What we do know and what we need to know about knowledge in the growth process

Rosa Caiazza Nicolai Foss Tiziana Volpe

POSITION PAPER

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Rosa Caiazza
Universita degli Studi di Napoli Parthenope, Napoli, Italy
Nicolai Foss
Copenhagen Business School, Copenhagen, Denmark, and
Tiziana Volpe
National Research Council, Naples, Italy

Abstract

Purpose – There is evidence for major positive effects of knowledge transfer and innovation diffusion on economic growth. Much research has addressed schooling, training, and other aspects of human capital accumulation, but less emphasis has been placed on the interaction between firms and other organizations as a key driver of the development of new knowledge and its economic use. There is an extensive body of literature that discusses various aspects of knowledge transfer and innovation diffusion between firms, and this literature may serve as a microfoundation for understanding the role of knowledge in the growth process. However, we need to understand the role of the entrepreneur as a missing link between knowledge and innovation. The purpose of this paper is to outline some foundations of endogenous (externally driven) growth models, and uses the knowledge spillover theory of entrepreneurship to propose a new model of latent and emergent entrepreneurship.

Design/methodology/approach – The paper uses the method of conceptual analysis to structure the literature and its assumptions. The authors review in broad terms what we know in the space of knowledge and growth, and what we still need to know. The authors curate informed views on the topic of knowledge and the way that entrepreneurs contribute to innovation diffusion.

Findings – The paper develops a new perspective on knowledge. Starting from the role of knowledge as a core element in the microfoundations of endogenous growth models, it uses the knowledge spillover theory of entrepreneurship to propose a new model of latent and emergent entrepreneurship.

Practical implications – The paper uses knowledge spillover theory to lay out a more complete and more realistic process through which knowledge gets converted into realized innovations, and as such, it makes the intervention points through which people management can facilitate organizational effectiveness through innovation more transparent.

Originality/value – The paper provides guidance for future researchers on knowledge and innovation diffusion. It encourages innovation in our thinking about the role of knowledge, and allows scholars to combine perspectives more flexibly both across levels of analysis (macro and micro), and across disciplines (economy and management).

Keywords Innovation, Knowledge, Growth

Paper type Research paper

General background

Knowledge evolves as new ideas are developed by individuals in private or public organizations in an often highly interactive process. New knowledge being turned into innovation is the main element of the microeconomic foundations of endogenous growth models (Romer, 1986; Lucas, 1993). However, the understanding of the entrepreneur's role in this process represents a potentially major research gap in the

Journal of Organizational Effectiveness: People and Performance
Vol. 3 No. 2, 2016
pp. 191-203

2051-6614
DOI 10.1108/JOEPP-03-2016-0022

existing literature. The gap is a major one, because knowledge is discovered, transformed, shared, combined, deployed, commercialized, and so on by entrepreneurial individuals with different characteristics, facing different opportunities and incentives, and exercising judgment under uncertainty (Foss and Klein, 2012). Thus, depending on such characteristics (e.g. entrepreneurial ability), and the opportunities and incentives to engage in entrepreneurial action, the processes involved from the discovery of knowledge to innovation can take different forms and go in different directions, with very real consequences for firm performance, economic well-being and growth.

Our attempt to define a more clear-cut role for the entrepreneur in the understanding of the innovation process, we starts by explaining the nature of endogenous growth models, and introduce the knowledge spillover theory of entrepreneurship in order to propose a new model of latent and emergent entrepreneurship (Acs *et al.*, 2009). In this literature, the expected value of any new idea is highly uncertain, and has a much greater variance than would be associated with the deployment of traditional factors of production. New ideas are also associated with asymmetries and costs because of their un-codified part (Acs *et al.*, 2009; Audretsch and Caiazza, 2016). Because of the existence of high uncertainty, asymmetries, and transactions costs of knowledge, the expected economic value of a new idea varies significantly across organizations. Such divergences in the valuation of new ideas will become even greater if the new idea is not consistent with the core competence and technological trajectory of the incumbent organizations (Almeida, 1996; Autio *et al.*, 1996; Bozeman *et al.*, 2015). Moreover, the pressures of the current economic crisis adds a strongly topical flavor to a conceptual analysis of what we know and what we need to know on how knowledge affects the economic growth of firms and regions given that the main current problem, particularly in Europe is one of slow growth and sluggish job creation (Caiazza *et al.*, 2015).

