



Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective



Xaver Neumeier^{a,*}, Susana C. Santos^{b,c}

^a School of Entrepreneurship, College of Business and Public Administration, University of North Dakota, USA

^b Entrepreneurship and Innovation Center, Warrington College of Business, University of Florida, USA

^c Instituto Universitário de Lisboa (ISCTE-IUL), Business Research Unit (BRU-IUL), Lisboa, Portugal

ARTICLE INFO

Article history:

Received 25 October 2016

Received in revised form

21 August 2017

Accepted 29 August 2017

Available online 29 August 2017

Keywords:

Entrepreneurial ecosystems

Sustainable business models

Social networks

ABSTRACT

The successful adaptation and creation of sustainable entrepreneurial ventures significantly influences the ability to create more environmentally and socially integrated economic systems. Sustainable business models are a critical component towards this goal. However, the development of sustainable business models is a complex process that requires a supportive entrepreneurial ecosystem. Integrating literature on sustainable business models, network theory, and entrepreneurial ecosystems, we analyze the influence of organizational-level (venture types and venture tenure) and individual-level factors (types of network actors and their demographic characteristics) that influence the social network connectivity of ventures with sustainable and conventional business models. To this purpose, we modeled two municipal entrepreneurial ecosystems in the Southeast United States through a complex network of stakeholders (e.g. entrepreneurs, investors, institutional leaders) and analyzed the resulting social connectivity measures. Our results indicate that sustainable entrepreneurs were underrepresented when compared to conventional entrepreneurs, but that their networks were more densely connected. We also found that different social clusters emerged, based on type of venture and business model, venture tenure, type of network actor (e.g. entrepreneur or investor), or demographic characteristic. With this study, we contribute to the literature on entrepreneurial ecosystems and sustainable business models.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

In the last decade, interest in alternative economic systems that balance environmental, financial, and social outputs has steadily increased. One of the main criticisms of traditional economic models is the exclusive focus on efficient resource allocation, ignoring societal well-being and the carrying capacity of biological ecosystems (Daly and Farley, 2011). Ecological economists and environmental scientists have repeatedly pointed out that increased environmental degradation – be that the depletion of the coral reefs or the amazon forest – can trigger a cascade of social and political unrest, significantly impacting future food supplies, waste management, and the population's level of health (Grant et al., 2012; Hicks et al., 2016; Lu et al., 2015). To address this unsustainable rate of consumption of natural resources, the development

of new (economic) systems with an emphasis on sustainable practices, technologies and processes is necessary (Bocken et al., 2014; Jackson, 2011). Such a significant transition is inherently tensional and requires the participation of all relevant stakeholders (e.g. government bodies, large corporations, entrepreneurs, and consumers) to modify existing transaction and coordination devices.

The (sustainable) business model is one such device, “helps describing, analyzing, managing and communicating (i) a company's sustainable value proposition to its customers and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social and economic capital beyond its organizational boundaries.” (Schaltegger et al., 2016, p. 268). The growing interest in business models by researchers and practitioners since the dotcom boom of the late 90s, has led to a multitude of definitions, conceptualizations and new questions. Business models have been described as planning tools for entrepreneurs that help them think through all the core components of their ventures (Shane and Delmar 2004; Chesbrough and Rosenbloom, 2002); communication tools that

* Corresponding author.

E-mail addresses: xaver.neumeier@und.edu (X. Neumeier), susana.santos@warrington.ufl.edu (S.C. Santos).

help to rationally inform investment decisions (Landström, 1998; Doganova and Eyquem-Renault, 2009); or a component of ritualized practices and norms in specific venture contexts (e.g. technology entrepreneurs and venture capitalists) (MacMillan et al., 1986; Doganova and Eyquem-Renault, 2009; Colombo et al., 2010). Therefore, business models coevolve through the interactions between founder(s) and their social environment where resources and information are exchanged through intermediaries such as business plans, IOUs, and other written and verbal correspondences. Such entrepreneurial networks have been studied using different contexts and theoretical lenses. For example, in a study conducted by Singh et al. (1999), the majority of entrepreneurs identified new business ideas through their social network. Furthermore, in a study on nascent entrepreneurs' emerging networks, Grossman et al. (2012) found that age and gender similarity positively correlate with resource multiplexity. Although this network perspective has gained traction over the last decade, research on how (social) networks affect the development of business models in entrepreneurial ventures is still in its infancy. This is particularly true with sustainable business models that lack a theoretical grounding in network and ecosystems theory. To address this shortcoming, our study addresses two research questions: (1) What are the differences in social connectivity between sustainable and conventional business ventures in an entrepreneurial ecosystem? and (2) How do organizational and individual level factors, including business model archetypes shape the emergence of social clusters in entrepreneurial ecosystems? To answer these questions, we combine insights from literature on sustainable business models, network theory, entrepreneurial ecosystems and venture typologies to explore the social constructivist nature of sustainable business models. We also argue that entrepreneurial ecosystems are more than just high-growth/high-technology clusters, but complex adaptive systems of interdependent actors that engage in entrepreneurial activities to create economic, social, as well as environmental value.

Using this broader delineation, our entrepreneurial ecosystem consists of conventional and sustainable business models (Bocken et al., 2014; Aagaard and Lindgren, 2016; Seelos and Mair, 2005; Morris et al., 2005), different types of entrepreneurial ventures (Morris et al., 2015; Acs and Mueller, 2008; Robbins et al., 2000), and a demographically diverse set of entrepreneurs (e.g. gender, race and ethnicity), and public and private support structures and initiatives (e.g. incubators, small business loans).

To empirically assess this complex system of different stakeholders, we employ a social network lens. Our data analysis methodology combines individual- (outdegree, indegree, out-two-step, and betweenness centrality), and network-level metrics (multiplexity and density) to socially reconstruct an entrepreneurial ecosystem related to sustainable entrepreneurial ventures. Specifically, this approach will allow us to examine the social connectivity of sustainable businesses, but also detect the emergence of social clusters and how organizational and individual level factors influence their configurations.

The paper is organized in five sections. We start with a theoretical discussion on sustainable and conventional business models. This is followed by a review on entrepreneurial ecosystems and social networks, emphasizing network theory as the adequate framework to address our research questions. We then present the organizational and individual level factors that are relevant for the social connectivity of sustainable and conventional business models, leading to our conceptual model. We next present our multilevel study design, describing the participants and municipalities we selected. In the results section, we present our findings on the effect of organizational and individual level factors on social network connectivity of ventures with conventional and

sustainable business models. The discussion section then deliberates on the contributions and limitations of this study, followed by a summary of future research directions.

2. Theoretical background

2.1. Sustainable and conventional business models

Aligned with the perspective of entrepreneurship as the nexus between individuals and opportunities (Shane, 2003), sustainable entrepreneurship is broadly defined as the recognition, evaluation and exploitation of opportunities by individuals who create future products and services that have economic, social and ecological gains (Cohen and Winn, 2007; Patzelt and Shepherd, 2011). This so-called triple bottom line is the ideological foundation of many sustainable entrepreneurs, who reject the singular focus on financial profitability or revenue growth and instead build entrepreneurial ventures to address market imperfections or failures such as climate change (Cohen and Winn, 2007). Similar to traditional entrepreneurship, the core component of a sustainable venture is its business model (Morris et al., 2005).

Business models have been widely defined and discussed (see Zott et al., 2011), yet different definitions imply that they are a concept/representation/statement/method describing the value proposition (what value a company introduced to existing and potential customers), value creation (how the business is formulated to create value), value creation infrastructures and conditions (what are the resources, infrastructure and circumstances needed to create value), and how the financial value is maintained for the company (Osterwalder et al., 2005; Zott et al., 2011). With respect to the sustainability component of a business model, a variety of different research streams exist.

Stubbs and Cocklin (2008) developed a seminal study titled "Conceptualizing a 'Sustainability Business Model'" proposing a group of normative principles of organizational development that are ideally part of a sustainability-oriented business model. These principles include the organizational and cultural attributes of the firm (e.g. the community spirit, promoting employees' trust and loyalty, and participation in sustainability assessment and reports) and performance measures, organizational goals, and values guided towards sustainability.

Since then, subsequent studies emerged trying to clarify the attributes and components of sustainable business models, taking primarily a corporate point of view. For example, Hansen et al. (2009) put forward the model of the sustainability innovation cube to assess the effects of sustainability-oriented innovations. Later, Boons and Lüdeke-Freund (2013) discussed the interrelations between business models and sustainability innovation and proposed four basic elements of a sustainable business model: (1) value proposition of products and services should focus on ecological, social and economic value; (2) overall infrastructure and logistics of the business guided by the principles of sustainable supply chain management; (3) interface with customers enabling close relationships between customers and other stakeholders to improve co-responsibility in production and consumption; and (4) equal distribution of economic costs and benefits among all actors involved. Nowadays, definitions of sustainable business models are aligned with the triple bottom line approach (Milne and Gray, 2013).

The increased scholarly attention to sustainable business models has also led to the conceptualization of different archetypes. For example, in a systematic literature review on sustainability innovation and practices Bocken et al. (2014) synthesized eight different sustainable business model archetypes, that they further grouped into three types of business model innovation:

Table 1
Summary on the grouping and definition of the archetypes of sustainable business models (Bocken et al., 2014).

Grouping	Archetypes	Definition
Technological	Maximize material and energy efficiency Create value from 'waste'	"Do more with fewer resources, generating less waste, emissions and pollution." (p. 48) "The concept of 'waste' is eliminated by turning waste streams into useful and valuable input to other production and making better use of under-utilized capacity" (p. 49)
	Substitute with renewables and natural processes	"Reduce environmental impacts and increase business resilience by addressing resource constraints 'limits to growth' associated with non-renewable resources and current production systems" (p. 50)
Social	Deliver functionality rather than ownership	"Provide services that satisfy users' needs without having to own physical products" (p. 50)
	Adopt a stewardship role	"Proactively engaging with all stakeholders to ensure their long-term health and well-being" (p. 51)
Organizational	Encourage sufficiency Re-purpose the business for society/environment	"Solutions that actively seek to reduce consumption and production." (p. 52) "Prioritizing delivery of social and environmental benefits rather than economic profit (i.e. shareholder value) maximization, through close integration between the firm and local communities and other stakeholder groups" (p. 53)
	Develop scale-up solutions	"Delivering sustainable solutions at a large scale to maximize benefits for society and the environment" (p. 53)

technological, social and organizational. The technological grouping (Tech) includes three archetypes: (1) maximize material and energy efficiency; (2) create value from 'waste'; and (3) substitute with renewables and natural processes. The social grouping (Soc) includes: (4) deliver functionality rather than ownership; (5) adopt a stewardship role; and (6) encourage sufficiency. Finally, the organizational grouping integrates two archetypes: (7) re-purpose the business for society/environment; and (8) develop scale-up solutions (see Table 1). Despite the pertinence and relevance of these efforts to deepen our knowledge of sustainable business models, many areas of interest remain underdeveloped. Specifically, the question of how sustainable ventures and their business models are (socially) connected to their surrounding entrepreneurship (eco)system requires more attention.

