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Financing innovation: two models of private equity investment

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The ability to adapt to fast-paced business change has become critical to firms’ competitiveness. Thus, it requires firms to continuously innovate. Extensive research efforts have been conducted to understand the drivers behind a firm’s capacity to constantly innovate. If significant advance has been made in the fields of innovation management and design theory, there is still a need for research in finance to integrate these developments. Especially in clarifying the relationship between private equity investment and corporate innovation. Thus, this paper specifically aims at exploring new investment models in private equity to support the development of firm’s sustained innovation capabilities.

Based on a literature review exploring the existing private equity investment practices and their potential links with innovation, we highlight the main model used by private equity. We show that this model cannot account for the two design regimes (extracted from design theories) required to support innovation capabilities. Therefore, we build a second hypothetical model that could complement the first one to do so. We then conduct an empirical study to assess whether actual private equity funds’ practices reflect the use of this second hypothetical model, and if so to refine it. From a managerial point of view, this research contributes to shape new valuation approaches and post-investment strategies that better foster invested firm’s innovation capabilities, among which R&D activities.

1. Introduction

The ability to adapt to fast-paced business change has become critical to firms’ competitiveness. There are several ways through which firms can occasionally increase their performance: designing one new and original product, redefining their strategy, optimizing their processes, etc. – but none is as important over the long term as the development of a capability to sustain innovation. This, in turn, has given way to extensive research efforts to understand the drivers behind a firm’s capacity to continuously innovate. If significant advance has been made in the fields of innovation management and design theory, for instance, there is however still a need for research in finance to integrate these developments, especially in clarifying the relationship between investment and innovation. This paper specifically aims at exploring new investment models in private equity to support the development of sustained innovation capabilities.

Firms have access to a broad range of external financing instruments – internal cash-flows, subsidies (e.g., the Horizon 2020 European Program or government-owned development banks programs), loans or external equity, some of which are specifically targeted at supporting innovation. Among these instruments, raising capital through private equity funding has long been considered to be a significant source of financing for innovative companies. In recent years, record amounts of resources have been allocated to this asset class, consisting of equity securities in non-quoted companies with high potential over the medium-to-long term (EVCA 2007). Rapidly increasing fundraising (+11% worldwide in 2017 (McKinsey 2018)) has driven a sharp rise in the amount of capital available. However, despite the existence of pockets of growth like France where volume and deal counts are booming, global private equity deal volume has been flat since 2016 and global deal count even declined in 2017 (McKinsey 2018). As a result, private equity funds face record levels of dry powder. Thus, there is an increasing demand for new allocation streams and new models of value creation levers, some of which are thought to rely on innovation capability (Torres 2015). In parallel, some investors are also calling for private equity funds to develop new investment models that drive more sustainable and longer-term growth for the companies they invest in (Fink 2018).

Surprisingly enough, literature remains unclear about the precise relationship between private equity investments and corporate innovation. On the one hand, literature on venture capital, depicted as a financing tool for young innovative companies, is limited to the very specific model of start-ups and mostly oriented towards the acceleration and commercialization of existing innovative projects rather than the development of new innovation capabilities. On the other hand, the bulk of the literature on private equity focuses on the impact of buyouts on portfolio companies’ or the drivers of successful investment strategies while minimizing the reliance on innovation to do so. Overall, except some recent papers linking entrepreneurship and buyouts, there is still a lack of conceptual framework and methods for private equity investors to take advantage of and foster corporate innovation.

This is why this paper aims at contributing to investigate the role of investors in fostering repeated innovation, addressing the following research question: how private equity mode of investment can foster the development of firm’s capability to repeat and sustain innovation?

Building on innovation management literature, and especially design theories, we first identify and describe two design regimes that are required to support a capacity to sustain innovation. Based on a literature review exploring the existing private equity investment practices and their potential links with innovation, we highlight the main model used by private equity investors to target companies, build their post-investment strategy and calculate their value at exit. We show that this model cannot account for the two design regimes required to support innovation capabilities, and therefore we build a second hypothetical model that could complement the first one to do so. We then conduct an empirical study to assess whether actual private equity funds’ practices reflect the use of this second hypothetical model, and if so to refine it. To do so, we collaborated with a French private equity fund known for investing in innovative firms. We chose to focus on middle-market firms. In between start-ups and large firms, small and medium sized companies (SME) and especially middle-market companies are often described as being in a transition or adolescent phase, relying both on historical core competencies and entrepreneurial activities. Therefore, they feel an acute need to constantly renew their activities through repeated innovation.

2. Literature review

2.1. Design theory input in modelling firms’ ability to constantly renew their activity

Innovation has become a major issue for firms’ competitiveness due to fiercer competitive environment and to rapidly changing markets. Over the past few decades, researchers have devoted much attention to differentiate various innovation outcomes, and to related organizational structures and management practices to generate them.

