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Financialization and Innovation

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Abstract

The rapid financialization of U.S. NFCs in the recent decades makes the link between finance and innovation even more critical. Historical data show that since 1970, U.S. NFCs have almost doubled the share of financial incomes in their incomes. Despite mounting financial incomes, NFCs' long-term growth has been constantly diminishing. This study set out to uncover the possible link between the financialization of the NFCs and their innovativeness. We theorize that financialization has a paradoxical effect on innovation. While supremacy of the financial logic can negatively affect the quantity and quality of NFCs' innovation, the means that it provides can help NFCs to boost their innovation. More importantly, it is the interaction between financial logic and financial profits that determines how financialization of the NFCs affects their innovation. Our findings, based on a longitudinal sample of the US public pharmaceutical firms from 1976 to 2006, support our main hypotheses and provide nuanced insights into how financialization of the organizations affects their innovativeness.

Financialization and Innovation

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“Where enterprise leads, finance follows.”

Joan Robinson (1952)

“The reality is that finance will eat strategy for breakfast any day; financial logic will overwhelm

strategic imperatives”

Christensen (2014)

INTRODUCTION

The past thirty years have seen a growing trend towards the dominance of the finance sector over the U.S. economy, which has imposed its logic to the other sectors of the economy, specifically the nonfinancial sector. Data show that since 1970, despite the mounting amount of assets that NFCs have held, their long-term growth has constantly decreased. As Christensen & van Bever (2014) state, “despite historically low interest rates, corporations are sitting on massive amounts of cash and failing to invest in innovations that might foster growth”. So, understanding how financialization affects the innovative behavior of the non-financial corporations (NFCs) is the first step to solve the old “capitalist’s dilemma”.

However, before studying the link between financialization and innovation, first we need to understand what financialization is and how we can measure it, and second we should have a clear idea about the role of finance in innovation.

Financialization literature offers two sets of financialization’s indicators –financial profits (Krippner, 2005; Van der Zwan, 2014) and financial logic (G. F. Davis & Kim, 2015; G. F. Davis, 2009; Krippner, 2005; Soener, 2015; Stockhammer, 2004; Van der Zwan, 2014; Yan, Shipeng, Ferraro,

Financialization and Innovation

Fabrizio, Almandoz, 2016). While these indicators can be positively correlated, they are not necessarily the same. By separating the “means” (financial profits) provided by the financialization from its “end-goals” (financial goal) (Yan, Shipeng, Ferraro, Fabrizio, Almandoz, 2016), we build a means-end-goals matrix, which gives us a more inclusive image of the financialization of the NFCs. According to this matrix firms can be financialized across two different dimensions (means and end-goals) and end up in different categories of financialization.

On the other hand, research on the link between finance and innovation has been split into two traditions, one on the presence of financial constraints for the innovative firms (Brown, Fazzari, & Petersen, 2009; Czarnitzki & Hottenrott, 2011; B. H. Hall & Lerner, 2010; Hottenrott & Peters, 2012; Kerr & Nanda, 2015; O’Brien, 2003) and the other on the corporate short-termism and managerial myopia (Begley, 2015; Bushee, 1998; Hitt, Hoskisson, Ireland, & Harrison, 1991; Kochhar & David, 1996; Lazonick, 2014; Lerner & Wulf, 2007; Marginson & McAulay, 2008; Stein, 1988). In short, according to this literature finance has a paradoxical role in the innovation process. While, it helps firms to overcome financial constraints they face during the innovation process, it can also make them short-termism and cause their managers behave myopic.

Connecting two branches of research on the link between finance and innovation to our financialization matrix allows us to produce several testable hypotheses about the effect of financialization on innovation. Our main claim is that while financial logic has a negative impact on the quantity and quality of NFCs’ innovation, financial profits helps NFCs to boost their innovation. More importantly, we maintain that it is the interaction between financial logic and financial profits that determines how financialization of the NFCs affects their innovation. Our findings, based on a longitudinal sample of the US public pharmaceutical firms from 1976 to 2006, support our main hypotheses and provide nuanced insights into how financialization of the organizations affect their innovativeness.

Financialization and Innovation

Putting all results together, this study offers a more comprehensive survey of the relationship between financialization and innovation in U.S. NFCs, and helps us to understand better how dominance of the finance since 70s has deterred some managers of U.S. firms from investing in innovative projects, while encouraged some other managers to innovate even more.

This paper complements the literature on the effect of finance on innovation, specifically the link between financialization and innovation. These debates are not new, and over the past years researchers have related financialization of the nonfinancial firms, though from very different perspectives and with different measures of innovation, suggesting a possible relation between financialization and firm's innovativeness (Begley, 2015; Bernstein, 2015; Bushee, 1998; Edmans, Fang, & Lewellen, 2013; Edmans, Heinle, & Huang, 2013; Gleadle & Haslam, 2010; Gleadle, Parris, Shipman, & Simonetti, 2012; Kochhar & David, 1996; Lazonick & O'sullivan, 2000; Lazonick, 2014; Mazzucato, 2015). In this study, we connect two main branches of this literature (financial constrains and corporate short-termism) to the different types of financialization of the firms. Doing this helps us to propose a clearer image of the link between financialization and innovation, which is consistent with both financial constrains theory and corporate short-termism theory.

Furthermore, our results strengthen criticisms of the shareholder value ideology (e.g., Davis, 2009; Fligstein & Shin, 2007; Ghoshal, 2005; Lazonick & O'sullivan, 2000; Lazonick, 2014), and contributes to the literature on financialization of nonfinancial corporates (e.g., G. F. Davis, 2009; L. E. Davis, 2016; Krippner, 2005, 2011; Lazonick, 2011; Soener, 2015). Shareholder value movement has been blamed for the corporate short-termism, the portfolio conception of corporation, and its shuffling-and-reshuffling strategy to maximize portfolio returns (L. E. Davis, 2016; Krippner, 2011). Our results support these criticisms. Moreover, our paper is the first study of financialization of NFCs that goes over balance sheet metrics of financialization and offers empirical evidences for the financialization of nonfinancial firms through shareholder value ideology.

Financialization and Innovation

One particular study that survey the similar decline in the investment of firms in innovation since 1970 is Arora, Belenzon, & Pataconi (2015). Arora et al. (2015) investigate carefully the shift away from the scientific research by large corporations between 1980 and 2007, and maintain that this transformation appear to be associated with the globalization and narrower firm scope. While, their research offers a careful and systematic analysis of the shift from long-term basic innovation to more technological applied innovation, the possible mechanism that they give for this shift are consistent with our results. As it mentioned in the next section, both globalization and narrower firm scope are associated with financialization of NFCs, and hence Arora et al. (2015) reinforce findings of this study.

The remainder of this essay is organized as follows: The subsequent sections review the related literature about the financialization and its link to the innovation literature. Following section begins by laying out the theoretical dimensions of the research, and contains our main hypotheses. A section describing data and research methods of our analyses follows it. We conclude with analyzing and discussing our results.