2.2. Entrepreneurial ecosystems

Entrepreneurial ecosystems (e.g. Spigel, 2017; Malecki, 2011; Isenberg, 2010) is a promising theoretical framework that has been widely contributing to understand the context of agglomeration of individuals, businesses and other regulatory bodies in a given geographic area. Nevertheless, sustainable business models have been relatively under-researched in entrepreneurial ecosystems. In the next section, we delve into the entrepreneurial ecosystems framework using the social network perspective.

Entrepreneurial ecosystems are the adequate framework to study the interdependence and connection between the different actors interacting in the complex economic system, such as individuals, organizations, entities, local, regional and national institutions, policymakers and stakeholders in a regional context (Morris et al., 2015; Nambisan and Baron, 2013; Cohen, 2006). Starting with Moore's introduction to the term "ecosystem" in the context of competition dynamics (Moore, 1993), research on entrepreneurial (eco)systems has seen spikes of interest, generating a variety of conceptualizations that share many common features and components (Ács et al., 2014; Feld, 2012; Foster et al., 2013; Isenberg, 2010; Neck et al., 2004; Stam, 2015; Spigel, 2017). Common components identified are a supportive culture, (venture) capital, active networks of entrepreneurs, local government officials, and investors, the presence of universities and support services to name just a few (see Ács et al., 2014; Feld, 2012; Foster et al., 2013; Isenberg, 2010; Neck et al., 2004; Stam, 2015; Spigel, 2017). One critical but understudied aspect is the relational structure between the different stakeholders in an entrepreneurship ecosystem. This is especially relevant for sustainable ventures whose business models are often deviating from the "conventional"

norm of their local economic context (Cohen and Winn, 2007).

A promising avenue to analyze this complex system of stakeholders is social network theory. In entrepreneurship, research on personal networks dates back to the 1980s, where studies explored the role business and personal networks played in the start-up phase of a new venture (Birley, 1986; Johannisson, 1987). Since then, the research scope of many studies expanded to better understand the effect of strong (e.g. friends, family, or mentors) and weak ties (e.g. acquaintances), homophily (e.g., similar age or gender), and geographic proximity, on measures of entrepreneurship such as opportunity discovery, resource acquisition, gaining trust and legitimacy. Such social networks do not only contain human and institutional agents, but also instruments and tools related to the creation of business models (Doganova and Eyquem-Renault, 2009). Accordingly, the structure and composition of such networks will vary as a function of factors between the different levels in an entrepreneurship ecosystem. At the organizational level, the different types of ventures (e.g. early stage versus established; or high-growth versus lifestyle) can form separate social clusters (Neumeyer and Poncela-Casasnovas, 2016) that can affect the characteristics and "survivability" of conventional and sustainable business models. For example, traditional high-growth entrepreneurial ventures with highly scalable business models, often require the financial support of venture capitalists, who in turn require a set of verbal and written indicators of satisfactory product/market fit, customer growth, and return on investment (Bygrave, 1988; Chen et al., 2009; MacMillan et al., 1986). In contrast, sustainable entrepreneurial ventures will differ with respect to stakeholder composition, but also with respect to the types of measures of venture impact (Austin et al., 2006). Therefore, organizational level factors are expected to be relevant to understand the social network connectivity of sustainable and conventional business models in an entrepreneurial ecosystem. Similarly, individual level factors, such as gender, race and ethnicity, are also relevant in this picture. The gender-aware framework in entrepreneurship (Brush et al., 2009; De Bruin et al., 2006) has shown that compared to male entrepreneurs, female entrepreneurs are still facing significant hurdles in the process of achieving high growth and substantial success (Brush et al., 2004). To analyze the relational schema of the different stakeholders, network theory (e.g. Scott and Carrington, 2011) offers a multitude of measures, such as network density, multiplexity, modularity, (in- and out) degree centrality, betweenness centrality and K-step reachability. Table 2 provides a brief definition as well as examples of research studies using these measures. Accordingly, these multilevel factors need to be considered in the discussion of sustainable business

Table 2
Network measures to estimate and compare the structure of the entrepreneurial ecosystems.

Network measure	Definition	Previous empirical studies
Density	Measures the level of information exchange or coordination. Density will be based on two different types of ties: (1) instrumental (e.g. funding, evaluation, professional assistance) and (2) sociational (e.g. advice, friendship).	R&D spillovers (Meagher and Rogers, 2004); Entrepreneurial networks (Hansen, 1995)
Multiplexity	Measure of tie strength and level of relationship; interaction of exchanges within and across relationships	Entrepreneurs' networks (Blieemel et al., 2015); Adult friendships (Verbrugge, 1979)
Modularity	Measure to detect community structure. We use the Girvan-Newman algorithm (Newman and Girvan, 2003), to examine the number of partitions in our ecosystem network.	Pollination networks (Olesen et al., 2007); Banking ecosystems (Haldane and Robert, 2011); Ecological networks (Fletcher et al., 2013)
Degree centrality	Measure of an actor's (entrepreneur or other stakeholder) ties with other members or the ecosystem.	AIDS transmission (Borgatti, 1995); knowledge transfer in organizations (Tsai, 2001)
Betweenness centrality	Measures the level of brokerage of an actor. Nodes with a high level of betweenness centrality act as relays in the ecosystem.	Exploration of novel technologies (Gilsing et al., 2008); Collaboration networks (Abbasi et al., 2012)
K-step reachability	Level of connectivity of an actor.	Connectivity in industrial processes (Yang et al., 2014); Automatic control (Leondes, 1996)

model networks that we will reflect on deeper in the next section.

2.3. Factors influencing sustainable and conventional business models

2.3.1. Organizational level factors: venture types and tenure

The question of what an entrepreneurial venture is and how it is defined goes back to Schumpeter and his view of entrepreneurs as disruptive innovators that bring creative destruction to an economy (Fagerberg, 2003). This view is supported by many current scholars and practitioners that consider “ambitious” entrepreneurs (Gundry and Welsch, 2001) and high-growth ventures to be the foundational core of entrepreneurship (Shane, 2009; Acs, 2011; Stangler, 2010). There is no doubt that aggressive or high-growth ventures are making a significant impact by introducing dynamic breakthroughs, creating new markets, types of jobs and competencies, as well as raising the competitive level of an economy (Acs, 2011; Acs and Mueller, 2008; Shane, 2009; Stam et al., 2011). On the other hand, this view does not reflect the existing diversity of entrepreneurs, ventures, and business models that are present in current socio-economic systems. Ventures have been approached as being dynamic or disruptive (Miller and Friesen, 1977), having different configurations of technology, structure and strategy (Miles et al., 1978), incorporating unique decision making styles (Miller, 1983), and differing in the ability to manage growth (Sexton and Bowman-Upton, 1991). Others posit that a firm is entrepreneurial if it demonstrates a high entrepreneurial orientation, measured by amounts of innovativeness, risk taking and proactiveness demonstrated by the firm (Covin and Slevin, 1989; Miller and Friesen, 1983). These various conceptual and empirically-based attempts to characterize entrepreneurial firms generally suffer from lack of inclusivity or comprehensiveness, and/or fall short in terms of descriptive detail, relevance and applicability. This is also pertinent to sustainable entrepreneurial ventures and their business models that are often overlooked in entrepreneurship studies. To address this deficit, a recent study on venture typologies Morris et al. (2016) posited that entrepreneurial ventures can be separated along four different types: (1) survival, (2) lifestyle, (3) managed growth, and (4) high growth or aggressive growth. Table 3 presents the definition and characteristics of each type of venture according to Morris et al. (2016). Integrating this typology with the characteristics of sustainable business models, we also put forward the sustainability characteristics and examples of these four types of ventures.

Based on the diverse operational characteristics and resource needs (Foss et al., 2008) of each type of venture, we expect to see differences in the social network connectivity in an entrepreneurial ecosystem between sustainable and conventional business models.

Another relevant organizational level boundary is venture tenure. Venture tenure was found to moderate the relation between entrepreneurial orientation and new venture performance (Lumpkin et al., 2006), as well as to influence a new venture's technological learning (Dodgson, 1993) and international business activities (Brush and Vanderwerf, 1992). Venture age also impacts its organizational routine (Lu and Beamish, 2006); older ventures have more established routines and consequently can have a higher level of organizational inertia (Hannan and Freeman, 1984), but can also be more reluctant to learning in new environments (Sørensen and Stuart, 2000). Yet, younger ventures were found to have a learning advantage in international expansion (Autio et al., 2000). Thus, previous research points towards the fact that venture tenure has a relevant role on explaining new venture performance, growth and adaptability. As such, we also expect that venture tenure will have an impact on the social network connectivity in an entrepreneurial ecosystem between sustainable and conventional business models.

2.3.2. Individual level factors: types of network actors and demographic characteristics

Despite the organizational level factors that might influence the social connectivity of sustainable businesses, individual level factors are also relevant to be considered. First and foremost, the types of actors that are part of a network are important. Entrepreneurship is a socially constructed phenomenon (Downing, 2005; Fletcher, 2006; Aldrich and Martinez, 2010), where many core components of how entrepreneurial ventures are created such as opportunity recognition, financing or the creation of new (sustainable) business models are shaped by the social interactions between entrepreneurs and other actors in their environment (Kenney and Goe, 2004; Jack and Anderson, 2002; Doganova and Eyquem-Renault, 2009). This is especially relevant for (sustainable) business models that have been traditionally viewed as mere objects of venture planning and assessment. New research, however, has expanded this narrow view to emphasize how business models often act as “narrative and calculative devices” (Doganova and Eyquem-Renault, 2009, p. 1559) between a network of stakeholders involved in the venture creation process. As such, the degree of connectivity with entrepreneurs, government agencies, incubator or accelerator organization member, investor or a higher education organization member influences the social network connectivity of sustainable and conventional business models. Thus, we postulate that one of the individual level factors for sustainable business models is the access to different types of network actors.

That access often depends on demographics characteristics such

Table 3
The typology of entrepreneurial ventures: Definition, characteristics and sustainable characteristics.

