**Expert Journal of Finance,** Volume 3, pp.45-53, 2015
 ISSN 2359-7712
http://Finance.ExpertJournals.com

# What Finance Can Learn from Biopharma Industry: A Transfer of Innovation Models

Francesco COREA*

LUISS Guido Carli University, Italy

*The financial sector is living a profound crisis in order to keep pace with the continuous technological breakthroughs that come out daily, while other sectors seem to be historically more growth-by-innovation-based (e.g., the pharma/biotech sector). This work focuses on an interdisciplinary approach to innovation, and on insights that the banking sector can draw from the pharmaceutical one. Hence, a unique dataset has been built, and it collects information on the most relevant players for both the fields. Different indicators have been created as well in order to empirically test whether the financial industry is actually less innovative with respect to the pharmaceutical one, and to understand the best growing strategy for the banking industry. The results confirm that there is an innovation gap between the two industries, as well as identify the corporate venture capital as the best mean to drive business growth through innovation.*

***Keywords:*** *Fintech, Biotech, R&D, venture capital, innovation, licensing, M&A*

***JEL Classification:*** *G32, G24, O31, O32, O33*

## 1. Introduction

The financial services sector is without doubt one of the biggest businesses in terms of size and turnover nowadays. With the last years' boom of financial technology (fintech) companies, the field is also becoming extremely trendy, and looking at some numbers, only financial technology (fintech) companies accounted for more than $23 billion dollar of venture capital investments in the last two years (Santander and Oliver Wyman, 2015). The fintech space is taking over every gap left by big institutions, banks, and regulators, and often is even trying to replace some of the existing players with faster, improved, and customized services.

These two realities, big banks, funds and institutions from one hand, and the plethora of fintech startups from the other, are indeed stretching out the sector, and they are creating a huge rift in the financial industry because of their intrinsic different natures. If it is true that big banks manage incredibly large pools of money, exploit economies of scale to cut down diverse kinds of costs, and that are "*too solid to fail*" institutions, it is also true that startups are extremely more agile, are not bound by strict hierarchical structures or excessive bureaucracy, and can disrupt the system from the ground. In other words, banks are presently stuck within their old-rigid cultural mentality, they have to take care of their daily revenue-generator activities, and are therefore having hard times in keeping the pace with the technological breakthrough (Perez, 2002; 2010).

* Corresponding Author:
Francesco Corea, Department of Economics and Finance, LUISS Guido Carli University, Roma, Italy

Article History:
Received 3 December 2015 | Accepted 28 December 2015 | Available Online 30 December 2015

Cite Reference:
Corea, F., 2015. What Finance Can Learn from Biopharma Industry: A Transfer of Innovation Models. *Expert Journal of Finance*, 3, pp. 45-53

Truth be told, historically speaking the banks did not need to drastically evolve, or to innovate continuously to earn market share. Both commercial and investment banks have about the same types of products and services of twenty years ago – surely more complicated, covering more nuances or clients' needs, but basically the same loans, stocks, bonds, derivatives, and so on so forth. Another example of how innovation is barely, deeply-rooted within financial services, comes directly from academic researches: Scott and White (2002) demonstrated, until the mid-nineties, there were no relevant contributions to financial innovation in academia, especially from an empirical perspective: in fact, in few survey articles (Cohen and Levin, 1989; Cohen, 1995) with more than 600 different articles and books quoted, none of them concerned financial innovation subjects. Although this is an exaggeration and even if different authors gave some theoretical insights over the past three decades (among many, Faulhaber and Baumol, 1988; Mayer, 1986; Merton, 1992; 1995; Miller, 1986; 1992), it is also a signal of how innovation seems to be marginally related to the financial world with respect to other fields of study.

Unfortunately for the banking industry though, this is a particular historic transition in which technology is taking over and playing a crucial role in every single sector, and therefore the necessity for revolutionary discovery is quickly becoming a key point in any banking board's agenda (Zepeda, 2015). So far, the type of innovation presented has been only on the product side – new products or services offered – but it is much more important to deal with the production process and with the innovation flow. It is relevant for the financial sector to start to wonder not about *what* type of innovation may be introduced, but rather *how*. Understanding the how would also allow the big institutions to manage and overcome the uncertainty of the returns associated to innovation investments (Hall, 2002; Hall and Lerner, 2009).

Banks, funds, regulatory bodies, institutional investors, all these players were used to boost their profitability or their efficiency by either enlarging the clients' base, or by lowering their costs, but they need right now to radically transform themselves for the sake of growing. The new technological paradigm is tightening the inner strong causal relation between innovation and growth, and is leading any business as the new golden rule to follow. The growth is then no more measured only in terms of profits achieved, but also with the degree of disruption, impact, and evolution it brings and generates.