LITERATURE REVIEW

Financialization

The past thirty years have seen a growing trend towards the dominance of finance sector over the U.S. economy (and other developed economies), and imposing its logic to the other sectors of the economy, specifically the nonfinancial sector. Scholars labeled this prevalence of finance in the society as the “financialization” of the society (Arrighi, 1994; Davis & Kim, 2015; Davis, 2009; Epstein, 2005; Krippner, 2005; Lin & Tomaskovic-Devey, 2013;; Stockhammer, 2004; Van der Zwan, 2014). Financialization refers to the prevalence of financial practices and activities in the society, which can occur at different levels. At the level of economy, financialization denotes the dominance of finance, financial markets, and financial institutions over the working economy (G. F. Davis & Kim, 2015; G. F. Davis, 2009; Epstein, 2005; Krippner, 2005; Lin & Tomaskovic-Devey,

Financialization and Innovation

2013). At the level of nonfinancial corporations (NFCs), financialization implies accumulation of profits through financial channels and activities rather than through trade and commodity production (Krippner, 2005; Van der Zwan, 2014), or it indicates the supremacy of the financial logic – maximizing shareholder value- in the managerial decision making (G. F. Davis & Kim, 2015; G. F. Davis, 2009; Krippner, 2005; Soener, 2015; Stockhammer, 2004; Van der Zwan, 2014; Yan, Shipeng, Ferraro, Fabrizio, Almandoz, 2016). According to the former definition of the financialization of the NFCs, we can measure the level of the financialization by looking at the share of their financial profits. While, the latter definition suggests we can measure the level of the financialization by examining the dominance of the financial logic within NFCs.

Regardless of the way we measure financialization, empirical evidences support the main idea. First, a quick look at U.S. NFCs' historical data shows a surge in their financial income compare to their operating income (Figure 1). According to the Federal Reserve dataset, since 1970, U.S. NFCs have almost doubled the share of the financial incomes in their incomes.

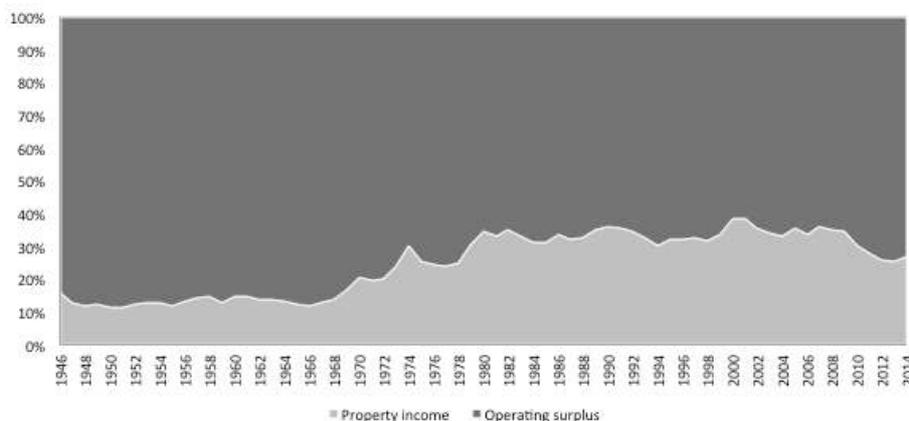


Figure 1 U.S. nonfinancial corporate businesses' income composition, 1946-2014. Ref.: Federal Reserve (*Property income* is the income receivable by the owner of a financial asset or a tangible non-produced asset in return for providing funds to or putting the tangible non-produced asset at the disposal of, another institutional unit; it consists of interest, the distributed income of corporations, reinvested earnings on direct foreign investment, property income attributed to insurance policy holders, and rent. *Operating surplus* is the surplus (or deficit) on production activities before account has been taken of the interest, rents or charges paid or received for the use of assets.)

The surge of financial incomes of U.S. NFCs has been accompanied by a nearly constant increase in the amount of financial assets that these firms have held (Figure 2). Like financial incomes, since 1970, U.S. NFCs have almost doubled the share of their financial assets.

Financialization and Innovation

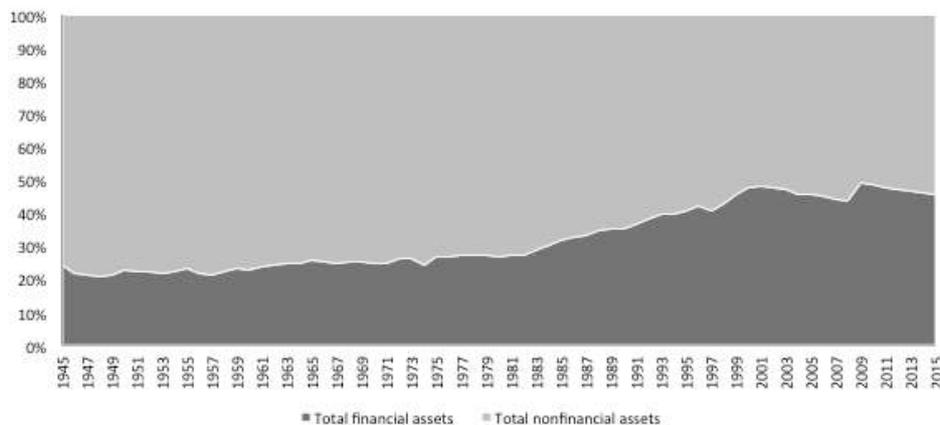


Figure 2 U.S. nonfinancial corporate businesses' assets composition, 1945-2014. Ref.: Federal Reserve

At the same time, U.S. NFCs were also zealous players of the financial markets. Federal Reserve's time series show that since 70's economic depression, U.S. NFCs on average have doubled the sum of their debts and equities (relative to their net worth) (Figure 3).

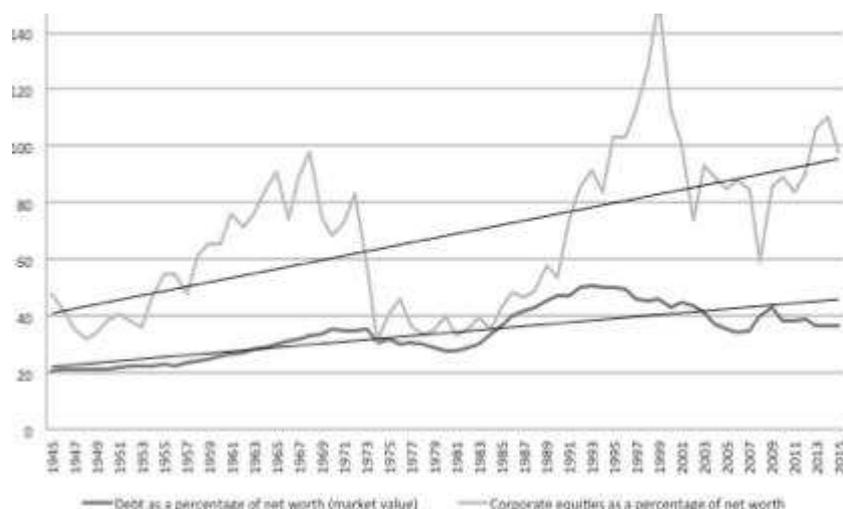


Figure 3 U.S. nonfinancial corporate businesses' capital structure, 1945-2014. Ref.: Federal Reserve