Abundant research has stressed the need for developing a capacity to repeat innovation in order to create sustainable long-term value. Overall, researchers agree on the fact that no long-term success is built on a one-off innovation. On the contrary, regular renewal is fundamental to every firm’s long-term survival in contemporary economies (Jelinek and Schoonhoven 1993, O’Connor 2008, Le Masson, Weil et al. 2010). For example,

Christensen demonstrated how leading firms could fail because they would develop misfit next generation of product thus missing a new wave of innovation (Christensen 1997).

To do so, research has shown that nurturing a set of specific innovation capabilities is crucial for a sustainable innovation process. In the 90's, Cohen and Levinthal shaped the concept of absorptive capacity and argued that the ability of a firm to integrate new knowledge was critical (Cohen and Levinthal 1990). Hamel work on core competencies insisted on the need for permanent collective learning (Hamel and CK Prahalad 1994). Van de Ven described innovation process as activities repeated over time and resulting, among others, in constant learning (AH. Van de Ven, Polley et al. 1999). Nonaka differentiated tacit and explicit knowledge, and showed the significance of their dynamic interaction for enabling innovation (Nonaka 2000). Teece focused on firm's agility based on the development of dynamic capabilities ensuring the ability to adapt to radical changes (Teece 2007). Building on systems theory, O'Connor also proposed a framework for building major innovation dynamic capability including, among other elements, the management of exploratory processes and skills development (O'Connor 2008). The need for constantly appropriating and renewing firm's knowledge and competencies is core to these researches on innovation capabilities.

Recent advances in design theories offer an integrated framework to describe and explore the organizations and processes required to sustain innovation capabilities over two distinct design regimes (Hatchuel, Masson et al. 2006, Le Masson, Weil et al. 2017). This framework indeed highlights the difference between a regime based on established design rules, where the new products and services can be described with existing and stable performance criteria, and designed using the least new knowledge possible ; and an innovative design regime, where the identity of products and services to be designed can be deeply regenerated, thus prompting the need for radically new competences and knowledge, and renewing the imaginaries used to represent future desirable objects.

In the first design regime, the development of new competencies and products happens gradually, guided by a stable concept. New activities constitute lineages sharing common attributes and emerging from the exploration of stable knowledge bases in known directions. In economics, ruled-based design relies on a rationale of uncertainty reduction, for instance through usual marketing, testing and validation tools. In the following, we will refer to development strategies relying on this design regime as “K-strategies”, meaning strategies mostly relying on already acquired knowledge. However, the acceleration of the pace of innovation and the generalization of an innovation intensive capitalism has required of companies to adopt more and more frequently an innovation design regime (Le Masson, Hatchuel et al. 2010), where refining existing concepts or products is not enough. To deeply renew their activity, companies must simultaneously explore unknown paths, break away from existing design rules, define new value, expand competencies, and generate new opportunities. In practice, this development relies on two different expansions: first, companies must explore unknown properties of their future products to regenerate their underlying concepts. It relates to fuzzy front-end phase (Koen, Ajamian et al. 2001), ideation phase, creativity, regeneration of imaginaries (Agogué 2012) and expectations (Le Masson, Caron et al. 2013). We will refer to strategies aiming at regenerating these concepts as “U-strategies” (strategies relying on the unknown). Second, innovative design requires the expansion of associated knowledge and competencies, for instance through research and development steered by innovation fields, to transform concepts into actual products and services, and organize knowledge exploration and accumulation. It can result in products constituting new heads of lineage. Significant financial support can be required for example for prototyping or acquiring key technologies or competencies. We will call this second phase as a “U-K development”, to refer to the efforts necessary to develop unknown concepts into known lineage of products.

With this vocabulary, sustaining a capability for repeated innovation requires not only sustaining “K-strategies” but also regularly following “U-strategies” and consenting to “U-K development” costs.

2.2. Relationships between private equity investment and firm's innovation dynamics

Historically, private equity literature has been split between researches on two distinct investment stages: venture capital and buyouts (Glachant, Lorenzi et al. 2008, Broere 2013). Venture capital refers to private equity investments made for the launch, early development, or expansions of start-up companies (EVCA 2007) and buyouts, in a broad definition, gather financial acquisitions usually financed through a combination of equity and

debt (Wright, Robbie et al. 1994, Berg and Gottschalg 2005). While venture capital focus on entrepreneurial undertaking, buyouts target more mature companies.

In the private equity asset class, venture capital stands apart when considering the topic of innovation as it targets start-ups which are known as strong drivers of disruptive innovation in contemporary economy (Timmons, 1986). Venture capital is, de facto, linked to financing of innovation (Kortum and Lerner 1998) by researchers and practitioners much more straightaway than the other investment stages. Therefore, the following literature review start by analyzing the relationship between venture capital and innovation.

2.2.1. *Venture capital: investing in young firms to foster a one-off innovation*

Since the 90's, researches have tackled the issue of the role of venture capital in fostering innovation, starting with a strong focus on technological innovation (Timmons and Bygrave 1986). Three major inputs are discussed in the literature about the relationship between venture capital and corporate innovation.