Knowledge has a potential value related to its ability to generate future inventions that are introduced to a market in the form of innovations (Almeida and Kogut, 1999; Amesse and Cohendet, 2001). Thus, knowledge has a cumulative nature and firms have to play a central role in this process of cumulativeness (Nelson and Winter, 1982). For every new idea, firms have to find a way to benefit economically from the new element it has added to the universe of ideas. Future inventions could be improved versions of the original idea, or derived inventions that use the original idea in a complementary way (Avenali *et al.*, 2013; Howells *et al.*, 2008). Invention is also a solution to some techno-economic problem, a source of enhanced utility, or lower cost for some set of beneficiaries. Thus, it has an intrinsic value that relates to the problem-solving aspect of the invention (Arrow, 1962). Consequently, a firm has to capture the greatest share of profits from the problem-solving invention that it has developed. This kind of appropriability refers to a firm's effectiveness in exploiting a given invention by translating it into some appropriable solutions for users (Teece *et al.*, 1997).

Innovation relates to two interrelated processes: the production of knowledge; and the exploitation of knowledge. The Oslo Manual (2005) defines innovation as the implementation of a new or improved product, process, marketing method, or organizational method in an organization or its external relations. By definition, all innovation must contain new knowledge. The Oslo Manual specifies that an innovation can be new to the world, new to the market, or new to the firm (Barney, 1991; Agrawal, 2001; Hamel, 1991; Inkpen, 2000). An innovation is new to the world when the organization is the first to introduce the innovation for all markets and industries.

Innovations are new to the market when the organization is the first to introduce the innovation to its market. The last concept covers the diffusion of innovation from organization to organization (Baughn *et al.*, 1997; Argote *et al.*, 2003). The innovation may have already been implemented by other firms, but may be new to the firm. Innovation, is therefore influenced by a wide range of factors, some of which can be influenced by policy.

The uncertainty, asymmetries, and high transaction costs of associated with the creation, identification, combination, sharing, deployment, etc. of knowledge create a divergence in evaluation of the expected value of new ideas (Arrow, 1962). This divergence in the valuation of knowledge across existing agents can induce some of them to avoid any exploitation of such knowledge in an economic way and lead new agents to start firms, as a mechanism to turn such new knowledge into innovations. Through diffusion, innovations spread from their very first implementation to different consumers, countries, regions, sectors, markets, and firms. Through this process an original idea, turned into invention and then innovation, may impact the creation of value beyond a single firm, potentially in a self-propelling manner.

Methodology

The paper presents a series of informed views on knowledge in order to contribute to the topic of organizational effectiveness, and the way that people management then contributes to effectiveness. It takes a stance on the importance of endogenous growth theories, and builds insights into these theories, proposing a new theoretical framework. It is based on conceptual analysis, that is, a structured examination of the topics of knowledge, innovation, and entrepreneurship. One of the difficulties in conducting a concept analysis is that there are no clearly defined methodological guidelines. The one guideline there is that it starts from the review of large body of literature on which one can draw for analysis. To develop our database we considered the main theoretical approach to the topic of knowledge and innovation diffusion. We acquired published studies from a variety of economic, managerial and innovation journals and selected studies on the basis of two criteria. First, we included studies that identify the main theories of knowledge and its transfer. Second, we conducted a qualitative investigation, and included those articles that evidenced the effects of such theories. This closer look at a selection of papers taking a qualitative approach, allowed us to create a more detailed statement about the current state of the research in terms of what we know and what we need to know about knowledge.

What we do know

The process through which resources spent in research and development (R&D) generate new ideas and their commercialization affects the economic growth of firms and countries. Most studies on knowledge and its effects can be traced back to the growth models developed from the first studies of Schumpeter. Schumpeter identified two major patterns of innovative activities. The Schumpeter Mark I pattern was proposed in The Theory of Economic Development (Schumpeter, 1934). This pattern of innovative activity is characterized by creative destruction, the technological ease of entry, and a major role played by new firms in innovative activities. This is a random process, with organizations fishing in a pool of technological opportunities which are accessible to everybody. Innovation generates a temporary monopoly power, subsequently eroded by the innovative activity of competitors. As a consequence,

new innovators systematically substitute for incumbents at the frontiers of technology (Fleming and Sorenson, 2001; Inkpen and Tsang, 2005). The Schumpeter Mark II pattern was proposed in Capitalism, Socialism and Democracy (Schumpeter, 1942). This pattern of innovative activity is characterized by creative accumulation, with the prevalence of established firms leading to the presence of relevant barriers to entry for new innovators. This view emphasizes the importance of technical knowledge, which has a strong tacit component, and is highly specific to individual firms. Moreover, firm-specific technical competencies significantly constrain the future technological performance of the firm. Over time, the firm specific, tacit, and cumulative nature of the knowledge base builds higher barriers to entry. As a consequence, the role of new innovators is limited and a few firms eventually come to dominate the market in what is a stable oligopoly.

