventures needs to be multi-faceted and needs to account for not only firm financial performance, but also measures of social wealth that consider the economic, social, and environmental impacts of new ventures (the so-called triple bottom line). Sustainability concepts thus may provide one solution to the dependent variable conundrum for entrepreneurship research. The work ahead then lies in finding ways to operationalize this three-pronged variable, and could draw on the growing number of country-level efforts to define such indicators (Smith, 2002; Buitenkamp et al., 1992).

Secondly, research streams would explore the relationship between *new venture creation and the triple bottom line*. The scientific evidence cited earlier indicates that our current trajectory is unsustainable. We argued that entrepreneurs are likely to be a critical force in enabling the world to change its path and to offer coming generations a sustainable future. Such research would need to bridge multiple levels of analysis.

Finally, while our analysis focused primarily on market opportunities for sustainable entrepreneurship, future work also needs to address additional *complexities of sustainable entrepreneurship*. Some of its inherent and at least partially intractable challenges are rooted in the characteristics of sustainable systems, which tend to be complex, dispersed, global, uncertain, interdependent and having long-term horizons. The challenge for sustainable entrepreneurial ventures is that they do not ‘just’ provide profits and jobs, but by definition they have an added requirement: innovations that result from sustainable entrepreneurial activity both lead to more sustainable ways of living, and displace current, unsustainable means. Recent promising work examines entrepreneurial innovations which produce radically new and sustainable technologies (Hart and Christensen, 2002; Prahalad and Hart, 2001). The question of just how sustainable entrepreneurship can provide the creative destruction of unsustainable practices and their replacement with sustainable technologies, business models and resulting lifestyles is bound to provide a fertile ground for rich and diverse research streams.

6. Conclusion

With this research, we hope to contribute to the literature in three ways. First, by examining the role of market imperfections in creating opportunities we begin to close knowledge gaps with respect to how entrepreneurial opportunities come into existence in the first place. Second, this study is one of the first to bring together two currently disparate fields, that of organizations and the natural environment, and that of entrepreneurship. Third, sustainable entrepreneurship is a very recent phenomenon, both in practice and as a topic of scholarly inquiry, and our paper offers a theoretical definition for this emerging field to build on. Research has been underway for some time examining the development of corporate “greening” initiatives and their impact on firm performance. However, much of this research is focused on incremental innovation through improvement of waste management practices or reducing the material and energy resources needed for production. We commend the efforts of researchers pursuing this line of research, as well as those established firms who put into action the idea that corporate greening makes financial sense and simultaneously contributes to improved environmental (and possibly social) performance. However, we see this as only a small piece of what is needed to move towards sustainable markets). By introducing the role of entrepreneurial innovations in addressing market imperfections in the environmental arena, we aim to contribute to the advancement of theory and practice on how the identification and exploitation of market imperfections in the natural environment leads simultaneously to the attainment of entrepreneurial rents and to more sustainable markets.

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