However, such an active engagement in the financial markets has had its cost. The data show that since 1970, despite the mounting amount of assets that NFCs have held, their long-term profitability has constantly declined (Figure 4). Considering the transformation of the U.S. economy from manufacturing to service that leads to the less assets dependency, this image is a conservative estimation of the decline of U.S. NFCs' profitability. This trend is consistent with the idea of the "capitalist's dilemma" introduced by Christensen & van Bever (2014) that, "despite historically low interest rates, corporations are sitting on massive amounts of cash and failing to invest in innovations that might foster growth".

Financialization and Innovation

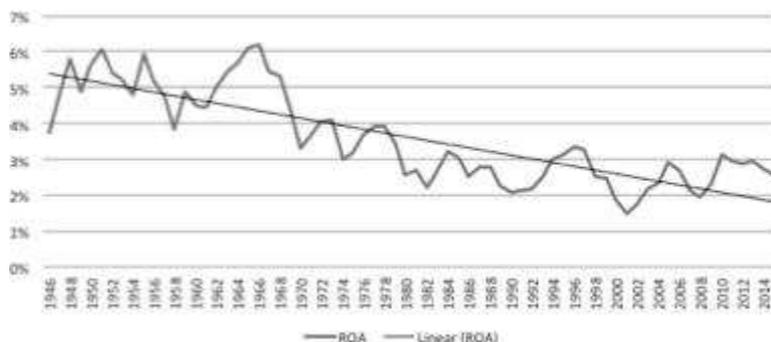


Figure 4 U.S. nonfinancial corporate businesses' ROA, 1946-2014. Ref.: Federal Reserve

In fact, a closer look at the composition of the financial incomes of U.S. NFCs indicates that these firms have increased their financial incomes more and more by earning higher interest incomes rather than by increasing dividends they received or profit from their FDI (Figure 5)¹. Putting the declining ROA and the increasing interest incomes together, the capitalist's dilemma sounds more justifiable. At least on the surface, it seems that firms are sacrificing investing in innovation at the altar of easy short-term profits from financial markets. However, Christensen & van Bever (2014) do not give empirical evidences for the capitalist's dilemma. So, the question remains that if financialization really hurts innovation or the patterns we observe is just the result of an unobserved common cause.

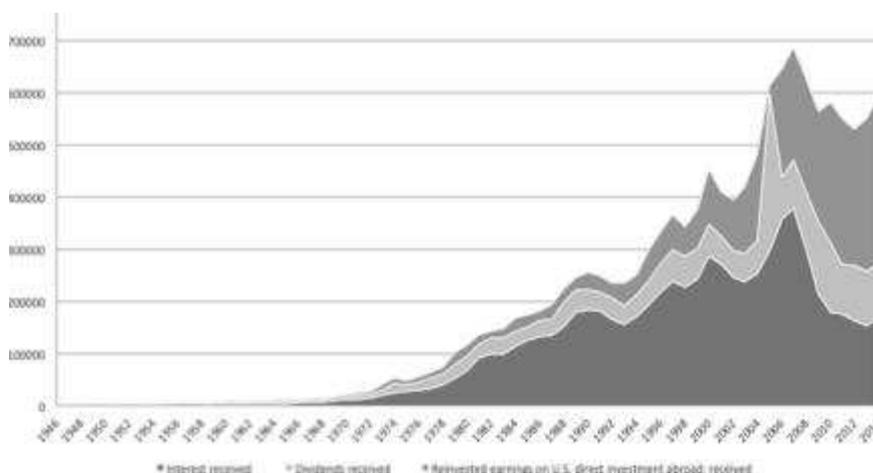


Figure 5 U.S. nonfinancial corporate businesses' property income composition, 1946-2014. Ref.: Federal Reserve

¹ These observations are consistent with Krippner (2005).

Financialization and Innovation

Why do firms get financialized?

Analyzing the relationship between financialization and innovation needs a clear understanding of the causes of the financialization itself. Putting it more precisely, why do firms get financialized in the first place? And which firms are more prone to the financialization? Economists, sociologists, and organizational theorists have proposed different but not mutually exclusive accounts of the roots of the financialization. Among these accounts, three of them that have been more echoed are “speculative mania”, “shareholder value”, and “capitalist development” (Krippner, 2011). Each of these explanations focuses on the different level of analysis and sector, and among them the shareholder value perspective on the rise of finance in the U.S. economy has been more appealing to organizational theorists as it focuses on the firm-level, and studies nonfinancial businesses (G. F. Davis & Kim, 2015; Krippner, 2011; Soener, 2015; Van der Zwan, 2014). Indeed, the shareholder value literature expands the analysis of the financialization from processes internal to financial markets to assess the relationship between nonfinancial firms, financial sector actors, and the state in forming and imposing a new standard for management (Krippner, 2011).

For instance, Stockhammer (2004) argues that the change from the “managerial capitalism” to the “financial capitalism” occurred through the shareholder revolution. Consistent with our observations, Stockhammer (2004) proposes that the "managerial capitalism" era (pre-1970) was mainly characterized by retain-and-reinvest policies of the relatively independent management that prioritized growth over profits. While, Shareholder revolution (post-1970) made managers’ interests aligned with those of shareholders, who prioritized profits over growth. This shift in the priorities changed managerial priorities from the growth of the market share to the short-term profits or simply the rise of the stock price (Lin & Tomaskovic-Devey, 2013; Stockhammer, 2004). Fligstein & Shin (2007) maintain that the pressure of the shareholder value maximization ideology forced managers to involve in precisely those forms of financial reorganizations that were suggested by the financial community. In fact, managers try to financially engineer their balance sheets (for instance by

Financialization and Innovation

borrowing money to pay for new companies, or by paying out cash to shareholders) to boost their share price and at the same time make their firm less valuable as the takeover target (Fligstein & Shin, 2007). In a recent survey of chief financial officers indicated that 78% would "give up economic value" and 55% would "cancel a project with a positive net present value" to meet shareholders' targets and fulfill their desire for "smooth" earnings (Mukunda, 2014). Therefore, it is not surprising if managers prefer financial engineering to production activities, and accumulate profits increasingly through financial channels rather than through production and trade (Krippner, 2005).