Hence, claiming that innovation is the quintessential factor for growing – if it is well implemented (Teece, 1986) -, and with the prior that rigid tiered financial organizations may not excel in innovating from the ground, it comes spontaneously out to wonder whether a successful innovation model can be imported from a different player, sector, or market where the equation that links innovation and growth is at the base of any wealthy business.

In fact, there exists in particular a sector that had to innovate to prosper by definition, i.e., the pharmaceutical and biotech sector. Research and Development (R&D) are key drivers for any big pharmaceutical firm, and each novelty is welcomed with huge investments.

In the biopharma industry, there are some important features that have to be highlighted in order to understand the business model the firms generally adopt: first of all, it is an extremely high-risky sector. The probability of failure is very high for each molecule in analysis, and the timeline for the development is quite long. On average, it oscillates between ten and fifteen years, with then a patent life of around twenty years, and the length of this cycle has turned then the business from a human-intensive sector into a capital-intensive industry. Most importantly, in spite of the already low success rate of the drugs produced, only three of them out of ten are indeed able to repay the development costs and provide a positive return on investment (Meyer, 2002). In fact, it seems that several companies operate at loss, and that the top 3% of the companies generates almost 80% of the total industry profit (Li and Halal, 2002). As a consequence, the field players have to prove to be risk-takers, able to assess efficiently where to allocate their funds, and they have to continuously innovate to survive, due to both the time constraint of the products they create (i.e., patent lives) and to the rolling-disruption that new technologies and drugs bring to the sector. It has been therefore essential to compensate the systematic risk with a more risk-averse approach and to develop new diversification techniques to spread the failure risks as much as possible. In contrast with the Venture Capitals' (VCs) model, in which the risk is shifted more to the market phase, i.e., whether you are able to match the clients' need with the product's characteristics, in the biopharma industry the development process is where the risk lies.

In other words, from one hand VCs invest a consistent amount of money in a selected spectrum of companies, hoping that at least a (low) number of them will pay back the total investments made, and from the other they increment the probability of success helping and leading the new company (usually obtaining some seats in the board of the firm), and focusing their attentions on the final stage of the supply chain. Biotech firms concentrate instead the risk-management in the first part of the supply chain, i.e., the ideation and development of the molecules.

Hence, given all the industry-specific issues, the big pharma companies have identified a range of different methods to foster their growth by innovation: first, the companies spent a large portion of their budget in pure research and development. Second, the firms have adopted a "*competitively-collaboration*" scheme, i.e., they have found a good balance between market competition and research collaboration. Alliances (Baum et al., 2000), joint ventures, and wider networks in general (Gulati and Singh, 1996; Powell et al., 2005), allow to pool resources enhancing the probability of developing the right molecule with a lower cost, and they usually run through licensing agreements in partnership with universities, with another company (e.g., *built-to-buy deals*, *venture co-creation*, *limited partners agreements*), or with a foundation. Alternatively, they started investing in businesses (typically biotech companies) that were already working for a certain drug instead of developing it from scratch, and they did it through a Corporate Venture Capital (CVC) mean. Of course, each strategy – either R&D, M&A or any kind of collaboration/joint ventures – has its own pros and cons: capital intensive use vs. low flexibility, possible synergies vs. long negotiation times, strategic expansion vs. loss of control in the company.

On the other side, big banks and financial institutions are mainly chasing innovation through direct acquisition of fully-operational companies, or cultivating their ecosystem setting up accelerators and business incubators. The first model is the most common one, since it is safer and more convenient to integrate a service instead of developing it from scratch – and it would culturally and historically be out of banks' scope -, while the second is a more recent one, and it borrows some features from the VCs model.

To sum up then, it seems that different businesses lead innovation in different ways. The biopharma model has been created to face industry-specific issues, such as expensive labs, difficult distribution, and high-risk of failure, but it evolved during time to become quite solid and profitable, although highly volatile. The banking sector has instead different traits and challenges to deal with (e.g., service integration issues more than high research expenses), but it needs to start innovating now more than ever, and it could probably borrow some ideas from the biopharma field.

Then, the aim of the paper will be to i) empirically verify that the assumptions so far explained hold, i.e., the pharma industry has an intrinsic higher innovation impulse with respect to the banking sector, which thus needs a new growth model, and ii) to identify how the banking sector innovates, what the financial services industry is or should borrow from the pharma sector, and where they are converging to. It is going to be eventually possible to provide an insight on a new growth innovation-based business model.

The structure of the work is then as follows: the next section shows some prior literature and studies related to biotech and pharmaceuticals industry and their ability to manage innovation. Section 3 deals with the data collection and construction, which is then used for discussion in Section 4. Section 5 concludes and draws some final thoughts on the relation between biopharma and financial services sectors.