Firstly, venture capital investors finance innovation as they invest in start-ups that are recognized as young innovative companies with high potential. Investment decision making determinants have been extensively discussed and it resulted in the identification of two key variables: business characteristics (investors would look for proof of technological maturity and market reality (Eckhardt, Shane et al. 2006, Bhidé 2010)) and management team, the latter being the most important for selection and ultimate success (Khanin, Baum et al. 2008, Gompers, Gornall et al. 2016, Gompers, N.Kaplan et al. 2016). However, when more precisely described, it appears that venture capital mainly provides funding for completing development and accelerating commercialization of creative concepts (Hellmann and Puri 2000). Thus, several studies show that venture capitalists do select innovative companies with the objective of helping them in the commercialization process rather than for generation of further innovations (Rin, Hellmann et al. 2011, Rin and Penas 2017). As mentioned in (Rin and Penas 2007): “*venture capital would therefore finance companies whose innovation strategies are already well developed, with the perspective of turning them soon into ‘cash cows’*”. Using the previous terms, VCs do help financing the “U-K development” phase, but only scarcely support the regeneration of concepts required in a following “U-strategy” to ensure a capacity to repeat innovation.

Secondly, an abundant literature has analyzed venture capitalist impact on backed start-ups. Especially, some papers search for ex-post correlation or causality between venture capital investment and innovation output of invested start-ups. This literature remains inconclusive. A stronger propensity to patent have been found for venture capital backed companies in the US (Kortum and Lerner 1998), but the results does not hold in the European context (S.Engel 2007). The number of new products and venture capital funding are shown to be correlated (Peneder 2010). However, the use of innovation indicators like patents or new products counts make it difficult to differentiate ruled-based design from innovative design. Few papers take a closer look at how investors influence start-up innovation strategy. Venture capital model of innovation acceleration (Engel 2011), known as the lean startup model, is described as a mean to find quickly an appropriate market for an existing product or pivot by trial and error to reach a first success. It is more about adjustment and development techniques than strategies to deeply renew ideas. Researchers also point out investor's network and brokering capabilities as an asset for start-up success often without linking it precisely to innovation strategy.

Lastly, the abundant academic literature that investigates valuation determinants agrees that exit considerations are the most important factor (Gompers, Gornall et al. 2016). However, there has been little attention paid to the relationships between investors' exit choice and innovation regimes except a theoretical paper (Schwienbacher 2008). It builds a framework showing that firms innovation strategy can be distorted by the entrepreneur to induce investor to exit through an IPO (preferred to industrial sale). It incorporates a level of innovation defined as “quality improvements compared to existing products” which can be related to the “K-strategies” of rule-based design. Another valuation challenge lies in the underlying pricing calculation method. Theoretical finance models based on income forecasts¹ are not applicable to start-ups at a very early stage because of their negative revenues. Applied at a later stage, it is not so accurate due to high uncertainties regarding their future. Comparable transactions methods are also difficult to apply as it gets tricky to find comparable firms for highly innovative activities. Even if some investors apply these models (Gompers, Gornall et al. 2016) further methods have been tailored by practitioners among which convention based approaches (Damodaran 2009, Meunier 2017). All these approaches

¹ discounted cash flow (DCF), internal rate of return, net present value, top down approach (which derives from DCF) Damodaran, A. (2009).

tend to forecast costs and revenues of known projects and don't apply when both market and product are still unknown which could explain why gut investment decisions are still used, especially at early stages (Gompers, Gornall et al. 2016).

Therefore, venture capitalists, who invest in start-up with the clear intention to exit after a limited amount of time, targets an innovative concept developed by a high potential firm and focus on funding its commercialization (one-off “U-K development” phase). They do not pay much attention to identifying and supporting the innovation strategy defined as the ability to repeatedly renew venture activity on the long run. Overall, financial valuation methods tend to get around the issue of assessing costs and revenues related to yet unknown activities. Venture capital strategies, even if critical for launching one-shot innovations, are not tailored to support firm's renewal through repeated innovation.

2.2.2. *Buyout: investing in mature firms to rationalize existing activities*

Unlike venture capitalists, it is well established in academic literature that buyout investors target mature and stable companies. As clearly stated by Nicole Torres in the Harvard business review, buyout investors “*don't invest in firms known for innovation*” but they “*are looking for companies that are dominant in a market, aren't risky, and have a predictable and steady stream of cash to pay back debt*” (Torres 2015).

Results of correlations between buyout investment and standard indicators for corporate innovation are mixed. On the one hand, there would be no impact on the amount of R&D expenses, no change in number, originality and genericity² of patents. On the other hand, patent portfolio would be overall more focused (Kaplan and Strömberg 2009, Lerner, Sorensen et al. 2011, Amess, Stiebale et al. 2015). Facing this lack of clear evidence on the relationship between investments and innovation, some researchers call for renewing indicators of innovation capabilities (Kerr and Nanda 2015) for example from patents, R&D expenses and number of new products (Kaplan and Strömberg 2009, Lerner, Sorensen et al. 2011, Amess, Stiebale et al. 2015) to development or acquisition of complementary assets (Teece 1986), the establishment of external collaborations and networking (Ahuja 2000) and external knowledge sourcing (Chesbrough 2012) as all these activities would impact the demand of external capital (Hall, Moncada-Paterno-Castello et al. 2016).