These Schumpeterian growth theories take into account the fact that innovations may be partly excludable through the use of intellectual property rights. These allow the innovator to retain some of the rents coming from an innovation and, thus, provide the necessary economic incentive to innovate. Nelson and Winter (1982) proposed the neo-Schumpeterian (evolutionary) model which applied the Schumpeter's principle of heterogeneous agents to the level of the firm. They saw innovation as the main factor affecting long-run economic development, based on evolutionary processes of innovation and diffusion.

Subsequent models went on to incorporate ideas about the spillover of knowledge within the innovation process. In the Romer (1986) and Lucas (1993) models of endogenous growth, knowledge is assumed to spillover automatically, from the firm or organization generating that knowledge for commercialization, to third-party firms (Schumpeter, 1934, 1942; Romer, 1986). Including the spillover of knowledge within growth models shifted the focus of policy to that of the management of knowledge, which became particularly potent in terms of its impact on growth when compared to the traditional factors of physical capital and labor, where no such spillovers and free access by third-party firms was possible (Lucas, 1993; McEvily and Zaheer, 1999; Morse *et al.*, 1996).

Reflecting this explicit recognition that investments in knowledge are a driving force of economic growth, particularly because of the propensity for knowledge to spillover, the policy debate subsequently began to shift away from the instruments to promote physical capital, and began to focus increasingly instead on the importance of knowledge capital, for example, the capital that resides in public research institutions (Darr *et al.*, 1995; Garud and Nayyar, 1994). In Griliches' (1979) model of the knowledge production function, innovative output is the result of systematic investment by firms to create knowledge and new ideas, and the subsequent efforts to appropriate the returns accruing from those investments through commercialization. Such investments to create new knowledge involve R&D and the enhancement of human capital through training and education. Thus, according to the Griliches' (1979, 1992) model, innovative opportunities are endogenously created by the purposeful and dedicated investments and efforts made by firms. Griliches also recognized that knowledge would spillover from the firm, enabling investments in new knowledge to be made by third-party firms at lower cost (Griliches, 1979; Hargadon and Sutton, 1997).

In the endogenous growth models, it was assumed that growth may go on indefinitely, because the returns on investment do not diminish as the economy develops (Dougherty, 1992; Griliches, 1992; Lane *et al.*, 2001). However, such models assumes that an economy automatically benefits from its investments in new

knowledge because knowledge is a public good that leads to innovation and economic growth (Caiazza, 2014, 2015a, b). One of the main assumptions underlying such models is that knowledge is considered to be non-exhaustive and non-excludable. This implies that the stock of existing knowledge, and the newly created knowledge, automatically spills over to all economic agents. Drawing upon Schumpeter (1934) and Romer's (1986) model assumed that knowledge automatically spills over from the source for being commercialized to third-party firms, while Griliches' (1992) model focussed on the decision-making context of the firm concerning the role of investments in new knowledge.

However, questions remained. Some of the benefits from innovation spillover to other agents, which helps foster new innovations and contribute to increasing productivity. Moreover, it is these technological spillovers that make sure that growth does not cease. Acs *et al.* (2009) proposed a model that shifted the unit of analysis from the firm to the individual worker, introducing the knowledge spillover theory of entrepreneurship. This theory was used to explain the European paradox by Braunerhjelm *et al.* (2010), who argues that "the spillover of knowledge may not occur automatically as typically assumed in models of our growth. Rather, a mechanism is required to serve as a conduit for the spillover and commercialization of knowledge from the source creating it, to the firms actually commercializing the new ideas" (p. 105). The contribution of Acs *et al.* (2009) and Braunerhjelm *et al.* (2010) is to extend the microeconomic foundations of such models – where the dominant view from the entrepreneurship literature is that opportunities are largely external to the firm – and to form a bridge with the economic literature on opportunity, which stresses the importance of entrepreneurs spotting and exploiting such opportunities. They do this through the use of the knowledge spillover theory of entrepreneurship, which holds that knowledge creation can lead to knowledge spillovers, creating technological opportunities, but that in terms of organizational effectiveness, incumbent firms must invest in R&D for creating knowledge and aim to develop the new idea within their own organizational structures in order to commercialize it (Uzzi, 1996; Turpin *et al.*, 1996; Zhara and George, 2002). If in the incumbent structure invention is not fully commercialized, then the knowledge spillover can be economically developed and commercialized by other firms (Fiol and Lyles, 1985; Granovetter, 1985; Lavie, 2007). Because of the divergence in the ability to turn an invention into innovations, this can lead some actors to start a new firm in order to appropriate the value of knowledge.