The shareholder value perspectives answers the question of why do firms get financialized in the first place, but does not offer an explanation for the variation of financialization within and across firms. Explanations for such variations in the literature are rare. Soener (2015) attempts to summarize this literature and test proposed explanations. According to his survey of the literature, globalization, competition, profitability, market uncertainty, focus, unionization, total and within industry levels of financialization, and connections to the financial consultants (auditing firms) are possible explanations for the variation of financialization within and across firms. Soener (2015) tests these explanations on a sample of apparel and footwear firms and finds supports for some of them. While, his empirical analyses can be criticized, his main point, which is there is variation across firms in the level of their financialization, sounds valid.

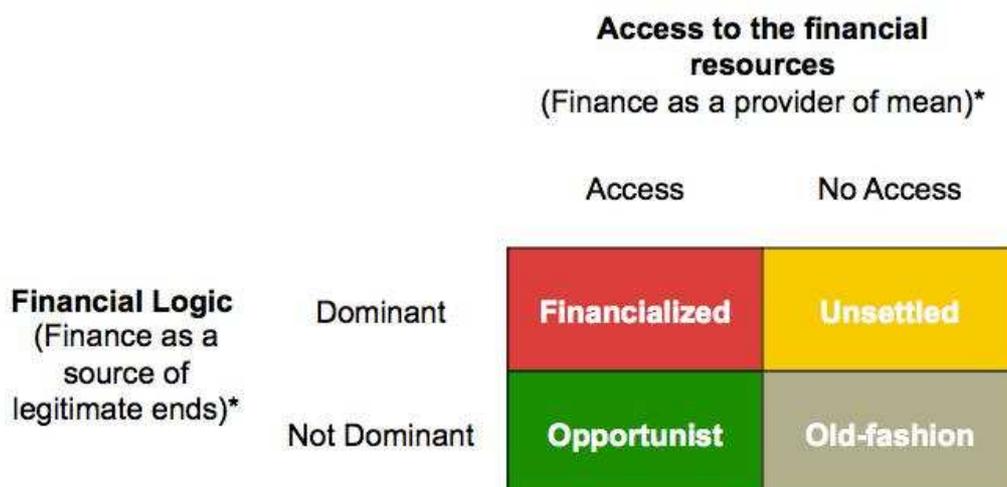
In another recent attempt, L. E. Davis (2016) studies the variation in the level and pattern of financialization across and within the NFCs. She explores systematic differences across subcategories of firms, and finds both firm's size and industry to be informative lenses, which systematically delineate the stylized facts describing post-1980 changes in NFCs' financial behavior. Specifically, systematic differences in the balance-sheet evolution of small and large firms signaling that the causes and consequences of the financialization differ by firm size.

Financialization and Innovation

Financialization Matrix

Two sets of financialization’s measures –financial profits and financial logic- while can be positively correlated are not necessarily the same. For instance increasing financial income does not necessarily implies a firm is getting more financialized, rather it shows the focal firm is looking for the new sources of the capital. Or keeping more financial assets can be a consequence of the increasing level of the uncertainty in the market. On the other hand, even when a firm embraces the financial logic as its main logic, it cannot be truly financialized until it has access to the financial channels to substitute them for its production.

In order to have a better measure of the financialization, we follow Yan et al. (2016) suggestion and separate the “means” provided by a financialization from its “end-goals”. It means while nonfinancial firms differ from financial firms in terms of their end-goals, they resemble mainstream financial firms in how they leverage the means provided by the financialization. Based on this separation, we build a means-end-goals matrix (Figure 6), which give a more comprehensive understanding of the financialization of the NFCs.



* Yan, Ferraro, and Almandoz (2015)

Figure 6 Means-end-goals matrix, categories of financialization

Based on this matrix (Figure 6), only those firms that adopt financial logic as their operational logic and actively make profits through financial channels rather than through production are truly

Financialization and Innovation

financialized. On the other hand those firms that stick to the principles of managerial capitalism and choose not to engage in financial activities are truly non-financialized firms (Old-fashion). The more interesting categories are “opportunist” and “unsettled” firms. Opportunist firms are those firms that deliberately make profit through financial channels but do not adhere to the principles of financial logic. In other words, opportunists enjoy benefits of financialization without getting financialized. The last category, unsettled firms, are those firm that adopt financial logic but cannot make financial profits, probably because they do not find such an opportunity.

Besides giving a clear image of the financialization of the NFCs, such a categorization helps us later to connect the innovation literature to the financialization literature, and produce testable hypotheses about the effects of the financialization of the NFCs on their innovativeness.

Finance And Innovation

Research on the link between finance and innovation has been split into two traditions, one on the presence of financial constraints for the innovative firms and the other on the corporate short-termism and managerial myopia.

Financial constraints theory explains why innovative firms have difficulties in financing their innovation projects, and suggests that internal capital market and equity market provide better sources of capital for these firms compare to the debt market (Brown et al., 2009; Czarnitzki & Hottenrott, 2011; B. H. Hall & Lerner, 2010; Hottenrott & Peters, 2012; Kerr & Nanda, 2015; O’Brien, 2003). One implicit implication of this theory is that innovative firms should be more active in the equity markets and be more engaged in financial activities that would help them to raise the necessary capital for innovation with a lower cost than what the debt markets offer to them. For instance, Brown, Fazzari, & Petersen (2009) show that finance helps innovative firms, to overcome the so-called financial constraints by accessing to the equity market as a source of fresh capital. Similarly, Hall & Lerner (2010) summarize that the “Anglo-Saxon“ economies, with their thick and

Financialization and Innovation

highly developed stock markets and relatively transparent ownership structures, typically exhibit more sensitivity and responsiveness of R&D to cash flow than continental economies.

Corporate short-termism and managerial myopia literature looks at the link between finance and innovation from a behavioral perspective. Building on behavioral agency model (Wiseman & Gomez-Mejia, 1998), this line of the literature suggests that because executives confront potentially conflicting pressures-maximizing shareholder wealth in the long term and appeasing shareholders in the short term (Sanders & Carpenter, 2003), they might behave myopic and sacrifice long-term interests in order to boost current profits and fall in the short-termism trap (Stein, 1988). Consequently, managerial myopia and corporate short-termism push firms to focus on the transfer of the financial resources towards opportunities with short-term near market opportunities, instead of investing in long-term innovation projects (e.g., Begley, 2015; Bushee, 1998; Edmans, Fang, et al., 2013; Edmans, Heinle, et al., 2013; Gleadle & Haslam, 2010; Gleadle et al., 2012; Hitt, Hoskisson, Ireland, & Harrison, 1991; Kochhar & David, 1996; Lazonick, 2014; Lerner & Wulf, 2007; Mazzucato, 2015). For instance, Hitt, Hoskisson, Johnson, & Moesel (1996) argue that firms engaging in acquisitions and divestitures emphasize financial controls suggested by agency theory, de-emphasize strategic controls, and thus produce less internal innovation and seek external innovation to gain short-term benefits. Similarly, Begley (2015) shows that firms facing stronger threshold-induced incentives to improve their Debt/EBITDA ratio during their credit rating process have a considerably higher likelihood of declines in the quantity and quality of their innovation output. In another study, Bernstein (2015) shows that while, the financing view predicts that access to the equity market would allow firms to enhance internally generated innovation by easing access to capital, the quality of firms' internal innovation declines following the IPO, and firms experience both an migration of skilled inventors and a decline in productivity of remaining inventors.