## 2. Literature Review

The literature about both the biopharma sector and innovation is quite huge, as well as the intersection between the two has been previously explored in some works. The biotech sector in particular disrupted the old pharmaceutical world (Gassmann et al., 2004) with its growing compulsion. This necessity of growing, as well as the hidden innovation potential of the biotech industry, have been widely explained by Baker (2003); conversely, in another study it has been claimed that the innovation curve is indeed concave and crystallizes at some plateau level (Linder et al., 2003). However, although some contrarian opinions may exist concerning the ability of biotech to innovate, the general consensus supports the idea that innovation in biotech is much more radical than in other sectors (Gans and Stern, 2004; Fuchs and Krauss, 2003), and it pushes biotech companies to explore new niche markets (Chin, 2004). Several attempts have been done to try to explain this innovation flow, as for instance through sequential stages of products development over a long period (Delois and Beamish, 2004). Moreover, Khilji et al. (2006) provided an integrated innovation framework for biotech firms starting from similar models (Rothwell, 1994) already implemented in different industries (manufacturing, technological – Lichtenthaler, 2008 -, etc.), in order to fill the gaps left by either the technology push, market pull, or organizational approaches. Respectively, as explained in the same work, the first one did not take into account any market forces (Lippitt et al., 1958), the second one looked at the market as the main source of innovation (Clark, 1979), while the last one basically found a compromise between the two assessing the relevance of some internal features to lead a change within the company (Meyer and Mugge, 2001).

This work will then augment from one hand the existing research, filling some gaps found in literature concerning the innovation as a source of growth, and from the other it will be able to compare different business model, creating a bridge between the far sector such as the pharmaceutical and the financial ones.

## 3. Data Collection and Research Design

In order to address the research question on the innovation models for both the banking and biopharma industries, an inductive study has been performed using a unique and longitudinal dataset built ad-hoc, with data extracted from 2003 to 2014. Several different datasets have been used to accomplish a higher level of accuracy, but the main ones were Medtrack, Osiris, and Zephyr. The main data concerning the pharmaceutical industry came indeed from Medtrack, while the financial sector ones from Osiris and Bankscope. Zephyr provided cross-industry information, and allowed for a crosschecking of some of data obtained from other sources.

Further in detail, relevant information has been collected for 50 major companies, i.e. 25 major investment and commercial banks, and 25 pharmaceutical firms. They have been selected based on the ranking report issued by Global Corporate Venturing (GCV, June 2010), and through a combination of The Wall Street Journal ranking and the EU scorecard, augmented for some Asian based bank to adopt a worldwide perspective and eliminate any geographic bias. The list of the companies is showed in the table.

***Table 1.*** *List of companies considered.*

| **Financial Services** | **Biopharma** |
|---|---|
| JP Morgan | Siemens |
| Wells Fargo | J & J |
| Bank of America Corporation | Clarian Health |
| Citigroup | Novartis |
| HSBC | DOW Chemical |
| Santander | Bayer |
| BNP | Roche |
| Barclays | Pfizer |
| Deustche Bank | Sanofi |
| Mitsubishi UFJ | GSK |
| Goldman Sachs | Astrazeneca |
| Morgan Stanley | Medtronic |
| Societe Generale | Abbott |
| UBS | Amgen |
| Unicredit | Eli Lilly |
| RBC | BMS |
| Lloyds | Takeda |
| BBVA | Novo |
| Credit Suisse | Merck |
| RBS | Astellas |
| Intesa | Biogen |
| Credit Agricole | Daiichi Sankyo |
| Mizuho | Mitsubishi Tanabe Pharma |
| ING | Boehringer Ingelheim |
| Nordea | Wellcome Trust |

From Zephyr it was possible to obtain precise estimates on the number of merger and acquisition deals implemented by each company, while Medtrack provided a full list of the corporate venture capital (CVC) deals for the biotech and pharmaceutical industries. The number of the CVC deals for the banking sector has been instead manually extracted through companies' website and financial prospects, and for two banks (HSBC and Barclays), it has been proxied with their competitors' behavior and weighted for the period of activity. Furthermore, data on licensing agreements have been gathered from Medtrack, the Biotech Gate, and the EU scorecard, and records of registered patents has been acquired from professional patents platforms (Freshpatents, Justia Patents, and Google Patents).

Osiris (and Bankscope as well) provided instead a series of important balance sheet and firm-related data, such as net income, number of recorded shareholders, and number of companies in the corporate group.

It has also been confirmed whether every company had backed or initiated an incubator or accelerator through companies' website, and finally the research and development data have been mined from the EU Scorecard, approximating the R&D amounts for American and Asian banks with some of their closer European competitors.