In terms of organizational effectiveness, this shifts the locus of attention. In the knowledge spillover theory of entrepreneurship, knowledge is external (exogenous) and is embodied within a worker. Thus, the level of analysis shifted away from firms, to the individual worker able to commercialize new knowledge. The firm is only created endogenously through the worker's efforts to appropriate the value of his knowledge through innovative activity (Braun, 1993; Howells, 2006; Lavie, 2006). Entrepreneurs exploit knowledge opportunities, leading to economic growth and development. New product innovations may come from both incumbent firms, and start-ups. Incumbent firms mainly produce incremental innovations from the flow of knowledge, whereas start-ups tend to exploit knowledge spillovers to produce radical innovations. Based on these ideas, Acs *et al.* (2009) developed a theoretical model in which transformation of knowledge into economic growth depends on how knowledge diffuses through both incumbent and new firms. Thus, the entrepreneur is seen as the missing link in our understanding of how we convert knowledge into innovation (Braunerhjelm *et al.*, 2010).

What we still need to know

In a review of the literature that links institutions, entrepreneurship, and economic growth, Bjørnskov and Foss (2016) point to several lacuna concerning our understanding of the mechanisms that link these phenomena. They suggest that we have an imperfect knowledge of top-down mechanisms (which policies and institutions influence entrepreneurship? How? How much? Through which transmission channels); the concrete form that entrepreneurship takes (how much is represented by start-ups? Established firms?); and of how entrepreneurship aggregates up to outcomes at the level of the economy (how much is due to improvements of total factor productivity? Product innovation?). Bjørnskov and Foss argue that management research (notably strategy, innovation, and entrepreneurship research) has a strong potential to further the understanding of the micromechanisms that mediate between aggregate variables. In the spirit of their discussion, in the following we offer some detail on such micromechanisms in the following.

Organizations, private firms or public research institutions, invest specific resources in order to produce new ideas, and work on them in order to develop an invention. The production of new knowledge requires specific structures, and high qualified resources, that invest their energy in a research project. The new knowledge needs to be protected in order to avoid its appropriability from incumbent organizations. Of course, a number of legal instruments are available for protecting new knowledge (Caiazza *et al.*, 2015), notably patents and licensing. A patent is an exclusive right to exploit (make, use, sell, or import) an invention over a limited period of time (typically 20 years from filing) within the country where the application is made. Patents are granted for inventions which are novel, inventive and have an industrial application. Organizations have also been encouraged by governments to patent their inventions and attempt to license them to industry in order to promote their commercialization (Caiazza and Volpe, 2015a, b). There are other types of exclusive rights over intangible assets, notably copyright, design protection, and trademarks, but patents provide a broader protection that extends beyond the specific expression of an invention to the invention itself.

However, the commercialization of new knowledge requires several other efforts, such as financing product development or market research. The outcome of this process is often uncertain and requires a risk-taking attitude. If the original organization is unable to develop innovation from their invention, then spillovers of such new knowledge can allow other organizations to commercialize the original idea. Incumbent firms that commercialize other knowledge have to be able to overcome all barriers impeding investments in new knowledge in order for it to spillover into commercialization.

But there is a gap – a knowledge filter – between knowledge that has a potential value – and knowledge that has an actual, realized value. The greater the knowledge filter, the more pronounced is the gap between new knowledge and innovation development. The lower the knowledge filter, the greater is the new idea diffusion across economic agents and its commercialization.