Venture Types	Definition and characteristics	Sustainability characteristics and examples
Survival ventures	<ul style="list-style-type: none"> Often launched due to a lack of employment opportunities and are essentially necessity based; Operate in highly competitive, price-based markets; Entrepreneurs typically sell their labor in exchange for financial compensation – predominantly cash transactions; Have no formal premises and acquire customers through friends, family and door-to-door sales. 	<ul style="list-style-type: none"> Usually low or absent score on social and environmental sustainability; Example of an exception- Fair-Trade initiative that provides consumers with higher-quality coffee and the traditionally impoverished coffee farmers with a higher end market (De Pelsmacker et al., 2005).
Lifestyle ventures	<ul style="list-style-type: none"> Have more formalization than survival ventures, have a stable income stream, and make modest reinvestments to stay competitive; Seek to be part of the local (business) community; Examples are local restaurants, galleries, bars, or local non-profits. 	<ul style="list-style-type: none"> Social and environmental sustainability scores are low; they depend on founder preferences and values, but also on the value that their local community places on sustainable business models. Typical examples include non-profit ventures such as local thrift stores, shelters or radio/television channels
Managed growth ventures	<ul style="list-style-type: none"> Have a workable business model and seek stable growth over time, as reflected in occasional new product launches, periodic entry into new markets, steady expansion of facilities, locations, and staff, as well as the development of a strong local and regional brand; Ongoing business development guided by continuous reinvestment in these businesses but moderate regional growth. 	<ul style="list-style-type: none"> Implementation of sustainable business models will depend on the regional climate towards social and environmental outcomes; Prominent examples of managed-growth ventures with a business model stirred towards social and environmental outcomes are Berkeley Mills, Chris King, or Green Mountain Energy (Choi and Gray, 2008).
Aggressive/High growth ventures	<ul style="list-style-type: none"> Referred to as gazelles, these are often technology-based ventures with strong innovation capabilities that seek exponential growth and are funded by equity capital; The launch of these ventures is opportunity-driven, with the founders (often a team) seeking to create new markets; Their market focus is typically national or international, and they often become candidates for initial public offerings or acquisition; The probability of implementing a sustainable business model will depend on the founders' and stakeholders' interests and motivations, the local and regional climate towards sustainability (e.g. consumer behavior, government policies, etc.). 	<ul style="list-style-type: none"> Prominent examples of aggressive growth ventures with social and/or environmental outcomes are Sterling Planet, Honest Tea, or AgraQuest (Choi and Gray, 2008).

as gender, that are proxies for socioeconomic status (Anderson and Miller, 2003). With respect to the position and role of women entrepreneurs in entrepreneurship ecosystems, studies found that social capital is an essential part of the bootstrap phase and that network diversity positively affected the use of personal sources of funding (Carter et al., 2003). Others have claimed that women entrepreneurs network differently, preferring to connect with other women in order to circumvent informal social barriers (Smeltzer and Fann, 1989). With respect to sustainability, previous studies have found that women are more prompt in adopting sustainable strategies. Galbreath (2011) analyzed the corporate sustainability of Australian firms and found that having women on the board of directors was positively related to social responsiveness and the economic growth dimension of sustainability. Fernandez-Feijoo et al. (2014) also found that women on boards increase the levels of corporate social responsibility, supporting that there are gender-related issues in sustainability (Casimir and Dutilh, 2003). The literature offers a set of justifications that support the influence of gender on sustainability (entrepreneurship). First, demographic characteristics such as gender have been found to influencing founder identity, which in turn influences the type of venture an entrepreneur will build (Morris et al., 2016). Second, women are particularly proficient in problem solving, dealing with ambiguity, conflicts and uncertainty (Rosener, 1997), have a greater orientation towards supporting and maintaining relationships, are more willingly focusing on the needs of others rather than their own need (Brush, 1992), and thus might be better equipped to represent the needs of non-business stakeholders than men (Biggins, 1999). Therefore, women would be expected to help their ventures develop a sustainability strategy that actively integrates

sustainability values and procedures (Miles et al., 2009). Entrepreneurial networks can also differ across racial and ethnic lines (Lin, 2000). For example, previous research showed that immigrant entrepreneurs tend to primarily connect in similar ethnic business networks (Min et al., 1993), suggesting that gender and race can be important boundaries to entrepreneurship (Robinson et al., 2007). Grounded in these arguments, we postulate that gender, race and ethnicity influence the level of social network connectivity of sustainable businesses and their business models in entrepreneurship ecosystems.

In summary, we drew from three strands of literature – sustainable business models, network theory, and entrepreneurial ecosystems – to get a better understanding of how conventional and sustainable entrepreneurs socially mesh. Fig. 1 presents our conceptual model, including the organizational level factors (venture types and venture age) and the individual level factors (types of network actors and their demographic characteristics) that impact the social network connectivity of sustainable and conventional business models. In contrast to previous studies that framed sustainable business models as a part of an alternative economic system, we examined how sustainable entrepreneurs are positioned socially in two different municipal entrepreneurial (eco) systems, which are described in the next section.

3. Methodology

3.1. Context of the study

This study was conducted in two municipalities in the Southeast US, hereinafter referred as municipal ecosystem 1 (MEco1) and 2

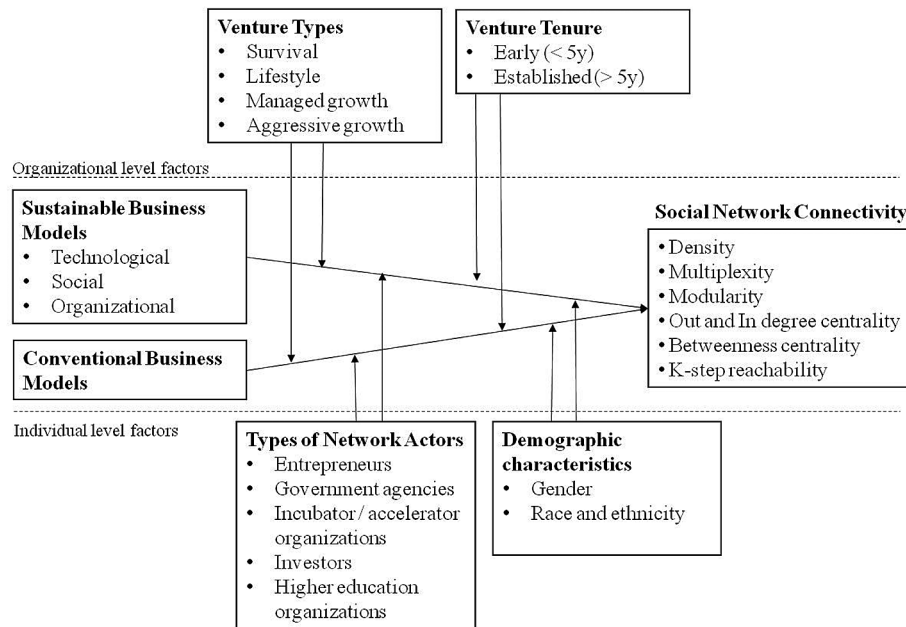


Fig. 1. Conceptual model on the organizational and individual level factors of sustainable business models.

(MEco2). The two municipalities are geographically proximate and have similar demographic and economic characteristics, as Table 4 demonstrates. As our focus is on sustainability, we also included an overview of selected sustainability indicators.

Municipal ecosystem 1 is smaller in land area (MEco1 61.31 miles² < MEco2 747 miles²) and population than municipal ecosystem 2, but they are similar on the economic and income indicators (see Table 4). Both MEco1 and MEco2 show also equivalent sustainability indexes on transportation, equity, economic development and income, as Table 4 shows.

3.2. Sampling strategy

Following a respondent-driven sampling procedure (Heckathorn, 1997; Weeks et al., 2002; Lu, 2013), we collected a total of 45 in-depth interviews from each municipality, comprising a total of 90 interviewees. All interviews were face-to-face, lasted about 45 min and were recorded. The researchers selected the initial set of interviewees and asked to provide referrals and introductions to new potential participants (Wejnert, 2010). Consequently, interviews were collected in multiple waves, starting with an initial seed of participants that represented entrepreneurs with sustainable business models, conventional business models and other stakeholders (e.g. government agencies, incubator/accelerator organizations, investors and higher education organizations).

Our initial group of participants included: three entrepreneurs with a sustainable business model; three entrepreneurs with a conventional business model; one entrepreneur from each type of venture (survival, lifestyle, managed-growth and aggressive growth); and four other stakeholders (from government agencies, incubator/accelerator organizations, investors and higher education organizations). This comprises an initial pool of fourteen participants in each municipal ecosystem. Using the referrals and introductions provided by this initial seed of participants, we reached 45 participants in each municipal ecosystem, totaling 90 interviewees.

3.3. Measures and data analysis procedure

The interview protocol included the following set of variables relevant to our conceptual model:

Sustainable business models: We asked entrepreneurs to describe their business model and subsequently categorized the information into the following three groupings: (1) Technological, (2) Social, and (3) Organizational; as well as the eight sustainable business model archetypes: (1) Maximize material and energy efficiency (MatEn), (2) Create value from waste (ValWas), (3) Substitute with renewables and natural processes (RenNat), (4) Deliver functionality rather than ownership (FunOw), (5) Adopt a stewardship role (Stew), (6) Encourage sufficiency (Suff), (7) Repurpose for society/environment (SocEnv), and (8) Develop scale up solutions (ScaleUp), that were developed by Bocken et al. (2014).

Venture types: Based on the venture typology developed by Morris et al. (2016), we categorized our sample into survival, lifestyle, manage growth or aggressive growth businesses;

Venture tenure: We asked participants how long their businesses have been operating, and subsequently coded their responses into two categories: (1) early stage – ventures have been operating less than five years; or (2) established – ventures have been operating for more than five years;

Types of network actors: We collected participants' information about their role and position in the entrepreneurship ecosystem (e.g. institutional leader, entrepreneur, investor);

Demographic characteristics: Collected information on gender, race and ethnicity of the interviewee;

Social Network connectivity: We collected participants' information about the nature of their interactions (instrumental and/or sociational), the number of referees and their personal history of entrepreneurship in order to capture their ties with the entrepreneurial ecosystem. We also collected information on common intermediaries used by the entrepreneurs and their stakeholders such as business plans, venture presentations, venture websites, business model canvases and other related documentation.

Each interview resulted in a set of nodes that could be

Table 4

Overview on the demographic, economic and sustainability indexes of the two municipal ecosystems as well as the US state located in the Southeast US.

	Municipal Ecosystem 1	Municipal Ecosystem 2	State in Southeast US
Geographic and demographic indicators			
Population, Census 2010 ^a	124,354	821,784	18,801,310
Population estimates 2016 ^a	131,591	880,619	20,612,439
Female persons, percent 2010 ^a	51.6%	51.5%	51.1%
Race and Ethnicity, percent, 2010 ^a			
White	64.9%	59.4%	75%
Black or African American	23%	30.7%	16%
Asian	6.9%	4.3%	2.4%
American Indian and Alaska Native,	0.3%	0.4%	0.4%
Hispanic or Latino	10%	7.7%	22.5%
Housing units, 2010 ^a	57,576	366,273	8,989,580
Land area (in square miles) ^a	61.31	747.00	53,624.76
Economic and income indicators			
GDP (2013) (per capita) ^b	\$38,577	\$41,752	\$38,321
Median household income (in 2015 dollars), 2011–2015 ^a	\$31,818	\$46,764	\$47,507
Per capita income in past 12 months (in 2015 dollars), 2011–2015 ^a	\$19,618	\$25,554	\$26,829
Business indicators			
Number of firms, 2012 ^a	9764	70,192	2,100,187
Men-owned firms, 2012 ^a	5038	33,828	1,084,885
Women-owned firms, 2012 ^a	3408	28,749	807,817
Minority-owned firms, 2012 ^a	2811	27,446	926,112
Nonminority-owned firms, 2012 ^a	6327	39,976	1,121,749
Number of venture capital firms ^c	3	3	~40–55
Venture capital investment (in \$ million) for 2014 ^c	7.4	5.1	866.5
Average rate of exits from 2003 to 2013 (in %) ^a	9.8	11.4	11.7
Average rate of entries from 2003 to 2013 (in %) ^a	11.4	13.7	13.8
Sustainability Indicators			
<i>Transportation</i>			
Commute mode share percentage (non-single-occupant vehicle) ^d	12.4%	4.9%	5.8%
Mean travel time to work (Minutes) ^d	20	26	26
Housing ^d			
Percent of households housing costs greater than 30% of income ^d	39.7%	41.4%	41.4%
<i>Equity</i>			
Poverty rate ^d	24.9%	16.9%	16.3%
Share of income held by top 5% of households ^d	24.3%	22.5%	23.6%
<i>Economic development</i>			
Unemployment ^d	8.6%	11.4%	11.7%
Share of population with a college degree ^d	40.5%	26.4%	26.4%
<i>Income</i>			
Median household income ^d	\$42,149	\$48,323	\$46,956

^a Source: census.gov.^b Source: Open Data Network.^c Source: Center for Venture Research.^d Sustainable Communities Hot Report - TheDataWeb, a partnership with the US Census Bureau.

subsequently assembled into a network representing a proxy for the entrepreneurial ecosystem. The resulting network of MEco1 and MEco2 contained 578 and 674 nodes respectively. We analyzed the data using UCINET, a specialized data analysis program for social networks (Borgatti et al., 1999). We examined the structure of the two municipal entrepreneurial ecosystems on a network and individual level using the six social network measures: (1) **Network density**, (2) **Multiplexity**, (3) **Modularity**, (4) **Degree centrality**, (5) **Betweenness centrality**, and (6) **K-step reachability** (see Table 2). These measures allowed us to describe the nature and distributions of relations among actors. We analyzed the formation of social clusters in MEco1 and MEco2 using the modularity score Q (Girvan and Newman, 2002; Newman and Girvan, 2004). Additionally, node-level regressions (e.g., Madden et al., 2011; Badar et al., 2013) were utilized to examine the influence of the organizational and individual level factors on the social network connectivity of sustainable and conventional businesses and their business models. In order to estimate and minimize the sampling bias, we computationally generated a population network based on our sample and compared it with existing network data from similar studies (Faust and Skvoretz, 2002; Wejnert, 2010; Ellison et al., 2007).