Buyout literature has also focused on value creation levers that generate returns for investors. Studies have historically emphasized operational and financial engineering as efficiency mechanisms used by investors to enhance financial performance (Holmstrom and Kaplan 2001, Bassoulet 2015, Gompers, N.Kaplan et al. 2016). Thus, buyout transactions have mainly been associated with cross-cutting activities, short-termism and downsizing workforce (Wright, Hoskisson et al. 2001, Harris, Siegel et al. 2005, Wright, Amess et al. 2009). This rationalization strategies depicted by literature, although generating strong returns for investors, are often accused of damaging R&D and more generally, innovation capabilities (Nadant and Perdreau 2011). Even if some other value creation levers, like internationalization and digitalization or product development (Bruining and Wright 2002, Berg and Gottschalg 2005), have been recently mentioned, researchers regret that scarce attention has been devoted to strategies that would invest in innovation and enable entrepreneurial growth (Meuleman, Amess et al. 2009) (Toma and Montanari 2017). Hence a call for a renewal of the historical rationalization strategies (Baker and Smith 2012, Hersh 2018).

Buyout valuation approaches (market and income) aim at estimating firm value at one point in time given its existing products and extrapolating its future developments for an infinite amount of time. Due diligence processes have been formalized to estimate probability of business plans to be accurate. In practice, these methods are known to be less reliable when it comes to innovative companies with potential to develop yet unknown products targeting unknown markets.

Market approach compares the firm to others with the same characteristics (same sector, size, region, structure...). There are two key variables: a common financial variable (e.g. EBITDA) used to compare firms and the multiple which depends both on firm's sector and on intrinsic specification. Income approach, embodied by the discounted cash-flow method, is now the most popular. It is an intrinsic valuation when the comparable method generates a

² An original patent quote patents from various patenting classes. A generic patent is cited by several other patents from distinct patenting class.

relative valuation. In theory, the method calculates firm valuation through the net present value of the benefit stream to be generated infinitely. It is based on forecasts about future firm performance.

$$\sum_{t=1}^{\infty} \frac{FCF_t}{(1 + WACC)^t}$$

This calculation method involves two key variables: firm future free cash flows (FCF) and “actualization” (WACC). FCF derives from future profit stream, taxes, working capital requirement and investments flow. Discounted cash flow and relative valuation may converge if the market is on average correct in the way it prices assets. The more innovative is the firm, the harder it is to find comparable activities or transactions or to extrapolate future cash-flow from past activities.

For various reasons, among which liquidity and legal requirements, private equity funds invest in companies with the clear desire of exiting after an average of five years. Investors holding period rarely exceed ten years. Thus, unlike in the theoretical financial model that considers expected value creation generated infinitely, in practice, private equity investors focus on a limited timeframe. Investor’s return on investment depends mostly on the difference between the selling and purchasing price of invested companies which is based on valuation calculations results. A second revenue stream comes from dividends, especially in leveraged buyout (LBO) deals where it is used to pay back investors’ debt.

Therefore, buyout investors preferred target are stable companies that would take advantage of being supported in rationalization strategies (i.e. “K-strategies”) to increase their revenues. Financial valuation approaches coming from historical corporate finance models serves such targets and strategies. Thus, buyout mode of investment is not tailored to support firms’ renewal through innovative design.

3. Characterization of several mode of investment

Based on the literature review, we define two main relationships between modes of investment and innovation that are summarized in table1. Overall, it appears that there is a research gap on the relationship between modes of investment and corporate innovation dynamics enabling firms’ renewal through innovative design regimes. Venture capital methods do foster part of the sequence of an innovative design process, that is a one-shot creative concept development and commercialization, but they do not focus on the renewal of these concepts (“U-strategies”) nor on the development of stable lineages (“K-strategies”). On the other hand, buyouts investors have trouble taking into account innovation capabilities as their historical operational mode is based on rationalization of existing activities more than their renewal.

Table 1: relationships between private equity modes of investment and innovation extracted from literature

	Venture capital	Buyout
Target selection	Young companies with high growth potential with an already defined creative concept and strong management team	Stable and mature firms
Post-investment strategy	Faster commercialization (one-off “U-K development” phase)	Rationalization (“K-strategies”)
Valuation	From early to later stages: gut decisions, convention based approaches, market and income approaches	Market and income (discounted cash flow) approaches