Financialization and Innovation

Financialization and Innovation: Building Hypotheses

Connecting two branches of research on the link between finance and innovation -financial constraints theory and corporate short-termism theory- to our financialization matrix allows us to produce several hypotheses about the effect of financialization on innovation.

According to the financial constraint literature, firms may seek out new sources of capitals through financial channels when they cannot access to the other sources of financial resources such as debts or internal slack. So, we can expect that innovative firms use these channels to overcome the so-called financial constraints without necessarily adhering to the financial logic. If that is true, then financial profits a firm makes should have a positive effect on the quantity and quality of its innovation. Moreover, from the financial constraint literature we know that smaller firms suffer more from external constraints for R&D investment than larger firms, and further, the level of constriction decreases monotonically with firm size (Czarnitzki & Hottenrott, 2011; B. H. Hall & Lerner, 2010; Kerr & Nanda, 2015). Hence, financial earnings should have a stronger positive effect on the quantity and quality of innovation of smaller firms.

Hypothesis 1-A-Financial incomes of NFCs positively affect their innovation quantity.

Hypothesis 1-B-The positive effect of financial incomes of NFCs on their innovation quantity is stronger for smaller firms.

Hypothesis 1-C-Financial incomes of NFCs positively affect their innovation quality.

Hypothesis 1-D-The positive effect of financial incomes of NFCs on their innovation quality is stronger for smaller firms.

On the other hand, based on the corporate short-termism and managerial myopia literature, supremacy of the shareholder value maximization, i.e. financial logic, cause managers to invest in opportunities with short-term near market opportunities and forgo long-term innovation projects. Hence, if this is true, we expect that financial logic has a negative impact on the quantity and quality of its innovation.

Financialization and Innovation

Hypothesis 2-A-Financial logic of NFCs negatively affects their innovation quantity.

Hypothesis 2-B-Financial logic of NFCs negatively affects their innovation quality.

And lastly and more importantly, we are interested in the effect of interaction between financial logic and financial profit on innovation. Based on the previous sets of hypotheses, financial incomes and financial logic have contradictory impacts on the innovativeness of the firm. These opposing effects help us to separate different types of firm based on our financialization matrix. In other words, we expect opportunist firms take advantage of the financialization without adopting the financial logic, and increase their innovation quantity and quality more than any other category. On the other extreme, we believe “unsettled” firms would be at a disadvantage (in terms of effect of financialization on innovation) with other categories and do less innovation and of lower quality compare to other firms. The “financialized” firms are in the middle and the effect of the financialization on their innovativeness depends on the magnitude of the effect of financial logic versus the magnitude of the effect of financial income. The “old-fashion” group would not be affected by financialization because they do neither engage in financial profit making activities nor embrace financial logic.

Hypothesis 3-A- Opportunist firms do more innovation than financialized firms, and financialized firms do more innovation than unsettled firms.

Hypothesis 3-B- Opportunist firms do higher quality innovation than financialized firms, and financialized firms do higher quality innovation than unsettled firms.

DATA AND METHOD

Data Description

The main panel data for testing these sets of hypotheses comprises from two separate parts that merge together. The first part of data is accounting data that has been collected from the COMPUSTAT database and includes information about NFCs’ financial data from 1976 to 2006. The second part of data is patent data that has been collected from the National Bureau of Economic

Financialization and Innovation

Research (NBER) Patent Citation database. This data source contains information on the owner, patent application date, patent grant date, and citation count of over three million patents granted by the United States Patent Trademark Office from 1976-2006 along with matching tables that facilitate merging these data with the COMPUSTAT. In this study, we focus only on pharmaceutical firms, which we explain why in the next section. After cleaning data, the main sample contains 2121 observations from 174 public pharmaceutical firms. This dataset would be used to test the first set of the hypotheses.

In order to test the remaining sets of the hypotheses, following Bertrand & Schoar's (2003) research design, we construct a manager-firm matched panel data set, which enables us to track the change of top managers within different firms over time. The data we use are part of the BoardEx database, from 1976 to 2006. The BoardEx database contains biographical information on most board members and senior executives of over 800,000 organizations around the world. These include CEOs, but also other top executives, most often the chairman, CFO, COO, CTO, and subdivision CEOs. Similar to the previous analysis, we restrict our attention to the subset of U.S. pharmaceutical firms for which are appear on the NBER patent and the COMPUSTAT databases. In doing so, we manually merged CEOs' data from the BoardEx database with patents data from the NBER database and accounting data from the COMPUSTAT based on firm's identification code (gvkey) and year. To ensure the accuracy of the new dataset, we randomly checked our data with the online Forbes database.

Table 1 Summary of CEOs' characteristics

	Freq.	%	Mean.
Age			48.7
Gender			4.4 % female
Tenure			4.3 years
Board position	590	89 %	
Accountant	25	3.8 %	
Finance	2	0.3 %	
Law	39	6 %	
Business	29	4.4 %	
MBA	202	30 %	
EMBA	16	2.4 %	
Dip	10	1.5 %	
BSc	523	79 %	
MSc	115	17.5 %	

Financialization and Innovation

	Freq.	%	Mean.
PhD	241	36.5 %	
Other Education	81	12 %	
Total No. of CEOs	664		

The resulting sample contains about 330 firms (46 private and 284 public firms) and 664 individual CEOs. The average length of stay of a CEO within a given firm is over four years in our data, the average age of CEOs is about 49 years, about 5% of CEOs in our data are female, and almost 10% of CEOs in our sample do not sit on their firm's board (Table 1). We concentrate our analysis on four most two educational degrees (MBA and PhD), while includes other information in our robustness tests.

Table 2 Change of firms by CEOs

No. CEOs	No. of changes of firms
649	1
14	2
1	3
664	Total number of CEOs

From the set of about 664 CEOs identified in our sample, 649 are individuals who worked for one firm, 14 are CEOs who worked for two firms, and just one CEO worked for three different firms (Table 2). On the other hand, over the period 1976-2007 a little over 40% of firms in our sample had just one CEO, 28% experienced two different CEOs, about 20% saw three different CEOs, and 12% worked with more than three CEOs (Table 3).

Table 3 Change of CEOs within firms

No. of firms	No. of CEOs	%
136	1	41%
94	2	28%
62	3	19%
25	4	8%
8	5	2%
5	6	2%
330	Total number of firms	

Why Pharmaceutical Industry?