4. Results

4.1. General characteristics of MEco1 and MEco2

Table 5 describes the sample of interviewees and nodes for the two municipal ecosystems and provides an initial understanding on the distribution of our variables of interest. Unsurprisingly, our sample collected from both municipal ecosystems contained more entrepreneurial ventures with conventional business models than sustainable business models ($CBM_{MEco1} = 68\% > SBS_{MEco1} = 32\%$; $CBM_{MEco2} = 74\% > SBS_{MEco2} = 26\%$). Among the sustainable business models, 43% (MEco1) and 34% (MEco2) of business models belonged to the technological grouping, 33% (MEco1) and 34% (MEco2) belonged to the social grouping, and 24% (MEco1) and 32% (MEco2) belonged to the organizational grouping. Table 5 further shows the distribution of interviewees and nodes in the eight archetypes of sustainable business models.

At the organizational level, the majority of ventures were managed-growth ($ManagedGrowth_{MEco1} = 32\%$; $ManagedGrowth_{MEco2} = 38\%$) and lifestyle ($Lifestyle_{MEco1} = 27\%$; $Lifestyle_{MEco2} = 35\%$), whereas survival ventures made up the smallest

Table 5
Descriptive characteristics of the MEco1 and MEco2.

		MEco1%		MEco2%		
		Interviewees N = 45	Nodes N = 578	Interviewees N = 45	Nodes N = 624	
Sustainable Business Models	Sustainable Business Models	32	36	26	31	
	Conventional Business Model	68	64	74	69	
	Tech	MatEn	12	10	8	12
		ValWas	15	13	14	16
		RenNat	16	14	12	11
	Soc	FunOw	11	16	8	10
		Stew	12	13	13	11
		Suff	10	11	13	14
	Org	SocEnv	11	9	17	10
		ScaleUp	13	14	15	16
Venture Types						
Organizational level boundaries	Aggressive growth	24	19	16	17	
	Managed growth	32	29	38	33	
	Lifestyle	27	37	35	29	
	Survival	17	15	11	21	
	Venture Tenure					
	Early-Stage	57	49	52	47	
	Established	43	51	48	53	
	Types of Network Actors					
	Entrepreneurial ventures	48	36	40	35	
	Government agencies	15	19	17	16	
Incubator/Accelerator organizations	12	13	22	18		
Investors	10	12	12	16		
Higher education organizations	15	20	9	15		
Individual level boundaries	Gender					
	Male	53	60	57	62	
	Female	47	40	43	38	
	Race and Ethnicity					
	African American	22	15	17	20	
	White	59	50	54	48	
	Asian	9	13	15	18	
	Hispanic	5	12	8	6	
	Mixed	3	7	4	5	
	Other	2	3	2	3	

Note. Tech– Technological grouping; MatEn– Maximize material and energy efficiency; ValWas– Create value from waste; RenNat = Substitute with renewables and natural processes; Soc– Social grouping; FunOw– Deliver functionality rather than ownership; Stew– Adopt a stewardship role; Suff– Encourage sufficiency; Org– Organizational grouping; SocEnv– Repurpose for society/environment; ScaleUp– Develop scale up solutions.

group. With respect to venture tenure, we found early-stage ($\text{EarlyStage}_{\text{MEco1}} = 57\%$; $\text{EarlyStage}_{\text{MEco2}} = 52\%$) and established ventures ($\text{Established}_{\text{MEco1}} = 43\%$; $\text{Established}_{\text{MEco2}} = 48\%$) were represented about equally in our sample.

With respect to the individual level variables, our sample mostly consisted of actors from entrepreneurial ventures ($\text{Entrepreneurs}_{\text{MEco1}} = 48\%$; $\text{Entrepreneurs}_{\text{MEco2}} = 40\%$), government agencies ($\text{Gov}_{\text{MEco1}} = 15\%$; $\text{Gov}_{\text{MEco2}} = 17\%$) and incubator and accelerator organizations ($\text{Incub}_{\text{MEco1}} = 12\%$; $\text{Incub}_{\text{MEco2}} = 22\%$). Furthermore, our sample was gender balanced, containing slightly more male participants ($\text{Male}_{\text{MEco1}} = 53\%$; $\text{Male}_{\text{MEco2}} = 57\%$) than female. With respect to race, the vast majority of our participants were white, followed by African Americans ($\text{White}_{\text{MEco1}} = 59\%$; $\text{White}_{\text{MEco2}} = 54\%$; $\text{AfricanAmerican}_{\text{MEco1}} = 22\%$; $\text{AfricanAmerican}_{\text{MEco2}} = 17\%$).

Table 6
Network densities in MEco1 and MEco2.

All	MEco1	MEco2
	0.22	0.18
Conventional Entrepreneurs		
Instrumental	0.17	0.15
Sociational	0.15	0.12
Sustainable Entrepreneurs		
Instrumental	0.34	0.27
Sociational	0.23	0.17

4.2. Social network connectivity characteristics of MEco1 and MEco2

Network density measures the level of connectivity between the nodes in the ecosystem. Our results indicate that MEco1 showed a higher level of connectivity than MEco2 ($\text{MEco1} = 0.22 > \text{MEco2} = 0.18$) (see Table 6). When comparing the network density of sustainable and conventional entrepreneurs, we found that sustainable entrepreneurs were more connected. This pattern could be found for both types of ties (instrumental and/or sociational). Specifically, the results of the network density of instrumental ties (e.g., funding, evaluation or professional assistance) among sustainable entrepreneurs in both ecosystems was higher than for conventional entrepreneurs (Instrumental ties: $\text{MEco1 SustEntrep} = 0.34 > \text{ConvEntrep} = 0.17$; $\text{MEco2: SustEntrep} = 0.27 > \text{ConvEntrep} = 0.15$). A similar pattern of results was found for the network density of sociational ties (e.g. friendship or advice based relations). The network density of sociational ties among sustainable entrepreneurs in both municipal ecosystems was higher than for conventional entrepreneurs (Sociational ties: $\text{MEco1 SustEntrep} = 0.23 > \text{ConvEntrep} = 0.15$; $\text{MEco2: SustEntrep} = 0.17 > \text{ConvEntrep} = 0.12$). When comparing instrumental and sociational ties, we found that networks that were based on instrumental ties (e.g. work- or assistance related) showed higher degrees of density than networks based on sociational (e.g. friendship) ties.

Multiplexity measures the tie strength and thus the overall

strength of the relationship between two actors. We measured multiplexity following the procedures suggested by Skvoretz and Agneessens (2007) and Agneessens and Skvoretz (2012), and compared the observed number of ties with the maximum number of pairs expected under a chance model. This approach has also been used in other empirical studies that analyzed the structure of intraorganizational networks (Lee and Lee, 2015), or knowledge transfer in an organization (Aalbers et al., 2014).

The results of the multiplexity analysis (Table 7) showed that in both municipal ecosystems observed multiplexity is higher among sustainable entrepreneurs than conventional entrepreneurs (MEco1: SustEntrep = 133 > ConvEntrep = 117; MEco2: SustEntrep = 113 > ConvEntrep = 67). Moreover, we found that the presence of multiplex ties is significant for sustainable entrepreneurs in both MEco1 and MEco2 (MEco1 = 150, $p < 0.05$; MEco2 = 127, $p < 0.01$). As multiplexity is also an indicator for relationship strength, the results suggest that sustainable entrepreneurs are more strongly connected than conventional entrepreneurs.

Another important aspect of entrepreneurial ecosystems is the formation of clusters. To examine the formation of social clusters, we computed and ranked the modularity score Q using the Girvan-Newman (GN) algorithm. Based on the modularity scores, the optimal number (with respect to the statistical fit) of clusters (or communities) is two for the MEco1 ($Q = 0.644$), and three for the MEco2 ($Q = 0.505$) (see Table 8).

Tables 9 and 10 describe the resulting cluster configurations for MEco 1 and MEco2 in more detail. In MEco1, the majority of ventures (72%) with a sustainable business model as well as aggressive- (63%) and managed-growth (55%) ventures are located in cluster 1. Furthermore, the majority of early-stage ventures are located in cluster 1 (77%). Among the sustainable business models, the majority of the technologically-oriented archetypes (MatEn = 59%; ValWas = 55%; RentNat = 63%), one social grouping archetype (FunOw = 53%) and one organizational grouping archetype (ScaleUp = 71%) are represented in cluster 1. Furthermore, the majority of network actors affiliated with government agencies (52%), incubator/accelerator organizations (67%), investment organizations (73%), and higher education organizations (56%) are located in cluster 1. Not surprisingly, most male actors (54%) were located in cluster 1.

Cluster 2 is characterized by two sustainable business archetypes from the social grouping (Stew = 66%; Suff = 69%) and one sustainable business archetype from the organizational grouping (SocEnv = 58%). Furthermore, the majority of conventional business models were located in cluster 2. With respect to venture type, the majority of lifestyle (59%) and survival (76%) ventures, as well as the majority of established ventures (62%) were located in cluster 2. With respect to gender, race and ethnicity, we found that the majority of women, and respondents with African-American, Hispanic, and Asian racial and ethnic background were located in cluster 2.

Table 10 shows the three clusters that emerged in MEco2. The majority of ventures with sustainable (58%) and conventional (38%) business plans were located in cluster 1. Among the sustainable

Table 7
Multiplexity analysis in MEco1 and MEco2.

	Observed Multiplexity	Maximum (based on total ties)
Conventional Entrepreneurs		
MEco1	117	180
MEco2	67	109
Sustainable Entrepreneurs		
MEco1	133	150*
MEco2	113	127**

* $p < 0.05$, ** $p < 0.01$.

Table 8
Ranking of modularity in MEco1 and MEco2.