A few research papers do contribute to investigate this research gap and characterize other ways to invest in innovation. Generally, studies on the impact of buyout on entrepreneurship have shifted from an historical claim that private equity would negatively affect firm's ability to sustain entrepreneurial activities to evidences that private equity backed firms do promote entrepreneurial investment opportunity (Amess, Stiebale et al. 2015), especially through MBO (Bruining, Verwaal et al. 2013). A paper emphasizes new conditions on investor mindset for a buyout operation to foster corporate innovation thanks to either incremental changes or renewal (Wright, Hoskisson et al. 2001). Instead of controlling managers like in the traditional perspective, this entrepreneurial approach focuses on promoting innovative ones. Yet, empowering managers still don't give investors clues on how to concretely impact innovation strategy. Another study (Toma and Montanari 2017) showed how a private equity investor may help the development of new organizational capabilities in the specific context of family firms. On the venture capital side, an original paper (Rin and Penas 2017) recently pointed out that investors urge firm's to strengthen their absorptive capacity, hence innovation strategy (Cohen and Levinthal 2000), by favoring a "make and buy" R&D. However, there is not any clear model yet that builds on this emerging literature and would complement existing approaches to help support repeated innovation capabilities.

In this paper, in line with the previous contributions on the relationship between investment and firm's innovation dynamics, we address the following research question: how can private equity support firm's repeated innovation capabilities? In the following, we hypothesize that private equity funds investing in innovative firms could use other approaches that are not yet traced in the academic literature. And we propose a hypothetical model that would take into account the latest advance made in design theory literature.

As our focus is on the way private equity investment can foster the development of repeated innovation capabilities, we exclude from our main model the early stages of venture capital, where the strategy mostly relies on the incubation of existing projects, with the hope that they include "golden nuggets", i.e. a portfolio strategy where the small percentage of successful invested firms should compensate for the failure of all others and ensure investor financial return. On the contrary, the development of a sustained innovation capability supposes a strategy at the firm-level, which is more likely to be found in already existing firms like small and medium-sized companies (SME), middle market firms or large ventures.

Building on buyout literature, we characterize a first "classical" investment mode (M1), mostly relying on "K-strategies". In this model, the valuation method based on DCF can only provide an estimation of a firm's value based on extrapolation of existing activities (previous cash flows) and target an increase in financial returns during the holding period. A rise in free cash flows provides both more dividends and a better valuation (through market and income approaches) at the exit. As for historical buyout operations, such valuation framework would favor investments in mature firms with reliable sources of income and low risk growth strategies. This valuation process values growth scenarios on known projects, even if still uncertain, like optimization of existing activities, operational and financial engineering or some types of build-up.

Following the three core attributes (target selection, strategy and valuation) depicted for other modes of investments we can build another mode of investment that would meet firms' need for repeated innovation (M2). Firstly, investors would look for firms' capabilities for repeated innovation which raise the question of how to identify them. Secondly, based on design theories, investment strategy should support both concept generation ("U-strategy") and foster their realization ("U-K development"). Finally, they would need valuation approaches that won't be only based on pure extrapolation of past performance (that is of "K-strategies") but would also take into account the future value of concepts that are still under development. Table 2 summarizes this second model.

Table 2: proposition of another mode of private equity investment (M2)

	Venture capital	M2	Buyout (M1)
Target selection	Young companies with high growth potential with an already defined creative concept and strong management team	Firms with innovation capabilities	Stable and mature firms
Post-investment strategy	Faster commercialization (one-off “U-K development” phase)	Support concept generation (“U-strategies”) and foster their realization (“U-K development” phase)	Rationalization (“K-strategies”)
Valuation	From early to later stages: gut decisions, convention based approaches, market and income approaches	Assess concept value	Market and income (discounted cash flow) approaches

4. Research setting

This empirical study aims at both validating the common use of the above defined extrapolation mode of investment extracted from literature (M1); and characterizing another one (M2) tailored to support firm’s innovation dynamics.

This research has been carried out thanks to a collaboration with a French private equity firm managing several investment funds known for targeting innovative companies. The partnership gave us the opportunity to explore investment strategies throughout a multiple case study methodology (Eisenhardt and Graebner 2007). We chose to focus on investments in middle market firms. Indeed, in between SMEs and large ventures, middle market firms, often operates in niche markets. Thus, they face the challenge of constantly renewing their activities through repeated innovation to sustain their competitive advantage. Although they are known for having entrepreneurial mindset (Grandclaude, Nobre et al. 2014). Unlike young firms, they benefit from a financial track record which provides a stronger ability to predict future revenues. Thus, investigating current private equity investment practice in European middle market firms should reveal other models and enrich both literatures on buyouts and venture capital.

We selected cases from two multi-sector funds specialized in mid-cap investments. These funds have invested in more than 45 firms since early 2009, soon after French legislation acknowledged middle-market companies as a distinct firm category. The sampling process was designed to provide firms with polar types to emphasize surprises and single out significant parameters. We aimed at selecting middle-market companies of different sizes in terms of workforce and turnover, operating in different business sectors, and implementing, at first glance, various growth strategies.