Pharmaceutical Industry is an ideal industry for this research on several counts. First, innovation has always been considered as the foundation of the pharmaceutical industry. Roberts (1999) argues that

Financialization and Innovation

given the role that innovation has always played in the pharmaceutical industry, this industry should serve as models for firms in other industries who must compete in increasingly dynamic competitive environments. Second as Cervantes et al. (2014) mention R&D investment in a pharmaceutical industry is a costly and timely decision, because discovery and development of new medicines is a long, complex and costly process. It takes roughly 10 to 15 years to develop a new drug, and in average it costs \$1.2 billion (Cervantes et al., 2014).

Third, the high cost of R&D investment has a direct effect on the organizational structure of innovation in pharmaceutical firms, and it is widely accepted that higher real R&D costs is the main factors underlying the mergers and industry consolidation in this industry (DiMasi, Hansen, Grabowski, & Lasagna, 1991). Fourth, as Hall, Helmers, Rogers, & Sena (2014) suggests patents are significantly more important to pharmaceutical firms compared with other high tech industries (see also Cohen, Nelson, & Walsh (2000)). The reason for this is because the costs of drug innovation are very high while the costs of imitation are relatively low; hence the industry is subject to significant free-rider problems (Cohen et al., 2000).

And last but not least, pharmaceutical firms are heavily criticized for their presence and activities in financial market (Lazonick, 2014; Mazzucato, 2015). For instance Lazonick (2014) indicates that “among leading pharmaceutical firms, in 1997-2010 Amgen did repurchases equal to 103 percent of R&D expenditures, Pfizer 64 percent, Johnson and Johnson 56 percent, and Merck 53 percent”.

In conclusion, innovation is highly important for Pharmaceutical firms. R&D investment decisions are mostly costly and long-term decisions that affect even the organizational structure of these firms. Patent is a reliable measure of innovation in the pharmaceutical industry. And pharmaceutical firms are relatively active in the financial markets, or in other words they are financialized.

Dependent Variables

We use two common measures of innovation: patent count and citation count. Patents count denotes firms' innovation output, and citations count gives a measure of firms' innovation quality.

Financialization and Innovation

Patent Count. Patent count is the raw measure of a firm's patent applications during a specific year that are eventually granted. Using simple patent counts as the quantity of the firms' R&D output is inherently limited in the extent to which it can capture differences in patent quality. But as we are focusing only on the pharmaceutical industry, we assume that there is homogeneity among different granted patents across the industry, hence the simple patent count can measure firms' innovation output. We use this dependent variable to test the hypothesis A of each set of hypotheses.

Patent's Quality (Citations per patent). To test the hypothesis B of each set of hypotheses we generate a dependent variable based on the number of the forward-citations a given firm received in a specific year. The interpretation is straightforward: more citations a patent receives, the higher quality has that patent. At the firm level, higher citations a firm receives for its patents, the higher quality has its innovation.

Independent Variable

As we discussed above, there are two indicators for the financialization of the NFCs: Financial incomes and financial logic. We use non-operative incomes as the proxy for the financial income and CEO's educational background as the proxy for the financial logic. We also control for the several other possibly influential variables.

One challenging issue here has to do with is the timing of awards and R&D expenditures. As Lerner & Wulf (2007) mention it would be clearly problematic to relate the number of patent awards in a specific year to the decisions have been made in that year, as the patents would have been filed on average two years before. Thus, as a typical patent takes approximately two years to issue, all independent variables are lagged for two year to control for the timing problem.

Non-operative Income. Typically defined as the portion of a firm's income that is derived from activities not related to its core operations. Non-operating income would include such items as dividend income, profits (and losses) from investments, gains (or losses) incurred due to foreign exchange, asset write-downs and other non-operating revenues and expenses.

Financialization and Innovation

CEO's Educational Background. For measuring the dominance of the financial logic, we need a proxy that allows us how managers think about the purpose of their business and the way they should manage their business. According to the financial logic the ultimate goal of a business is to maximize value of the capital for the owner(s) of that business (Damodaran, 1996). As Christensen & van Bever (2014) point out “a big part of the answer [to the capitalist’s dilemma] lies in an unexamined economic assumption. The assumption—which has risen almost to the level of a religion—is that corporate performance should be focused on, and measured by, how efficiently capital is used. This belief has an extraordinary impact on how both investors and managers assess opportunities. And it’s at the root of what we call the *capitalist’s dilemma*.”

Hence, if we can understand if managers believe in such logic then we can define a proxy for the financial logic. We propose that CEOs’ education background allows us to understand, though imperfectly, how they think about the purpose of their business. Although, this variable cannot wholly explain the variations in CEOs’ assumptions and beliefs, but it show us that how managerial and professional beliefs of CEOs have been shaped. Interestingly, several organizational scholars criticized the dominance of shareholder value ideology, i.e. financial logic, in MBA programs (e.g., Christensen & van Bever, 2014; Ghoshal, 2005; Lazonick, 2014; Mukunda, 2014). For instance, Ghoshal (2005) warns that “we have taught our students that managers cannot be trusted to do their jobs—which, of course, is to maximize shareholder value—and that to overcome “agency problems,” managers’ interests and incentives must be aligned with those of the shareholders by, for example, making stock options a significant part of their pay”².

Hence, we believe holding an MBA degree could be a valid proxy for the supremacy of the financial logic in managerial decision-making.

² Here, one question could be why did business schools start to favor the shareholder value ideology? According to the literature, since 1980s, fewer MBA graduates have gone into industrial corporations, and financial services remains the most common career path for MBA graduates. So, business schools saw the demand and tailored their faculty to match this trend (Lazonick, 2016; Mukunda, 2014).

Financialization and Innovation

Control Variable

Operating Income after Depreciation and Amortization. It measures the amount of profit realized from a firm's operations, after subtracting operating expenses such as cost of goods sold (COGS), wages and depreciation. The association between profitability and innovation has been one of the main concerns of the innovation scholars since Schumpeter theorized that firms should enjoy monopoly profit in order to involve in innovative activities. Hence, controlling for the operative income, as a proxy of profitability, helps to alleviate such a concern.

R&D Expenditure. R&D expenses is a signal for the amount of the capital a firm is investing in the innovation projects. Thus, it is necessary to control for the level of R&D expenditure of a firm when we are studying innovation decision and output.

Cash Holding. It defines as the assets that a firm holds in ready cash, as opposed to property, shares, bonds, etc. On the one hand, since R&D is an activity intrinsically connected with uncertainty, the positive association of R&D and cash holdings is a natural one (B. H. Hall & Lerner, 2010). On the other hand, the more a firm gets financialized, the more it uses its cash to invest in financial markets in the shape of the short-term investments (Soener, 2015); Hence it is not clear which motivation lies behind the cash holding strategy is reality.

Number of Employees. To control for the size of the firm, we use the simple number of employee as the indicator of the firm's size. As Cohen (2010) summarizes, while there are robust results indicating that R&D expenditures are closely linked to firm size, the literature provides less guidance about whether large or small firms are more capable at generating innovations.