Rank	MEco1		MEco2	
	# of clusters	Q	# of clusters	Q
1	2	0.644	3	0.505
2	3	0.387	4	0.363
3	4	0.231	2	0.278
4	6	0.189	5	0.155
5	5	0.111	7	0.098

business models, cluster 1 contained the majority of technologically-oriented business model archetypes from the technological grouping (MatEn = 62%; ValWas = 56%; RenNat = 70%), one archetype from the social grouping (FunOw = 47%) and one archetype from the organizational grouping (ScaleUp = 61%). With respect to venture type, cluster 1 contained the majority of aggressive- (59%) and managed-growth (55%) ventures, as well as the majority of early stage (73%) ventures. As for individual level variables, cluster 1 contained the majority of male respondents (45%) as well as participants affiliated with incubators/accelerators (75%), investment (73%) and higher education organizations (61%). Cluster 2 included the majority of two sustainable business model archetypes from the social grouping (Stew = 46%; Suff = 44%), as well as the majority of lifestyle (54%) and established ventures (52%). This cluster also contains the majority of female participants as well as the majority of the participants with African-American, Hispanic, and Asian racial and ethnic background. Cluster 3 contains the majority of ventures with sustainable business models that aim to re-purpose the business for society/environment (SocEnv = 63%) as well as the majority of survival ventures (67%).

Overall, MEco1 and MEco2 showed comparable distributions of their first and second clusters with respect to sustainable business model archetypes, as well as organizational level and individual level variables. The emergence of a third cluster in MEco2 shows that this municipal ecosystem is more compartmentalized than MEco1. One possible explanation is the differences in geographic area which can subsequently lead to more dispersity and segregation.

Finally, we computed a node-level OLS regression analysis for each municipal ecosystem (Table 11). Results indicate that entrepreneurs with sustainable business models are significantly less connected than their conventional counterparts in MEco1 (Outdegree centrality = -1.094^{**} ; Indegree centrality = -1.146^*) and MEco2 (Outdegree centrality = -1.028^* ; Indegree centrality = -1.115^*). Survival venture entrepreneurs are also significantly less connected than entrepreneurs of aggressive-growth ventures in both municipal ecosystems (Outdegree centrality_{MEco1} = -2.222^{**} ; Indegree centrality_{MEco1} = -1.567^{**} ; Outdegree centrality_{MEco2} = -1.064^* ; Indegree centrality_{MEco2} = -1.237^*). We could not find statistically significant differences between entrepreneurs of aggressive-growth and any other type of venture. Concerning venture tenure, we found that entrepreneurs of early stage ventures, were significantly less connected than entrepreneurs of established ventures in MEco1 (Indegree centrality = -1.462^{**}) as well as MEco2 (Indegree centrality = -1.359^{**}). The effect of gender was also found to be significant, showing that women are less connected than men in both MEco1 and MEco2 (Outdegree centrality_{MEco1} = -1.077^* ; Indegree centrality_{MEco1} = -2.539^{***} ; Indegree centrality_{MEco2} = -1.041^*). However, results also showed that female entrepreneurs in MEco1 had higher levels of betweenness centrality than their male counterparts, indicating that they bridge different parts of the ecosystem. With respect to race and ethnicity, we found that in MEco1 black and hispanic

Table 9
Rank 1 cluster configuration for MEco1.

	Variable	Category	Cluster 1 (in %)	Cluster 2 (in %)	
Sustainable Business Models	Conventional Business Model		48	52	
	Sustainable Business Model		72	28	
	Technological grouping	MatEn		59	41
		ValWas		55	45
		RenNat		63	37
Social grouping	FunOw		53	47	
	Stew		34	66	
	Suff		31	69	
	Organizational grouping	SocEnv		42	58
Organizational level boundaries	Venture Types	ScaleUp		71	29
		Aggressive growth		63	37
		Managed growth		55	45
		Lifestyle		41	59
		Survival		24	76
Individual level boundaries	Venture Tenure	Early		77	23
		Established		38	62
	Type of Network Actors	Entrepreneurial ventures		49	51
		Government agencies		52	48
		Incubator/Accelerator org.		67	33
		Investment org.		73	27
	Gender	Higher education org.		56	44
		Male		54	46
	Race and Ethnicity	Female		45	55
		White		57	43
Black			40	60	
Asian			33	67	
Hispanic			29	71	
	Mixed		35	65	

Table 10
Rank 1 cluster configuration for MEco2.

	Variable	Category	Cluster 1 (in %)	Cluster 2 (in %)	Cluster 3 (in %)	
Sustainable Business Models	Conventional Business Model		38	33	29	
	Sustainable Business Model		58	31	11	
	Technological grouping	MatEn		62	25	13
		ValWas		56	30	14
		RenNat		70	21	9
Social grouping	FunOw		47	35	18	
	Stew		33	46	21	
	Suff		29	44	27	
	Organizational grouping	SocEnv		12	25	63
Organizational level boundaries	Venture Types	ScaleUp		61	26	13
		Aggressive growth		59	29	12
		Managed growth		55	31	14
		Lifestyle		22	54	24
		Survival		7	26	67
Individual level boundaries	Venture Tenure	Early		73	20	7
		Established		25	52	23
	Type of Network Actors	Entrepreneurial ventures		37	43	20
		Government agencies		44	38	18
		Incubator/Accelerator org.		75	12	13
		Investment org.		73	27	0
	Gender	Higher education org.		61	24	15
		Male		45	34	21
	Race and ethnicity	Female		26	48	26
		White		60	27	13
Black			33	50	17	
Asian			42	31	27	
Hispanic			29	45	26	
	Mixed		23	53	24	

stakeholders are significantly less connected than their white counterparts. No such differences could be found in MEco2.

5. Discussion

5.1. Theoretical and empirical contributions

Entrepreneurial ventures with sustainable business models are

still more of a prospective value than a reality (Earley, 2016). New sustainable ventures confront the challenge of establishing their legitimacy in entrepreneurship/business ecosystems that are often dominated by conventional economic outputs such as revenue growth and profit. The focus on sustainability serves as both a source of competitive advantage and as a liability for new ventures. Sustainability orientation serves as a source of advantage in that sustainable ventures address challenges and create environmental

Table 11
Subgroup differences: OLS Regression coefficients.

	Outdegree centrality	Indegree centrality	Out 2-step reach centrality	Betweenness centrality
MEco1 Business model type^a				
Sustainable	-1.094*	-1.146*	-1.480**	0.807
Venture type differences^b				
Managed growth	-0.412	-0.524	-0.206	-0.421
Lifestyle	-0.317	-0.543	-0.538	-0.265
Survival	-2.222***	-1.567**	-1.619**	-1.772**
Venture Tenure differences^c				
Early	-0.630	-1.462**	-1.233*	-1.391**
Gender differences^d				
Female	-1.077*	-2.539***	-1.322**	1.694*
Ethno-racial differences^e				
Black	-0.666	-0.578	-1.267**	-2.043***
Asian	-0.487	-0.350	-0.444	-0.581
Mixed	-0.338	-0.229	-1.101*	-0.894
Hispanic	-0.599	-0.315	-0.686	-1.165*
MEco2 Business model type^a				
Sustainable	-1.028*	-1.115*	-0.704	0.686
Venture type differences^b				
Managed growth	-0.297	-0.466	-0.323	-0.578
Lifestyle	-0.473	-0.700	-0.514	-0.406
Survival	-1.064*	-1.237*	-0.759	-1.291**
Venture Tenure differences^c				
Early	-0.879	-1.359**	-1.600**	-1.199**
Gender differences^d				
Female	-0.923	-1.041*	-1.250*	1.340*
Ethno-racial differences^e				
Black	-0.536	-0.670	-0.301	-0.222
Asian	-0.227	-0.555	-0.270	-0.351
Mixed	-0.168	-0.243	-0.393	-0.299
Hispanic	-0.490	-0.181	-0.266	-0.542

*p < 0.05, **p < 0.01, ***p < 0.001.

^a Dummy-coded variable, with “conventional business model” as reference category.

^b Dummy-coded variable, with “aggressive-growth” as reference category.

^c Dummy-coded variable, with “established” as reference category.

^d Dummy-coded variable, with “male” as reference category.

^e Dummy-coded variables, with “white” as reference category.

and societal value where other market participants often fail (Muñoz and Dimov, 2015), thereby occupying a “defendable” market niche. But, sustainability orientation is also a liability because the lack of familiarity with what constitutes a sustainable business model serves as a burden when acquiring resources from potential stakeholders in the ecosystem. To overcome this “validity” burden, sustainable entrepreneurs engage in various approaches including partnering with a diverse set of better-known organizations, resource leveraging, value creation, creative problem solving, and building and using networks (Morris et al., 2013). Social connectivity, in particular, is an important metric to understand how sustainable ventures and their business models are positioned in an entrepreneurship ecosystem. However, research in this area is still in its early stages. Our study addressed this shortcoming by examining the social network connectivity of sustainable and conventional ventures. With respect to our first research question (What are the differences in social connectivity between sustainable and conventional business ventures in an entrepreneurial ecosystem?) we found a social disconnect between different types of (sustainable) ventures. Our results indicate the emergence of different social clusters within each of the municipal ecosystem we examined. Sustainable and conventional business models were not in different clusters *a priori*, but they were segregated based on the types of venture, venture age, type of actors they are connected with, gender, and ethnicity and race. Ventures with different sustainable business models archetypes are segregated by organizational and individual level factors. On the one hand,

technologically-oriented sustainable business model archetypes (focused on maximizing the material and energy efficiency; creating value from ‘waste’; and substituting with renewables and natural processes) as well as archetypes that develop scale-up solutions were mainly associated with aggressive- and managed-growth ventures as well as incubators, higher-education institutions and risk capital. On the other hand, socially-oriented sustainable business archetypes (focused on adopting a stewardship role and encouraging sufficiency) and archetypes that repurpose for society/environment were predominantly associated with lifestyle and survival ventures. With respect to our second research question (How do organizational and individual level factors, including business model archetypes shape the emergence of social clusters in entrepreneurial ecosystems?), we found that female and minority entrepreneurs are faced with an access gap when it comes to ventures with technologically-oriented sustainable business model archetypes and archetypes related to developing scale up solutions. In contrast, no such gap could be found for sustainable business model archetypes related to repurposing for society/environment, adopting a stewardship role and encouraging sufficiency. This pattern is congruent with previous research on social partitions in entrepreneurial ecosystems (Neumeier and Poncela-Casasnovas, 2016) as well as conventional high-growth technology businesses, where women and minority entrepreneurs are often underrepresented (Greene et al., 2001; Harrison and Mason, 2007). This also reinforces scholarly work showing that women are more alert towards social contributions on their businesses (Brush, 1992). Furthermore, gendered norms surrounding (high-growth) entrepreneurship can marginalize the perspectives of female and minority entrepreneurs (Ahl and Marlow, 2012; Calas et al., 2009) and ultimately hinder the adoption rates of technologically-oriented sustainable business model archetypes. While prior research attributed this gap to the lack of (social) access to venture capital, we suggest that access is also limited to other parts of the high-growth venture “supply chain”, such as incubators or accelerators.