The organizational effectiveness literature has addressed this issue. As organizations became more overtly designed around strategically important information markets, this literature highlighted the importance of a series of integration mechanisms that brought together the varied knowledge of individuals in order to produce important organizational solutions, either within a single organization or across organizations (Sparrow and Cooper, 2014). New knowledge generated within an established organization can be turned into economic knowledge not only by

incumbent firms, but also from a start-up born as spin-off from the original organization. By resorting to the start-up of a new firm in order to actualize the commercialization of ideas that otherwise might have remained dormant in the incumbent firm, it is the process of entrepreneurship that serves as the conduit for knowledge spillovers. As such, the firm that develops an innovation may not be the same organization creating the new knowledge, neither need it be an incumbent firm (Dougherty and Hardy, 1996; Lane and Lubatkin, 1998). If the exploitation of those opportunities by the entrepreneur does not involve full payment to the original firm for producing those opportunities, such as through a licence or royalty, then the entrepreneurial act of starting a new firm serves as the mechanism for knowledge spillovers (Dixon, 2000; Geisler, 1993; Hansen, 1999). Entrepreneurial opportunities are generated not just by investments in new knowledge and ideas, but also through the propensity for only a distinct subset of those knowledge opportunities to be fully pursued and commercialized by incumbent firms (Autio and Laamanen, 1995; Baum and Ingram, 1998; Foss and Klein, 2012; Caiazza and Ferrara, 2016).

Reflecting these assumptions, and starting from the assumptions of the knowledge spillover theory of entrepreneurship, Caiazza *et al.* (2015) proposed a new model of both latent and emergent entrepreneurship, as summarized in Figure 1.

Caiazza *et al.* (2015) conceptualize entrepreneurship as the intended and completely implemented entrepreneurship process that leads to the creation of a new firm from new knowledge. For an entrepreneurial project to be perfectly deliberate – that is, realized entrepreneurship is equal to intended entrepreneurship – at least three conditions need to be satisfied (Caiazza, 2015a, b; Bryant and Reenstra-Bryant, 1998):

(1) there must have existed precise intentions in the original organization to realize new knowledge for implementing a new firm (Crossan *et al.*, 1999; De Long and Fahey, 2000);

(2) this project has to involve all the actors able to turn a new idea in a firm able to commercialize this idea; and

(3) these collective intentions must have been realized exactly as intended, which means that no external barriers (limited availability, knowledge filter, or innovation barriers, etc.) could limit them (Braunerhjelm *et al.*, 2010).

These three conditions constitute mean it might not be possible to find any perfectly deliberate entrepreneurial process within an organizations. However, it can still happen that organizations that realize research activity and develop new knowledge, may still

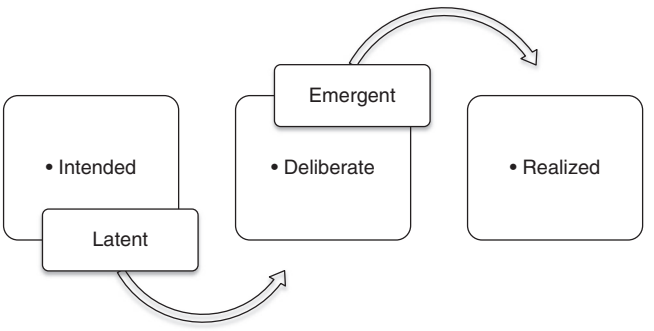

Figure 1.
Latent and emergent theory of entrepreneurship

not be able to use it for commercial purposes, and also neither be able to develop a new entrepreneurial activity aimed at using the knowledge in an economic way (Bessant and Rush, 1995; Haase *et al.*, 2000; Arrow, 1962; Bozeman, 2000).

There is an important phenomenon here which represents a drag on organizational effectiveness – called non-realized entrepreneurship – which includes all the entrepreneurial projects that are not realized at all, despite the existence of new ideas (Caiazza *et al.*, 2015; Cantner and Krüger, 2008). This situation can lead to the creation of some latent entrepreneurship, based on the existence of new knowledge that is not fully developed or commercialized from the original firm. Thus, both incumbent firms or new firms, may use knowledge spillover in order to realize an emergent process of entrepreneurship, one based on spillovers of knowledge developed from other firms. As such, realized entrepreneurship is actually formed from either deliberate, or emergent, entrepreneurial projects.