Firm Fixed-effect. Firms' characteristics are determinant in shaping their business strategy. These characteristics are usually hard to observe and are not measured by data collectors. One way to control for heterogeneity among firms is to use a dummy variable for each firm to control for the firm-effect. The other issue is the change in demand conditions, which can affect firms' incentive to engage in innovative activity (Cohen, 2010). While, we do not access to the accurate data about the

Financialization and Innovation

demand of pharmaceutical industry, we try to control the demand condition by controlling for time (i.e., here year). Year effect is especially suitable to absorb the effect of business cycles, which in turn can explain cycles in the time series on patents.

Table 4 presents the summary of statistics and the matrix of zero-order correlations between all dependent and independent variables utilized in this study. There are some strong correlations between some independent variables. To subside the possibility of multicollinearity among independent variables, in our robustness tests we center all the independent variables on their mean by standardizing them. After this change our main results remain unchanged.

Table 4 Summary of statistics and zero-order correlation coefficients among all variables under study

		Mean	S.D.	X ₁	X ₂	X ₃	X ₄
X ₁	Patents Count	8.91	35.37	1.00			
X ₂	Patents' Citations	65.25	309.47	0.74 (0.00)	1.00		
X ₃	Number of Employees	4.38	14.89	0.67 (0.00)	0.55 (0.00)	1.00	
X ₄	Nonoperating Income	21.56	149.23	0.35 (0.00)	0.14 (0.00)	0.53 (0.00)	1.00

Method

To test the first set of our hypotheses, we estimate the following logistic regression³:

$$y_{it} = \beta NOPI_{it-2} + \delta OIADP_{it-2} + \eta EMP_{it-2} + \gamma CH_{it-2} + \alpha_i + \lambda_t + \epsilon_{it}$$

Where *i* indexes firms, *t* indexes time, y_{it} represents our dependent variables, $NOPI_{it-2}$ is a variable that measures NFCs' non-operative income, $OIADP_{it-2}$ represents the operating income after depreciation and amortization, EMP_{it-2} and CH_{it-2} are our control variables for the size of firms and their cash holding, α_i are firm fixed-effects, λ_t are year fixed effects, and ϵ_{it} is the error term.

To test the second set of our hypotheses, we estimate the following logistic regression:

$$y_{ijt} = \beta X_{it-2} + \theta Z_{jt-2} + \delta MBA_{jt-2} + \eta PhD_{jt-2} + \alpha_i + \lambda_t + \epsilon_{ijt}$$

³ As our dependent variables are count variables, logistic regression is the appropriate model for testing our hypotheses.

Financialization and Innovation

Where i indexes firms, j indexes CEOs, t indexes time, y_{it} represents our dependent variables, X_{it-2} is a vector of firm characteristics, Z_{jt-2} is a vector of CEO characteristics including age and gender, MBA_j is a dummy variable that equals 1 if CEO_j completed an MBA and 0 otherwise, PhD_j is a dummy variable that equals 1 if CEO_j completed a PhD degree and 0 otherwise, α_i are firm fixed-effects, λ_t are year fixed effects, and ϵ_{ijt} is an error term. Similar to Bertrand & Schoar (2003), our model includes firm fixed effects. Our identification is therefore not driven by average differences across firms in the type of CEOs they select. Instead, our identification comes from within-firm variation in the type of education of the CEOs. This helps us to partially solve the CEO selection problem.

To test the last set of our hypotheses, we estimate the following logistic regression:

$$y_{ijt} = \varphi X_{it-2} + \beta NOPI_{it-2} + \delta MBA_{jt-2} + \rho NOPI_{it-2} * MBA_{jt-2} + \eta PhD_{jt-2} + \vartheta NOPI_{it-2} * PhD_{jt-2} + \theta Z_{jt-2} + \alpha_i + \lambda_t + \epsilon_{ijt}$$

This model includes financialization variables and their interaction, $NOPI_{it-2} * MBA_{jt-2}$. The rest of the model is similar to the previous model.

RESULTS AND FINDINGS

Table 5 presents results of regression analyses for the hypothesis 1-A. According to this hypothesis we expect that firms' non-operative incomes have a positive impact on their innovation scale. Model 2 supports this hypothesis and gives a significant and positive coefficient for the non-operative income variable. Next, to test hypothesis 1-B we divide our sample to two subsamples: small firms with less than 500 employees, and big firms with more than 500 employees. Model 3 and 4 report the results of regression analyses for these two subsamples. Interestingly, model 3 shows that the non-operating income has stronger positive effect, both in terms of significant and magnitude, on the number of the patent a firm produces for smaller firms compare to the general model. Whereas, the positive effect of the non-operating income on the innovation scale turns insignificant once we just

Financialization and Innovation

include big firms. These results are in line with our hypotheses 1-B, and financial constraints literature.

Table 5 Financial incomes and quantity of the innovation's output (Dependent variable: Number of patents)

Independent Variables Number of patents	Model 1	Model 2	Model 3 (Small NFCs)	Model 4 (Big NFCs)	Model 5
Hypothesis	-	1-A	1-B	1-B	-
Non-operating Income		0.083* (0.03)	0.144** (0.04)	0.033 (0.07)	0.144*** (0.02)
Operating income	-0.000 (0.00)	-0.000 (0.00)	0.039*** (0.01)	-0.000 (0.00)	-0.000*** (0.00)
R&D Exp.	0.007 (0.06)	0.013 (0.06)	0.131* (0.06)	-0.092 (0.24)	0.155*** (0.03)
No. Employees	-1.184*** (0.33)	-1.389*** (0.34)	-1.381 (1.31)	-0.794 (0.47)	0.793*** (0.07)
Cash	0.033 (0.04)	0.021 (0.05)	-0.021 (0.05)	-0.150 (0.12)	0.012 (0.03)
Constant					-0.656*** (0.05)
Fixed-effects	Yes	Yes	Yes	Yes	No
2-year lag	Yes	Yes	Yes	Yes	Yes
Firm size	All	All	Small	Big	All
R-sqr					0.1283
No. Observation	2121	2121	1443	555	2801
No. Firms	174	174	134	50	-
BIC	1741.0	1742.9	1245.4	377.3	3385.5

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table 6 presents results of regression analyses for the hypothesis 1-C. According to this hypothesis we expect that firms' non-operative incomes have a positive impact on the quality of their innovation. However, the results of our fixed-effect logistic regression models do not provide support for this hypothesis. Even we look at the two subsamples of small and big firms we cannot find any significant and positive effect. Only the pool model gives a positive and significant coefficient for the non-operative incomes.

One reason for the lack of support for the hypotheses 1-C and 1-D could be that although financial incomes would help firms to overcome the external constraints for R&D investment, it cannot change the nature of the R&D activities of the firm. In other words, financial incomes can help firms

Financialization and Innovation

do more of innovation they are doing, but it would not necessary help them to produce different types of innovation.