Another interesting finding was that female stakeholders showed significantly higher scores of betweenness-centrality than their male counterparts, indicating that they could serve as a “bridge” connecting different parts of the entrepreneurial ecosystem. Although this finding was unexpected, we think that a potential explanation lies in the weak-tie theory (Milroy and Milroy, 1993). It postulates that lower status second-order actors (e.g. racial minorities) act as network interfaces due to their need to compensate for their lower social status that often results in lower ties with high-status members. Similarly, we hypothesize that female stakeholders need to compensate for their lower status by developing weaker ties than their male counterparts and therefore gain a position of influence. Therefore, providing more targeted resources for female stakeholders to develop sustainable businesses could help support the transformation of conventional to sustainable entrepreneurial ecosystems.

Yet, the results of our density and multiplexity analyses showed that the social networks of entrepreneurs that engaged in sustainable business models showed a higher degree of density (were more connected) than entrepreneurs with conventional business models. This result is interesting and suggests that, despite constituting a minority, sustainable ventures operate in stronger-tie networks than conventional ventures. This finding also suggests that ventures that create sustainable business models develop unique structures, procedures and strategies, promoting in-group support and a pronounced value system.

Our results also depict entrepreneurial ecosystems as an agglomeration of social clusters with deviating compositions and properties, expanding current conceptualizations (Spigel, 2017;

Stam et al., 2011). This would suggest that entrepreneurial practices and beliefs in these clusters vary significantly from the normative underpinnings described in the research literature. This is particularly relevant for future studies on sustainable business models and circular economies that have neglected the social embeddedness of sustainable entrepreneurial ventures (Geng and Doberstein, 2008; Park et al., 2010; Bohnsack et al., 2014).

Lastly, our choices with respect to study design and methodology provided a bridge between scholarly work on complex systems, sustainable business models and entrepreneurial ecosystems. Given that the empirical development of (sustainable) entrepreneurial ecosystems is still at an early stage, our approach offered empirical insights to develop an assessment framework that is not exclusively relying on macroeconomic data. Specifically, our approach offers the possibility to examine how hard-to-reach entrepreneurial networks (e.g. sustainable entrepreneurs) interface with other areas of the entrepreneurial ecosystem. Research has predominantly focused on developing single scale views of entrepreneurship. The unit of analysis is the entrepreneur or the entrepreneurial firm, with only a few notable exceptions (DiPrete and Forristal, 1994; Moliterno and Mahony, 2011). Our research breaks new ground in that it combines network measures with organizational and individual-level variables to characterize the social position of conventional and sustainable entrepreneurs in entrepreneurial ecosystems. Moreover, the use of node-level regression allowed us to quantify if the roles and positions of traditionally under researched groups such as minorities and women differed significantly from male and non-minority entrepreneurs, building and expanding current social network analysis methods (Newman and Girvan, 2004; Salganik and Heckathorn, 2004).

5.2. Limitations and future research avenues

We recognize several important limitations of our study. First, the sample is limited in size and geographic scope. Although we included a broad sample of demographic and firm-level variables were collected, expanding the geographic scope could provide critical insights into how sustainable business model archetypes are socially connected in economic systems. Secondly, our sample data was collected using respondent-driven sampling, which is time-consuming, not scalable and strongly dependent on the quality and quantity of information that can be extracted from the initial set of seed nodes. However, due to the lack of large, standardized social network datasets available for entrepreneurial ecosystems, this procedure represents the state of the art. On a related note, due to time and resource constraints, our data is cross-sectional and does not contain multiple time points. Social networks are dynamic, live entities, and the creation and maintenance of a relational tie will vary with time. Therefore, in order to address the shortcomings of our sampling method as well as the lack of different time points, future studies need to create longitudinal social network datasets. One promising avenue is to acquire data from social media sites such as LinkedIn, Twitter, Kickstarter, or Facebook and analyze the characteristics of sustainable venture networks over time.

Third, the emergence of sustainable business models in an entrepreneurial ecosystem is still an underdeveloped research stream, and thus we took an exploratory perspective. The organizational and individual level variables included in this study do not cover the entire spectrum of relevant constructs that are part of an entrepreneurial ecosystem and that might influence sustainable business models. Future research should focus on other relevant domains of the sustainable entrepreneurial ecosystem, and include variables such as human capital, culture, markets, policy and

finance (see Isenberg, 2011).

Finally, research on sustainable entrepreneurial ecosystems that are defined as “an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures” (Cohen, 2006, p.3), is still in its infancy. Therefore, we suggest the following areas for future research:

- (a) Components – Do sustainable and conventional entrepreneurial ecosystems share the same components? Understanding how the creation of environmental, social and economic value is traduced in a community or region, and the role that different stakeholders play in this complex economic (eco)system (e.g., role of universities and higher education institutions; government agencies and policy makers; public and private support systems; financing institutions, among others) are areas that deserve more attention;
- (b) Norms and values – What are the formal and informal rules that define membership in sustainable entrepreneurial ecosystems? Although norms on conventional entrepreneurial characteristics (Gartner, 1988; Shane and Venkataraman, 2000; Ahl and Marlow, 2012) are well known and established, research on how norms and values of sustainability can be spread in an entrepreneurship ecosystem require more attention;
- (c) Success factors and measurement – How can we define success in sustainable entrepreneurial ecosystems? And how can we measure and assess sustainable entrepreneurial ecosystems? Scholarly research on conventional entrepreneurship ecosystems has focused on economic outputs such as revenue and customer growth or profitability. However, as the triple bottom line (Milne and Gray, 2013) has become the reference for sustainable ventures, more research needs to be devoted exploring outcomes for sustainable entrepreneurship ecosystems as well.
- (d) Digitalization and online sources – So far, and to our best knowledge, scholarly research has focused on physical boundaries of entrepreneurship ecosystems (Spigel, 2017; Stam, 2015). Yet, entrepreneurial ecosystems nowadays are also present in the online world, and networks are built physically and virtually. Therefore, digitalization opens new pathways for sustainability (Seele and Lock, 2017), that will also affect the characteristics of sustainable entrepreneurial ecosystems. Prominent examples include the emergence of online social networks such as zerofootprint.net, markemesustainable.com, or change.org.

6. Conclusions

The model linking sustainable business model archetypes with social connectivity as well as individual- and organizational-level factors presented here incorporates ideas from the sustainability, entrepreneurship and network theory literature. The integration of ideas from these different literature lays a foundation for a more nuanced understanding of the way different types of sustainable business models are socially embedded in entrepreneurship ecosystems. The model allows us to consider how different individual- and organizational-level factors such as gender, ethnicity, race, or venture type affect the role and position of stakeholders in sustainable entrepreneurship.

Although our model was tested exclusively in the Southeast US, it can be applied to any geographical context, providing policy makers with a tool to assess sustainable entrepreneurial activities in local and regional ecosystems and foster economic diversity and

inclusion. While efforts to establish sustainability principles and measures in the wider economy are ongoing (e.g. clean energy funds, the EU's 2030 Agenda for Sustainable Development), the majority of these efforts targets certain venture types that have a history of underrepresentation with respect to female and minority entrepreneurs. Therefore, our model supports the implementation of public policies that target a broad spectrum of sustainable ventures and their business model archetypes. Entrepreneurship is strongly shaped by its social context (Downing, 2005) and we put forward that the same is true for sustainable business ventures.

Therefore, our study calls for the social integration of sustainable businesses by actively supporting the formation of bi-directional ties between stakeholder networks of conventional and sustainable businesses. We truly hope that these insights invite scholars in the field to further study the interactions between the social structure of entrepreneurial ecosystems and the emergence of sustainable business models.