An innovation can be diffused from the innovator to adopters in several ways. On one side, the innovator can push innovation diffusion through their production and marketing activity (Van Wijk *et al.*, 2008; Tushman, 1977; Teece *et al.*, 1997; Szulanski, 1996). Specifically, they can implement and develop several complementary products that are able to support the original innovation's use. They can also realize several marketing activities that help to diffuse information concerning innovation and its potential uses. On the other side – namely, the receiving side – the adopter has to support several switching costs and risks in using the innovation (Lynn *et al.*, 1996; Nelson and Winter, 1982; Szulanski, 2000; Tsai and Ghoshal, 1998). For example, they may have to change their previous network of suppliers, and several other established processes, in adopting the innovation. All these changes lead to market costs for both the innovators and adopters, costs which may, however be reduced (or increased) by the structural and cultural barriers inherent in the institutional contexts in which they operate. In order to reduce these barriers, both policy-makers and metaorganizations, can play a role in supporting the diffusion process through various public and private measures (Zander and Kogut, 1995; Van der Meulen and Rip, 1998).

Conclusions

In this paper we have described out a more complete and realistic process through which knowledge gets converted into realized innovations. We believe that Figure 1 makes the intervention points through which people management can facilitate organizational effectiveness through innovation more transparent. Following this depiction of the knowledge spillovers, and starting from the assumptions of Schumpeter, which were not revisited and extended upon until the significant contribution made by Acs *et al.* (2009), then we would argue that the current economic crisis may be seen as a source of opportunities for researchers and innovators. The global financial crisis resulted in a temporary negative shock to innovation, a shock that has led to a subsequent but very slow recovery. The future direction of this recovery will depend, however, on the abilities of organizations to take the risk of investing in the resources necessary for the creation of new knowledge, their capabilities to interact with each other to order to develop invention, their entrepreneurial attitudes, and finally government support for innovation diffusion. As such, the interests of policy-makers and researchers will have to focus on several aspects of knowledge and innovation. First, researchers will have to investigate the new frontiers of knowledge which are necessary to invest in supporting social changes. Second, they will need to identify and classify the knowledge filters that affect the

diffusion of new ideas, and their commercial use, with the aim of reducing them. Third, future studies will have to focus on all the private and public measures able to reduce and deal with the barriers to innovation diffusion. Moreover, researchers will have to evidence the long-run effects on skills of any negative contingencies, such as existing and future economic and financial crises, and find ways to overcome them. They will also have to investigate the effects of innovation investments in the near future on future innovation performance, and those investments not made in the present, and try to find ways to avoid any reductions to the pool of opportunities for successful innovations and entrepreneurship that they might create.

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About the authors

Rosa Caiazza is a Board Advisory Member of Academy of Management Perspective, Corporate Governance and several other A journals. She was a Visiting Researcher at the Wharton University of Philadelphia (USA) and Univeristè Libre de Bruxeles (Belgium). She is the Author of many articles published in top-tier academic journals on interlocking directorates and M&A. She was the Chairman of many Eiasm Conferences on M&A. She had "Emerald Literati Network Awards for Excellence." Her main research topics are: corporate and business strategies, internationalization, cross-cultural management, M&A and corporate governance. Rosa Caiazza is the corresponding author and can be contacted at: rosa.caiazza@uniparthenope.it

Nicolai Foss has served as a Member of the Senate of the CBS, is a Panel Member of the European Research Council, a Member of the Academia Europaea, and a Member of the Board of Directors of the Strategic Management Society. Educated as an Economist from the Copenhagen University (1989), Foss has received his PhD degree from the Copenhagen Business School in 1993, where he has been an Assistant, an Associate, and a Full Professor. His work has been published in the *Academy of Management Review*, *Academy of Management Journal*, *Organization Science*, *Strategic Management Journal*, *Journal of International Business Studies*, and several other leading journals. He has published books with leading publishers, such as Cambridge University Press and Oxford University Press, and is widely cited in the literature. Foss has supervised 19 PhD students.

Tiziana Volpe has a PhD in "Agro-food and Environment Resource Economy." She has been involved in many research activities such as: research project on "Logistic as strategic activity for firm competitive advantage" for the Institute for Service Industry Research in partnership with the Institut National de Recherche sur les Transports et leur Sécurité (INRETS); research project on "Transport in the firm process of logistic innovation" for the Department of Study on Territorial System of the Parthenope University of Naples; research project on "Formation in touristic sector in Campania" for Prisma S.a.s.; research project on "Entrepreneurship culture and learning in the internationalization of SME: Campania Case-study" for the Comark Consulting S.a.s. Her research interests concern agro-food, tourism, logistic, and other activities of value chain. She wrote many articles on these topics for national and international journals.