We had a unique access to contrasted data both from investors’ side (interviews, due diligences, follow-up documents), and firms’ side (interviews with firm’s founder, management teams, research teams and partners). On the one hand, investors in charge of the deal would help understanding the investments’ rationale. On the other hand, a direct access to middle-market firms would enable to better analyze their innovation strategies. We also triangulated this data with press articles and open-access patent databases. We faced one main constraint due phases of re-negotiations that can arise during the investment cycle (related, for example, to exit or reinvestment). By that time, both firms and investors are reluctant to disclose information. Based on our selection criteria and the above constraint, a sample of three middle-market companies was chosen for an extensive study. In this paper, we choose to present only the case of NRJ firm which sums-up our results.

5. Empirical analysis

NRJ, created a few decades ago, manufactures and sells the core component of an energy production device. NRJ’s first product resulted from a newly-patented technology which gave the firm a sustainable competitive edge. Building on this first one-off innovation, intensive R&D activity have generated a whole range of product families as well as improvements to the manufacturing process. Around 2010, one of the two founders sold its shares to a private equity fund (that will be called “PEF”) which became the majority shareholder, thus deeply changing historical shareholder distribution.

5.1. Ex-post analysis of PEF investment strategy in 2010

By that time, NRJ was already a mature firm. Working on the concept of an “instant product line”, major improvements in manufacturing process duration had been made, shrinking it from more than an hour to a few minutes (“U-K development”).

Each new product had systematically been protected by a patent application. An in-depth analysis of NRJ patents showed NRJ historical ability to constantly renew its value proposition and formulate original concepts (“U-strategy”) directly embodied in new patents, then generating head of lineage (“U-K development”) finally completed by related lineages extensions (“K-strategy”). In addition to the first historical product, there had been a focus on energy efficiency and compactness improvement (in terms of volume and weight). NRJ had also generated two other concepts (modular and easy to plug products) from which emerged two lineages that provided steady returns. Besides, in 2010, other products based on new technologies recently patented by NRJ were about to be launched. They were mature enough for PEF to quantify remaining investments needed to finish their development and the related future incomes. This analysis of the period before PEF’s investment demonstrates that NRJ already had some capabilities to develop innovative design strategies. Based on a detailed patent analysis, Fig.1 shows the various design spaces that have been generated over time and the related patents and products.

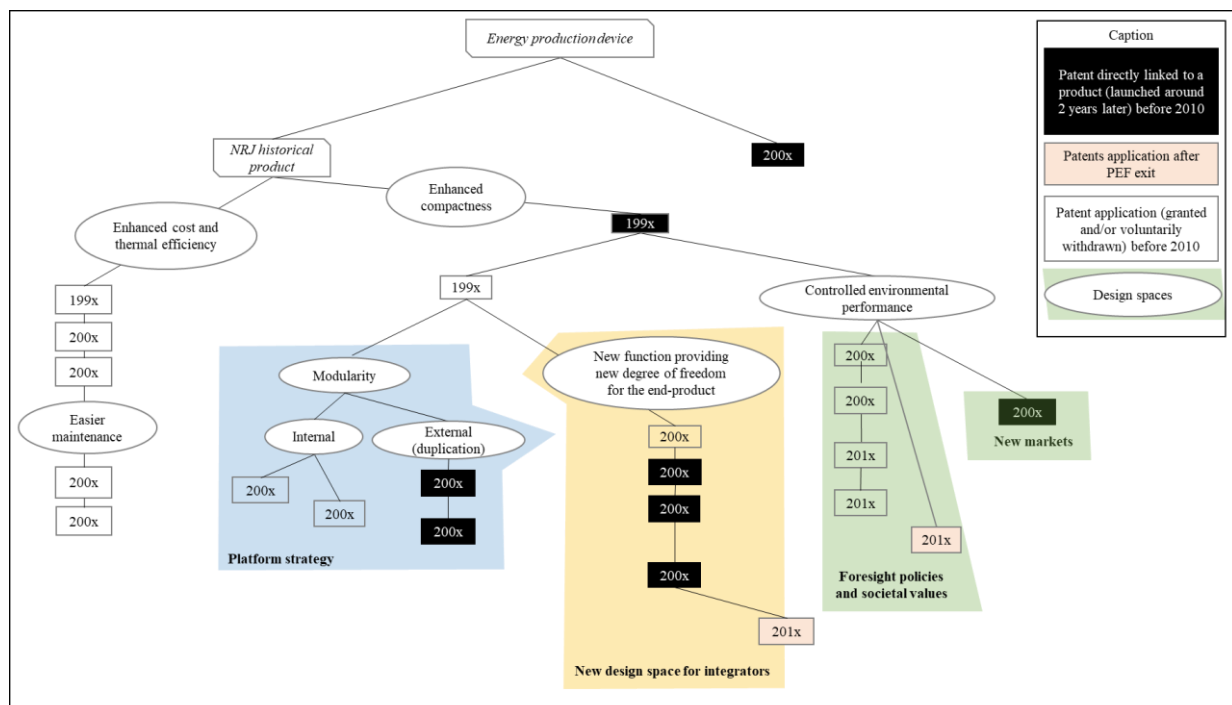


Figure 1 : patent analysis and design spaces generated by NRJ since its creation

Through the due diligence process, PEF had access to product roadmap and related patents. Therefore, PEF could write a business plan that faced low uncertainty by building on both existing revenues from newly commercialized products, and forecasts on remaining development costs and upcoming revenues of products that were about to be launched.