References

- Aagaard, Annabeth, Lindgren, Peter, 2016. Understanding and evaluating the levels of sustainability in business models over time and across dimensions. *Long Range Plan.*
- Aalbers, Rick, Dolfma, Wilfred, Koppius, Otto, 2014. Rich ties and innovative knowledge transfer within a firm. *Br. J. Manag.* 25 (4), 833–848.
- Abbasi, Alireza, Hossain, Liaquat, Leydesdorff, Loet, 2012. Betweenness centrality as a driver of preferential attachment in the evolution of research collaboration networks. *J. Inf.* 6 (3), 403–412.
- Acs, Zoltan J., 2011. 6 High-Impact Firms: Gazelles Revisited. In: *Handbook of Research on Entrepreneurship and Regional Development: National and Regional Perspectives*, vol. 133.
- Acs, Zoltan J., Autio, Erkkko, Szerb, László, 2014. National systems of entrepreneurship: measurement issues and policy implications. *Res. Policy* 43 (3), 476–494.
- Acs, Zoltan J., Mueller, Pamela, 2008. Employment effects of business dynamics: mice, gazelles and elephants. *Small Bus. Econ.* 30 (1), 85–100.
- Agneessens, Filip, Skvoretz, John, 2012. Group differences in reciprocity, multiplexity and exchange: measures and application. *Qual. Quant.* 46 (5), 1523–1545.
- Ahl, Helene, Marlow, Susan, 2012. Exploring the dynamics of gender, feminism and entrepreneurship: advancing debate to escape a dead end? *Organization* 19 (5), 543–562.
- Aldrich, Howard E., Martinez, Martha A., 2010. Entrepreneurship as Social Construction: a Multilevel Evolutionary Approach. In: *Handbook of Entrepreneurship Research* Springer, pp. 387–427.
- Anderson, Alistair R., Miller, Claire J., 2003. 'Class Matters': human and social capital in the entrepreneurial process. *J. Socio Econ.* 32 (1), 17–36.
- Austin, James, Stevenson, Howard, Wei-Skillern, Jane, 2006. Social and commercial entrepreneurship: same, different, or both? *Entrepreneursh. Theory Pract.* 30 (1), 1–22.
- Autio, Erkkko, Sapienza, Harry J., Almeida, James G., 2000. Effects of age at entry, knowledge intensity, and imitability on international growth. *Acad. Manag. J.* 43 (5), 909–924.
- Badar, Kamal, Hite, Julie M., Badir, Yuosre F., 2013. Examining the relationship of co-authorship network centrality and gender on academic research performance: the case of chemistry researchers in Pakistan. *Scientometrics* 94 (2), 755–775.
- Biggins, J. Veronica, 1999. Making board diversity work. *Corp. Board* 20, 11–16.
- Birley, S., 1986. The role of networks in the entrepreneurial process. *J. Bus. Ventur.* 1 (1), 107–117.
- Bliemel, Martin J., McCarthy, Ian P., Maine, Elicia M.A., 2015. Levels of multiplexity in entrepreneur's networks: implications for dynamism and value creation. *Entrepreneursh. Res. J.* 0 (0).
- Bocken, N.M.P., Short, Samuel W., Rana, P., Evans, S., 2014. A literature and practice review to develop sustainable business model archetypes. *J. Clean. Prod.* 65, 42–56.
- Bohnsack, René, Pinkse, Jonatan, Kolk, Ans, 2014. Business models for sustainable technologies: exploring business model evolution in the case of electric vehicles. *Res. Policy* 43 (2), 284–300.
- Boons, Frank, Lüdeke-Freund, Florian, 2013. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *J. Clean. Prod.* 45, 9–19.
- Borgatti, Stephen P., 1995. Centrality and AIDS. *Connections* 18 (1), 112–114.
- Borgatti, Stephen P., Everett, Martin G., Freeman, Linton C., 1999. UCINET 6.0 Version 1.00. Analytic Technologies, Natick.
- Brush, Candida G., 1992. Research on women business owners: past trends, a new perspective and future directions. *Entrepreneursh. Theory Pract.* 16 (4), 5–31.
- Brush, Candida G., De Bruin, Anne, Welter, Friederike, 2009. A gender-aware framework for women's entrepreneurship. *Int. J. Gend. Entrepreneursh.* 1 (1), 8–24.
- Brush, Candida G., Vanderwerf, Pieter A., 1992. A comparison of methods and sources for obtaining estimates of new venture performance. *J. Bus. Ventur.* 7 (2), 157–170.
- Brush, Carter, Gatewood, Greene, Hart, 2004. *Clearing the Hurdles: Women Building High-growth Businesses*. Prentice-Hall, Upper Saddle River, NJ.
- Bygrave, William D., 1988. The structure of the investment networks of venture capital firms. *J. Bus. Ventur.* 3 (2), 137–157.
- Calas, Marta B., Smircich, Linda, Bourne, Kristina A., 2009. Extending the boundaries: reframing 'entrepreneurship as social change' through feminist perspectives. *Acad. Manag. Rev.* 34 (3), 552–569.
- Carter, Nancy, Brush, Candida, Greene, Patricia, Gatewood, Elizabeth, Hart, Myra, 2003. Women entrepreneurs who break through to equity financing: the influence of human, social and financial capital. *Ventur. Cap. An Int. J. Entrepreneurial Finance* 5 (1), 1–28.
- Casimir, Gerda, Dutilh, Chris, 2003. Sustainability: a gender studies perspective. *Int. J. Consum. Stud.* 27 (4), 316–325.
- Chen, Xiao-Ping, Yao, Xin, Kotha, Suresh, 2009. Entrepreneur passion and preparedness in business plan presentations: a persuasion analysis of venture capitalists' funding decisions. *Acad. Manag. J.* 52 (1), 199–214.
- Chesbrough, Henry, Rosenbloom, Richard S., 2002. The role of the business model in capturing value from innovation: evidence from xerox corporation's technology spin-off companies. *Ind. Corp. Change* 11 (3), 529–555.
- Choi, David Y., Gray, Edmund R., 2008. Socially responsible entrepreneurs: what do they do to create and build their companies? *Bus. Horiz.* 51 (4), 341–352.
- Cohen, Boyd, 2006. Sustainable valley entrepreneurial ecosystems. *Bus. Strategy Environ.* 15 (1), 1–14.
- Cohen, Boyd, Winn, Monika I., 2007. Market imperfections, opportunity and sustainable entrepreneurship. *J. Bus. Ventur.* 22 (1), 29–49.
- Colombo, M., Mustar, P., Wright, M., 2010. Dynamics of science-based entrepreneurship. *J. Technol. Transf.* 35 (1), 1–15.
- Covin, Jeffrey G., Slevin, Dennis P., 1989. Strategic management of small firms in hostile and benign environments. *Strateg. Manag. J.* 10 (1), 75–87.
- Daly, Herman E., Farley, Joshua, 2011. *Ecological Economics: Principles and Applications*. Island Press.
- De Bruin, Anne, Brush, Candida G., Welter, Friederike, 2006. Introduction to the special issue: towards building cumulative knowledge on women's entrepreneurship. *Entrepreneursh. Theory Pract.* 30 (5), 585–593.
- De Pelsmacker, Patrick, Driesen, Liesbeth, Rayp, Glenn, 2005. Do consumers care about ethics? willingness to pay for fair-trade coffee. *J. Consum. Aff.* 39 (2), 363–385.
- DiPrete, Thomas A., Forrestal, Jerry D., 1994. Multilevel models: methods and substance. *Annu. Rev. Sociol.* 331–357.
- Dodgson, Mark, 1993. Organizational learning: a review of some literature. *Organ. Stud.* 14 (3), 375–394.
- Doganova, Liliiana, Eyquem-Renault, Marie, 2009. What do business models do?: innovation devices in technology entrepreneurship. *Res. Policy* 38 (10), 1559–1570.
- Downing, Stephen, 2005. The social construction of entrepreneurship: narrative and dramatic processes in the coproduction of organizations and identities. *Entrepreneursh. Theory Pract.* 29 (2), 185–204.
- Earley, Katharine, 2016. More than half of all businesses ignore un's sustainable development goals. In: *The Guardian*, September 30, Sec. *Guardian Sustainable Business*. <http://www.theguardian.com/sustainable-business/2016/sep/30/businesses-ignore-un-sustainable-development-goals-survey>.
- Ellison, Nicole B., Steinfield, Charles, Lampe, Cliff, 2007. The benefits of facebook 'friends': social capital and college students' use of online social network sites. *J. Comput. Mediat. Commun.* 12 (4), 1143–1168.
- Fagerberg, Jan, 2003. Schumpeter and the revival of evolutionary economics: an appraisal of the literature. *J. Evol. Econ.* 13 (2), 125–159.
- Faust, Katherine, Skvoretz, John, 2002. Comparing networks across space and time, size and species. *Sociol. Methodol.* 32 (1), 267–299.
- Feld, Brad, 2012. *Startup Communities: Building an Entrepreneurial Ecosystem in Your City*. John Wiley & Sons.
- Fernandez-Feijoo, Belen, Romero, Silvia, Ruiz-Blanco, Silvia, 2014. Women on boards: do they affect sustainability reporting? *Corp. Soc. Responsib. Environ. Manag.* 21 (6), 351–364.
- Fletcher, Denise E., 2006. Entrepreneurial processes and the social construction of opportunity. *Entrepreneursh. Reg. Dev.* 18 (5), 421–440.
- Fletcher Jr., Robert J., Revell, Andre, Reichert, Brian E., Kitchens, Wiley M., Dixon, Jeremy D., Austin, James D., 2013. Network modularity reveals critical scales for connectivity in ecology and evolution. *Nat. Commun.* 4.
- Foss, Nicolai J., Klein, Peter G., Kor, Yasemin Y., Mahoney, Joseph T., 2008. Entrepreneurship, subjectivism, and the resource-based view: toward a new synthesis. *Strateg. Entrepreneursh. J.* 2 (1), 73–94.
- Foster, George, Shimizu, Carlos, Ciesinski, S., Davila, A., Hassan, S., Jia, N., Morris, R., 2013. Entrepreneurial ecosystems around the globe and company growth dynamics. In: *World Economic Forum*, 11.
- Galbreath, Jeremy, 2011. Are there gender-related influences on corporate sustainability? A study of women on boards of directors. *J. Manag. Organ.* 17 (1), 17–38.
- Gartner, W.B., 1988. Who is an entrepreneur? Is the wrong question. *Am. J. Small Bus.* 12 (4), 11–32.
- Geng, Yong, Doberstein, Brent, 2008. Developing the circular economy in China: challenges and opportunities for achieving 'leapfrog development'. *Int. J. Sustain. Dev. World Ecol.* 15 (3), 231–239.
- Gilsing, Victor, Nooteboom, Bart, Vanhaverbeke, Wim, Duysters, Geert, Oord, Ad van