Table 6 Financial incomes and quality of the innovation's output (Dependent variable: Number of citations)

Independent Variables Number of citations	Model 1	Model 2	Model 3 (Small NFCs)	Model 4 (Big NFCs)	Model 5
Hypothesis	-	1-C	1-D	1-D	-
Non-operating Income		-0.016 (0.04)	-0.005 (0.05)	0.060 (0.06)	0.085*** (0.02)
Operating income	-0.000* (0.00)	-0.000* (0.00)	0.048*** (0.01)	-0.000** (0.00)	-0.000*** (0.00)
R&D Exp.	0.113 (0.06)	0.112 (0.06)	0.230*** (0.07)	-0.006 (0.24)	0.185*** (0.03)
No. Employees	-1.997*** (0.33)	-1.957*** (0.34)	-2.824* (1.44)	-1.228** (0.44)	0.803*** (0.07)
Cash	-0.048 (0.05)	-0.046 (0.05)	-0.064 (0.06)	-0.368** (0.12)	-0.072* (0.03)
Constant					-1.231*** (0.05)
Fixed-effects	Yes	Yes	Yes	Yes	No
2-year lag	Yes	Yes	Yes	Yes	Yes
Firm size	All	All	Small	Big	All
Pes. R-sqr					0.1116
No. Observation	1952	1952	1315	560	2801
No. Firms	152	152	120	43	-
BIC	1638.8	1646.2	1079.7	413.2	3118.8

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Next, model 2 of Table 7 tests hypothesis 2-A, which predicts firms with CEO who completed an MBA degree – as the proxy for financial logic- will produce fewer number of patents compare to firms without such a CEO. Coherent with our prediction, firms with CEO who completed an MBA significantly produce fewer patents (models 3 and 4).

Model 4 tests the hypothesis 3-A about the effect of the interaction of financial income and financial logic. In agreement with the hypothesis 3-A, results of this model show that opportunist firms (MBA=0, NOPI>0) have higher probability of producing more patents (sum of coefficients=0.308NOPI) than financialized firms, and financialized firms (MBA=1, NOPI>0) have higher probability of producing more patents (sum of coefficients=0.058NOPI-1.686) than unsettled firms (MBA=1, NOPI=0, sum of coefficients=-1.686).

Financialization and Innovation

Table 7 CEO's characteristics and quantity of the innovation's output (Dependent variable: Number of patents)

Independent Variables Number of patents	Model 1 (Controls)	Model 2	Model 3	Model 4	Model 5
Hypothesis	-	2-A	1-A	3-A	-
MBA Degree		-1.770*** (0.45)		-1.686*** (0.46)	-0.004 (0.14)
Non-operating Income			0.199*** (0.06)	0.308*** (0.09)	0.200*** (0.04)
Interaction MBA				-0.250* (0.10)	-0.047 (0.05)
Constant					2.465*** (0.42)
Firm fixed-effects	Yes	Yes	Yes	Yes	No
2-year lag	Yes	Yes	Yes	Yes	Yes
Pes. R-sqr					0.1461
No. Observation	1220	1220	1220	1220	1699
No. Firms	128	128	128	128	
BIC	935.6	930.9	929.8	931.7	2055.9

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Firm-level Controls: size, profit, cash, R&D expenditure

CEO-level Controls: age, gender, PhD, interaction non-operative income and PhD

Finally, model 2 of Table 8 tests hypothesis 2-B, which predicts firms with CEO who completed an MBA degree – as the proxy for financial logic- will produce patents of lower quality compare to firms without such a CEO. Coherent with our prediction, firms with CEO who completed an MBA significantly produce fewer patents (models 3 and 4). The fact that there is a significant negative impact of financial logic on the quality of the innovation, while we cannot find such an effect for the financial income is intuitive. While, financial income would not necessarily change the type of innovations firms are doing, financial logic would change the type of innovation because managers with different logics in their mind have different set of preferences or different biases in their decisions.

Model 4 tests the hypothesis 3-B about the effect of the interaction of financial income and financial logic on the quality of innovation. As there is no significant effect of the non-operative income on the number of patent citations, it is not surprising that the interaction's coefficient is not significant. Hence, we cannot support hypothesis 3-B.

Financialization and Innovation

Table 8 CEO's characteristics and quality of the innovation's output – H5 (Dependent variable: Number of citations)

Independent Variables Number of citations	Model 1 (Controls)	Model 2	Model 3	Model 4	Model 5
Hypothesis	-	2-B	1-C	3-B	-
MBA Degree		-1.616*** (0.42)		-1.604*** (0.45)	0.022 (0.15)
Non-operating Income			0.032 (0.05)	-0.001 (0.08)	0.136** (0.04)
Interaction MBA				-0.032 (0.09)	-0.055 (0.05)
Constant					1.873*** (0.45)
Firm fixed-effects	Yes	Yes	Yes	Yes	No
2-year lag	Yes	Yes	Yes	Yes	Yes
Pes. R-sqr					0.1212
No. Observation	1008	1008	1008	1008	1699
No. Firms	96	96	96	96	
BIC	806.5	799.7	813.0	817.9	1860.3

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Firm-level Controls: size, profit, cash, R&D expenditure

CEO-level Controls: age, gender, PhD, interaction non-operative income and PhD

CONCLUDING REMARKS

The rapid financialization of U.S. NFCs in the recent decades makes the link between finance and innovation even more critical. Historical data show that since 1970, U.S. NFCs have almost doubled the share of financial incomes in their incomes. Despite mounting financial incomes, NFCs' long-term growth has been constantly diminishing. This study set out to uncover the possible link between the financialization of the NFCs and their innovativeness.

Our analyses show that financialization has a paradoxical effect on innovation. While supremacy of the financial logic can negatively affect the quantity and quality of NFCs' innovation, the means that it provides can help NFCs to boost their innovation. More importantly, it is the interaction between financial logic and financial profits that determines how financialization of the NFCs affects their innovation. For instance, those firms that deliberately utilize financial means without adopting financial end-goals would increase their innovation quantity and quality more than any other firms.

Financialization and Innovation

Putting all the results together, this study offers a more comprehensive survey of the relationship between the financialization and innovation, and helps us to understand better how dominance of the finance logic since 70s has deterred some managers of American NFCs from investing in innovative projects, while encouraged other managers to innovate even more.

The generalizability of our findings is subject to certain limitations. First, our sample only includes pharmaceutical firms and does not give us a view across different industries. Second, we only study U.S. NFCs and their financialization processes; hence considering different paths of financial developments in different countries, our findings are limited to the U.S. context. Third, in this study we only focused on CEOs of firms, but we believe that including information of the other members of the top-management-team can enhance our understanding about the question posed at this paper. Hence, we suggest future studies at the top-management-team level assess the validity of these findings across industries and countries.

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