At the beginning of the holding period, PEF did complete the product development (“U-K development”), launched the new products as well as enhanced the production capacity by building additional production lines and extending NRJ factories. Although R&D expenses remained stable, no additional patent nor product emerged during the whole PEF holding period. NRJ benefited from an underlying booming market on which the firm was well positioned thanks to environmental regulations favoring the in-house technology. Combined to reduced workforce costs and a sharp decrease in capital expenditures, free cash flow increased. This empirical analysis highlights that PEF investment matches (M1) investment mode targeting an increase in financial returns during the holding period through the exploitation of existing activities.

Patent analysis also attests that the first patents filed after PEF exit filed long enough after PEF exit to assume that the underlying concept had not been developed during their holding period, thus deterring the hypothesis that they supported a “U-strategy”.

5.2. Empirical analysis of investment strategies at the time of PEF exit in 2015

Around five years after closing the deal, PEF wished to exit.

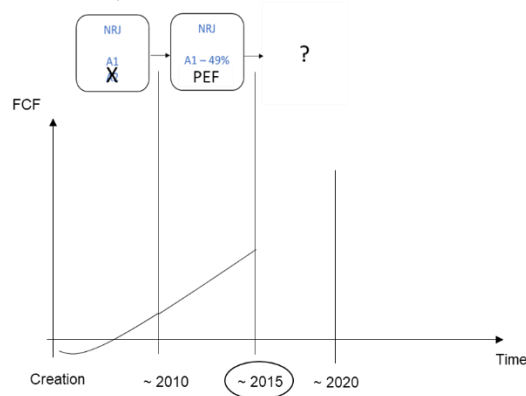


Figure 2: Capital structure and recorded free cash flows of NRJ from its creation to 2015

Among others, the French private equity fund we collaborated with considered the deal. Due diligence documents stated that no external growth nor product development were considered for valuation assessment. A decrease in unit margins was forecast due to products obsolescence and competition while sales in volumes were foreseen as increasing and everything else stable. Therefore, free cash flows were forecast to be only slowly raising during the next holding period. This analysis is consistent with the literature on innovation management: absent any regeneration strategy on the offer of products and services of the company, “K-strategies” are at risk to become obsolete in a rapidly-changing environment. How then should the company be valued at that time (fig. 2)?

Our interviews with the company’s CEO, as well as press articles published at the time, show that given this limited valuation potential over the next 5 years period, several private equity funds offered to buy NRJ with the strategy of relocating part of production lines in foreign and cheapest countries, and optimizing the production costs. Again, consistent with the (M1) model, this strategy consists in rationalizing existing projects with stable knowledge and is not conducive to a repeated innovation strategy.

Following a strategic exchange with NRJ’s CEO, the French private equity fund agreed to buy the company for the same price as the other funds, but refusing the relocation strategy, and preserving the historical amount of R&D expenses and capital expenditures. Using the traditional valuation method, based on the extrapolation of previous cash-flows, it appears that the French private equity fund would therefore have over-invest to buy NRJ. Yet, knowing that this French private equity fund is legally bound to do its utmost to ensure the best return on investment, it reveals that it valued something else that required further R&D and CAPEX investments. In other words, this strategy is inconsistent with the (M1) investment model, which corroborates that usual mode of investment and related valuation approaches are sometimes incomplete.

Building on (M2) mode of investments, we can assume the three following hypotheses. First, the French private equity fund usually targeting innovative firms has identified the innovative capabilities NRJ showed before the PEF investment period, which remarkably gave birth to various patents and several successive lineages of products, although none was developed after 2010.

Second, their post-investment strategy did not consist in supporting “K-strategies” by rationalizing investments and costs on already existing projects, but aimed at supporting concepts and products renewal during the holding period i.e. “U-strategies” and “U-K development”. This explains why they invested in R&D and capital expenditures. This point is crucial: it highlights that the potential use of invested funds can be different in model (M1) and model (M2).

Third, the traditional valuation calculation cannot account for the strategy followed in model (M2). Because (M1) model would value an extrapolation of existing projects in addition to an increase in cost efficiency $\Pi_{(M1)}$ linked to the relocation strategy, it means that the model (M2) assumes another kind of added value $\Pi_{(M2)}$, similar to the previous one, but mostly linked to “U-strategies” and “U-K development”. Data gathered since 2015 shows that two new patents and one product was launched, prompting the hypothesis of a new lineage based on a new cycle of “U-K development”. If so, the valuation calculation for model (M2) must include a valuation of these new products. Therefore, this valuation would have been split in two parts. On the one hand, a usual extrapolation of revenues due to existing products. On the other hand, a premium resulting from the exploration of the unknown, which was financed and supported by the fund. Fig. 3 shows in green the expected valuation following a “K-strategy” and in blue the expectation of a strategy based on higher R&D and capital expenditures, with later earnings due to new products and services.