- den, 2008. Network embeddedness and the exploration of novel technologies: technological distance, betweenness centrality and density. *Res. Policy* 37 (10), 1717–1731.
- Girvan, Michelle, Newman, Mark EJ., 2002. Community structure in social and biological networks. *Proc. Natl. Acad. Sci.* 99 (12), 7821–7826.
- Grant, Stanley B., Saphores, Jean-Daniel, Feldman, David L., Hamilton, Andrew J., Fletcher, Tim D., Cook, Perran LM., Stewardson, Michael, et al., 2012. Taking the 'waste' out of 'wastewater' for human water security and ecosystem sustainability. *Science* 337 (6095), 681–686.
- Greene, Patricia G., Brush, Candida G., Hart, Myra M., Saporito, Patrick, 2001. Patterns of venture capital funding: is gender a factor? *Ventur. Cap. Int. J. Entrep. Financ.* 3 (1), 63–83.
- Grossman, Elissa B., Yli-Renko, Helena, Janakiraman, Ramkumar, 2012. Resource search, interpersonal similarity, and network tie valuation in nascent entrepreneurs' emerging networks. *J. Manag.* 38 (6), 1760–1787.
- Gundry, Lisa K., Welsch, Harold P., 2001. The ambitious entrepreneur: high growth strategies of women-owned enterprises. *J. Bus. Ventur.* 16 (5), 453–470.
- Haldane, Andrew G., Robert, M., May, 2011. Systemic risk in banking ecosystems. *Nature* 469 (7330), 351–355.
- Hannan, Michael T., Freeman, John, 1984. Structural inertia and organizational change. *Am. Sociol. Rev.* 49, 149–164.
- Hansen, Eric L., 1995. Entrepreneurial networks and new organization growth. *Entrepreneursh. Theory Pract.* 19 (4), 7–20.
- Hansen, Erik G., Grosse-Dunker, Friedrich, Reichwald, Ralf, 2009. Sustainability innovation cube—a framework to evaluate sustainability-oriented innovations. *Int. J. Innov. Manag.* 13 (04), 683–713.
- Harrison, Richard T., Mason, Colin M., 2007. Does gender matter? Women business angels and the supply of entrepreneurial finance. *Entrep. Theory Pract.* 31 (3), 445–472.
- Heckathorn, Douglas D., 1997. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc. Probl.* 44, 174–199.
- Hicks, Christina C., Levine, Arielle, Agrawal, Arun, Basurto, Xavier, Breslow, Sara J., Carothers, Courtney, Charnley, Susan, et al., 2016. Engage key social concepts for sustainability. *Science* 352 (6281), 38–40.
- Isenberg, Daniel J., 2010. How to start an entrepreneurial revolution. *Harv. Bus. Rev.* 88 (6), 40–50.
- Isenberg, D.J., 2011. Introducing the entrepreneurship ecosystem: four defining characteristics. *Forbes*. Available at <http://www.forbes.com/sites/danisenberg/2011/05/25/introducing-the-entrepreneurship-ecosystem-four-defining-characteristics/>. (Accessed 1 September 2017).
- Jack, Sarah L., Anderson, Alistair R., 2002. The effects of embeddedness on the entrepreneurial process. *J. Bus. Ventur.* 17 (5), 467–487.
- Jackson, Tim, 2011. *Prosperity without Growth: Economics for a Finite Planet*. Routledge.
- Johannisson, Bengt, 1987. Beyond process and structure: social exchange networks. *Int. Stud. Manag. Organ.* 3–23.
- Kenney, M., Goe, W. Richard, 2004. The role of social embeddedness in professorial entrepreneurship: a comparison of electrical engineering and computer science at UC Berkeley and Stanford. *Res. Policy* 33 (5), 691–707.
- Landström, Hans, 1998. Informal investors as entrepreneurs: decision-making criteria used by informal investors in their assessment of new investment proposals. *Technovation* 18 (5), 321–333.
- Lee, Seungyoon, Lee, Cheolhan, 2015. Creative interaction and multiplexity in intraorganizational networks. *Manag. Commun. Q.* 29 (1), 56–83.
- Leondes, Cornelius T., 1996. *Digital Control and Signal Processing Systems and Techniques: Advances in Theory and Applications*, vol. 78. Academic Press.
- Lin, Nan, 2000. Inequality in social capital. *Contemp. Sociol.* 29 (6), 785–795.
- Lu, Jane W., Beamish, Paul W., 2006. SME internationalization and performance: growth vs. Profitability. *J. Int. Entrepreneursh.* 4 (1), 27–48.
- Lu, Xin, 2013. Linked ego networks: improving estimate reliability and validity with respondent-driven sampling. *Soc. Netw.* 35 (4), 669–685.
- Lu, Yonglong, Jenkins, Alan, Ferrier, Robert C., Bailey, Mark, Gordon, Iain J., Song, Shuai, Huang, Jikun, et al., 2015. Addressing China's grand challenge of achieving food security while ensuring environmental sustainability. *Sci. Adv.* 1 (1), e1400039.
- Lumpkin, G.T., Wales, William J., Ensley, Michael D., 2006. Entrepreneurial orientation effects on new venture performance: the moderating role of venture age. In: *Academy of Management Proceedings*, 2006:N1–N6.
- MacMillan, I.C., Siegel, R., Narasimha, P.N., 1986. Criteria used by venture capitalists to evaluate new venture proposals. *J. Bus. Ventur.* 1 (1), 119–128.
- Madden, J.R., Drewe, J.A., Pearce, G.P., Clutton-Brock, T.H., 2011. The social network structure of a wild meerkat population: 3. position of individuals within networks. *Behav. Ecol. Sociobiol.* 65 (10), 1857–1871.
- Malecki, Edward J., 2011. Connecting local entrepreneurial ecosystems to global innovation networks: open innovation, double networks and knowledge integration. *Int. J. Entrepreneursh. Innov. Manag.* 14 (1), 36–59.
- Meagher, Kieron, Rogers, Mark, 2004. Network density and R&D spillovers. *J. Econ. Behav. Organ.* 53 (2), 237–260.
- Miles, Raymond E., Snow, Charles C., Meyer, Alan D., Coleman, Henry J., 1978. Organizational strategy, structure, and process. *Acad. Manag. Rev.* 3 (3), 546–562.
- Miles, Morgan P., Munilla, Linda S., Darroch, Jenny, 2009. Sustainable corporate entrepreneurship. *Int. Entrep. Manag. J.* 5 (1), 65–76.
- Miller, Danny, 1983. The correlates of entrepreneurship in three types of firms. *Manag. Sci.* 29 (7), 770–791.
- Miller, Danny, Friesen, Peter H., 1977. Strategy-making in context: ten empirical archetypes. *J. Manag. Stud.* 14 (3), 253–280.
- Miller, Danny, Friesen, Peter H., 1983. Strategy-making and environment: the third link. *Strateg. Manag. J.* 4 (3), 221–235.
- Milne, Markus J., Gray, Rob, 2013. W (h)ither ecology? The triple bottom line, the global reporting initiative, and corporate sustainability reporting. *J. Bus. Ethics* 118 (1), 13–29.
- Milroy, James, Milroy, Lesley, 1993. Mechanisms of change in urban dialects: the role of class, social network and gender. *Int. J. Appl. Linguist.* 3 (1), 57–77.
- Min, Gap, Pyong, Waldinger, Roger, Aldrich, Howard, Ward, Robin, 1993. *Ethnic Entrepreneurs: Immigrant Business in Industrial Societies*. Sage, Newbury Park, CA.
- Molteni, Thomas P., Mahony, Douglas M., 2011. Network theory of organization: a multilevel approach. *J. Manag.* 37 (2), 443–467.
- Moore, James F., 1993. Predators and prey: a new ecology of competition. *Harv. Bus. Rev.* 71 (3), 75–83.
- Morris, M., Schindehutte, M., Allen, J., 2005. The entrepreneur's business model: toward a unified perspective. *J. Bus. Res.* 58 (6), 726–735.
- Morris, Michael H., Neumeier, Xavier, Jang, Yongseok, Kuratko, Donald F., 2016. Distinguishing types of entrepreneurial ventures: an identity-based perspective. *J. Small Bus. Manag.* <http://dx.doi.org/10.1111/jsbm.12272>.
- Morris, Michael H., Neumeier, Xavier, Kuratko, Donald F., 2015. A portfolio perspective on entrepreneurship and economic development. *Small Bus. Econ.* 45 (4), 713–728.
- Morris, Michael H., Webb, Justin W., Fu, Jun, Singhal, Sujata, 2013. A competency-based perspective on entrepreneurship education: conceptual and empirical insights. *J. Small Bus. Manag.* 51 (3), 352–369.
- Muñoz, Pablo, Dimov, Dimo, 2015. The call of the whole in understanding the development of sustainable ventures. *J. Bus. Ventur.* 30 (4), 632–654.
- Nambisan, Satish, Baron, Robert A., 2013. Entrepreneurship in innovation ecosystems: entrepreneurs' self-regulatory processes and their implications for new venture success. *Entrepreneursh. Theory Pract.* 37 (5), 1071–1097.
- Neck, Heidi M., Dale Meyer, G., Cohen, Boyd, Corbett, Andrew C., 2004. An entrepreneurial system view of new venture creation. *J. Small Bus. Manag.* 42 (2), 190–208.
- Neumeier, Xavier, Poncela-Casasnovas, Julia, 2016. Detecting social boundaries in entrepreneurial ecosystems. In: *Academy of Management Proceedings*, 2016: 14065. Academy of Management.
- Newman, Mark EJ., Girvan, Michelle, 2003. Mixing patterns and community structure in networks. In: *Statistical Mechanics of Complex Networks*. Springer, pp. 66–87.
- Newman, Mark EJ., Girvan, Michelle, 2004. Finding and evaluating community structure in networks. *Phys. Rev. E* 69 (2), 026113.
- Olesen, Jens M., Bascompte, Jordi, Dupont, Yoko L., Jordano, Pedro, 2007. The modularity of pollination networks. *Proc. Natl. Acad. Sci.* 104 (50), 19891–19896.
- Osterwalder, Alexander, Pigneur, Yves, Tucci, Christopher L., 2005. Clarifying business models: origins, present, and future of the concept. *Commun. Assoc. Inf. Syst.* 16 (1), 1.
- Park, Jacob, Sarkis, Joseph, Wu, Zhaoxi, 2010. Creating integrated business and environmental value within the context of China's circular economy and ecological modernization. *J. Clean. Prod.* 18 (15), 1494–1501.
- Patzelt, Holger, Shepherd, Dean A., 2011. Recognizing opportunities for sustainable development. *Entrepreneursh. Theory Pract.* 35 (4), 631–652.
- Robbins, D. Keith, Pantuosco, Louis J., Parker, Darrell F., Fuller, Barbara K., 2000. An Amprirical assessment of the contribution of small business employment to US state economic performance. *Small Bus. Econ.* 15 (4), 293–302.
- Robinson, Jeffrey, Blockson, Laquita, Robinson, Sammie, 2007. Exploring stratification and entrepreneurship: African American women entrepreneurs redefine success in growth ventures. *Ann. Am. Acad. Political Soc. Sci.* 613 (1), 131–154.
- Rosener, Judy B., 1997. *America's Competitive Secret: Women Managers*. Oxford University Press on Demand.
- Salganik, Matthew J., Heckathorn, Douglas D., 2004. Sampling and estimation in hidden populations using respondent-driven sampling. *Sociol. Methodol.* 34 (1), 193–240.
- Schaltegger, Stefan, Lüdeke-Freund, Florian, Hansen, Erik G., 2016. Business models for sustainability: a co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation. *Organ. Environ.* 29 (3), 264–289.
- Scott, John, Carrington, Peter J., 2011. *The SAGE Handbook of Social Network Analysis*. SAGE Publications.
- Seele, Peter, Lock, Irina, 2017. The game-changing potential of digitalization for sustainability: possibilities, perils, and pathways. *Sustain. Sci.* 12 (2), 183–185. <http://dx.doi.org/10.1007/s11625-017-0426-4>.
- Seelos, Christian, Mair, Johanna, 2005. Social entrepreneurship: creating new business models to serve the poor. *Bus. Horiz.* 48 (3), 241–246.
- Sexton, D.L., Bowman-Upton, N.B., 1991. *Entrepreneurship: Creativity and Growth*. Macmillan New York.
- Shane, S.A., 2003. *A General Theory of Entrepreneurship: the Individual-opportunity Nexus*. Edward Elgar Publishing.
- Shane, Scott A., 2009. Why encouraging more people to become entrepreneurs is bad public policy. *Small Bus. Econ.* 33 (2), 141–149.
- Shane, Scott, Delmar, Frederic, 2004. Planning for the market: business planning before marketing and the continuation of organizing efforts. *J. Bus. Ventur.* 19 (6), 767–785.
- Shane, Venkataraman, S., 2000. The promise of entrepreneurship as a field of

- research. *Acad. Manag. Rev.* 217–226.
- Singh, Robert P., Hills, Gerald E., Lumpkin, G.T., Hybels, Ralph C., 1999. The entrepreneurial opportunity recognition process: examining the role of self-perceived alertness and social networks. In: *Academy of Management Proceedings*, 1999:G1–G6. Academy of Management.
- Skvoretz, John, Agneessens, Filip, 2007. Reciprocity, multiplexity, and exchange: measures. *Qual. Quant.* 41 (3), 341–357.
- Smeltzer, Larry R., Fann, Gail L., 1989. Gender differences in external networks of small business owner/managers. *J. Small Bus. Manag.* 27 (2), 25–32.
- Sørensen, Jesper B., Stuart, Toby E., 2000. Aging, obsolescence, and organizational innovation. *Adm. Sci. Q.* 45 (1), 81–112.
- Spigel, Ben, 2017. The relational organization of entrepreneurial ecosystems. *Entrepreneursh. Theory Pract.* 41 (1), 49–72.
- Stam, Erik, 2015. Entrepreneurial ecosystems and regional policy: a sympathetic critique. *Eur. Plan. Stud.* 23 (9), 1759–1769.
- Stam, Erik, Hartog, Chantal, van Stel, André, Thurik, Roy, 2011. Ambitious entrepreneurship, high-growth firms and macroeconomic growth. In: *The Dynamics of Entrepreneurship: Evidence from Global Entrepreneurship Monitor Data*. Oxford University Press, New York, pp. 231–249.
- Stangler, Dane, 2010. *High-growth Firms and the Future of the American Economy*. Kauffman Foundation, Kansas City.
- Stubbs, Wendy, Cocklin, Chris, 2008. Conceptualizing a 'sustainability business model'. *Organ. Environ.* 21 (2), 103–127.
- Tsai, Wenpin, 2001. Knowledge transfer in intraorganizational networks: effects of network position and absorptive capacity on business unit innovation and performance. *Acad. Manag. J.* 44 (5), 996–1004.
- Verbrugge, Lois M., 1979. Multiplexity in adult friendships. *Soc. Forces* 57 (4), 1286–1309.
- Weeks, Margaret R., Clair, Scott, Borgatti, Stephen P., Radda, Kim, Schensul, Jean J., 2002. Social networks of drug users in high-risk sites: finding the connections. *AIDS Behav.* 6 (2), 193–206.
- Wejnert, Cyprian, 2010. Social network analysis with respondent-driven sampling data: a study of racial integration on campus. *Soc. Netw.* 32 (2), 112–124.
- Yang, Fan, Duan, Ping, Shah, Sirish L., Chen, Tongwen, 2014. *Capturing Connectivity and Causality in Complex Industrial Processes*. Springer Science & Business Media.
- Zott, Christoph, Amit, Raphael, Massa, Lorenzo, 2011. The business model: recent developments and future research. *J. Manag.* 37 (4), 1019–1042.