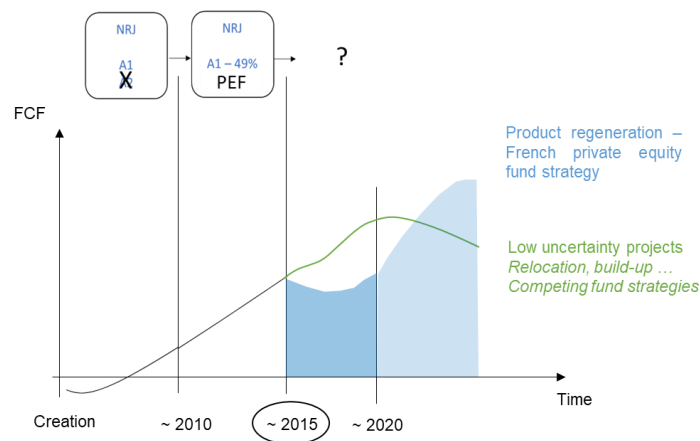


Figure 3: From 2015, expected valuation forecast by the French private equity fund and its competitors

Based on the usual definition of free cash flows, including earnings (EBITDA) and spending in capital expenditures (CAPEX), a calculation of this (M2) valuation supposes an evaluation of net earnings forecast with new products, but also of spending necessary to develop from a partially unknown concept to a known lineage.

$$Valuation = \sum_{t=1}^{\infty} \frac{FCF(\text{existing_products})}{(1+WACC)^t} + \Pi$$

$$\text{with : } \Pi_{(M2)} = EBITDA_{(\text{unknown_products})} + CAPEX_{(\text{unknown_products})}$$

6. Discussion and conclusion

According to the empirical study, the French private equity investor has been able to identify firm's innovation capabilities among which a highly structured R&D department, an historical ability to constantly develop new concepts and renew its products accordingly. The fund has also assessed the amount of investment needed to revive NRJ's innovative design regime.

Indeed, it seems that from 2010 to 2015, PEF brought NRJ's innovative design activities to a standstill. In 2015, competing offers were planning to relocate NRJ manufacturing plants abroad. We could assume that innovation would not have been considered as a value creation levers. Similar rationalization strategies implemented through successive investment cycles could risk to irreversibly damage NRJ innovation capabilities. Indeed, product obsolescence and external competition would end eroding firm's financial performance and valuation.

On the contrary, the French private equity fund chose to invest in firm's renewal although keeping a wise valuation approach that doesn't account for future revenues from new products. Three hypotheses can be made. Either investors wished to keep their investment strategy secret thus not writing everything down. Either they gave back freedom of action and a funding envelop to managers assuming they would better know how to support NRJ renewal. Or, current tools like due diligence frameworks and valuation calculations are not adjusted for such innovative firms.

In line with this last hypothesis, we propose a new mode of investment and especially, a renewed valuation approach that takes into account both forecasts extrapolated from past activity and a premium related to innovative design activities. In 2020, when the French private equity fund could wish to exit, two scenarios can be foreseen (assuming stable revenues from existing activities). If the fund faces an investor using the traditional (M1) mode of investment, then only products linked to "K-strategies" or nearly completed "U-K development" would be considered in valuation calculations. Therefore, if, in 2015, the French private equity fund failed in generating both new concepts and related products within its holding period, it will sell at a loss. If the fund faces in 2020 an investor using (M2) mode of investment, then, even if no new products have been launched during the holding period, if it succeeded in tailoring relevant new concepts and in exploring their related value, thus generating new "U-K development" phases, it could still benefit from an increase valuation (forecast $\Pi_{(M2/2020)} = EBITDA_{(U-K \text{ development})2020} - CAPEX_{(U-K \text{ development})2020} > CAPEX_{(U-K \text{ development})2015}$). (M2) mode of investment aiming at supporting both "U-K development" and generation of new concepts ("U-strategy"), further research could aim at including into valuation calculation (i.e. Π and CAPEX) the value of "U-strategies" (i.e. value of underlying concepts). Yet, it would raise the issue of expectation management (Le Masson, Caron et al. 2013) and the risk of creating valuation bubbles by over evaluating attractive promises.

Finally, this research contributes to the venture capital and buyout literatures that investigate the impact of private equity investment on firm's innovation capabilities. By building on recent advances in design theories, it further refines the relationship between main modes of investment described in venture capital and buyout literatures and firm's innovation dynamics. Besides, it explains previously unnational deals by proposing an original mode of investment that meets firms' need for support to repeated innovation. From a managerial point of view, it confirms that a mismatch between firm's design regime and private equity fund mode of investment can, in the long run, hinder firms' innovation capabilities. It also begins to shape new valuation approaches and post-investment strategies that better foster invested firm's innovation capabilities, among which R&D activities.

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