## 4. Discussion

For the sake of this work, innovation has been defined as pure technological development (i.e., product innovation), and two hypothesis have been formulated and tested:

- Proposition 1: *The banking/fintech sector is intrinsically less innovative than the biopharma one;*
- Proposition 2: *The growth by innovation is converging to venture funding as privileged mean of financing;*

The first hypothesis has been validated through an empirical study: a new indicator has been developed, in order to map each player with respect to both his imperative to innovate and his commitment to do so. The innovation impulse indeed has been assembled as the log amount of the number of patents times the number of recorded shareholders, and eventually standardized to zero. The number of patents tends to capture the external pressure to innovate, because of then growing competition within the industry, while the amount of recorded shareholders characterizes the internal innovation pressure, because to a high number of shareholders corresponds a higher profit target as well as a well-established institution, which has reached the mature phase and as to innovate to overcome the revenues' plateau. Furthermore, it is worthy to be noticed that the internal pressure is more closely related to the banking sector, while the external pressure is more common in the biotech world, and therefore the indicator so created is consistent with a cross-sectional analysis. Figure 1 plots indeed the innovation impulse with respect to the innovation commitment (indicated by the R&D intensity), and weighted for their net income for both the sectors (pharma in red, banks in blue).

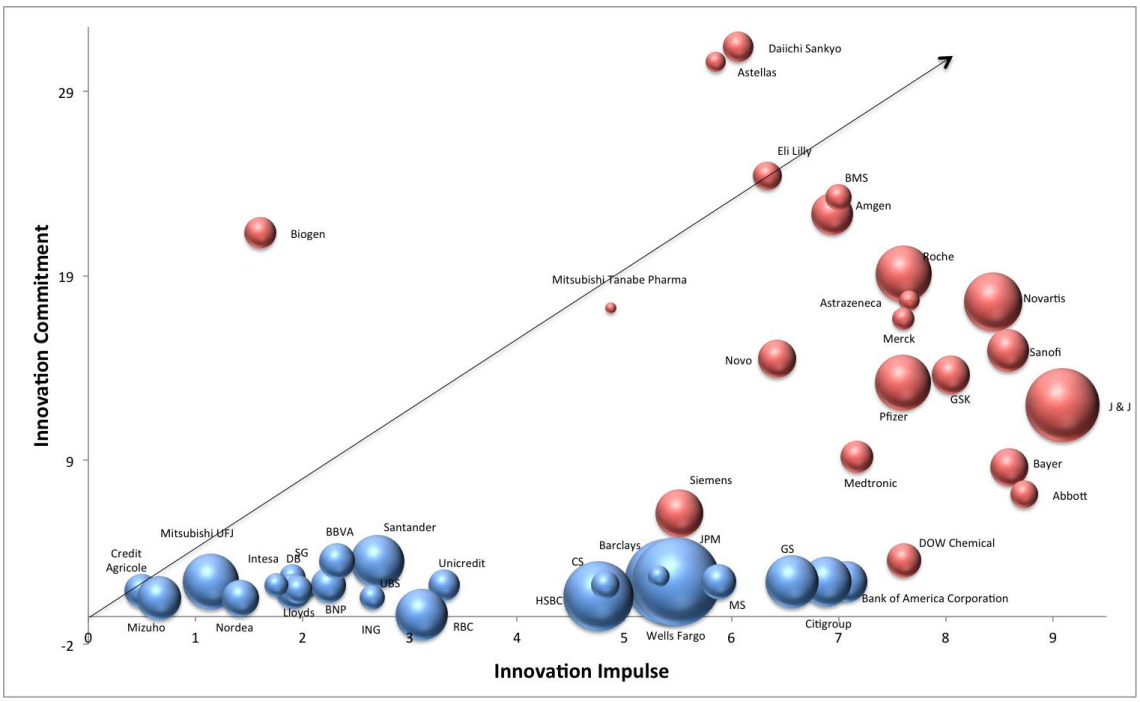


***Figure 1**. Innovation drivers map.*

The banking sector fills mainly the down side of the picture, meaning that the banks' commitment to innovate is fairly low, although the impulse to innovate is growing. This is particularly verified for high-income companies, and thus in the old-minded banking industry growing by innovation seems to be a prerogative of biggest and most profitable companies. Oh the other hand, in the biopharma world, both the

commitment and the inner impulse to innovate are quite high, and completely unrelated with respect to the income size.

In order to test the second hypothesis instead, two different indicators have been constructed: the first one with the aim of capturing the degree of innovation for each company, while the second with the goal to understand the innovation intensity across single firms. In particular, the *degree of innovation* has been assembled equally weighting five different kinds of growth initiatives, i.e. research and development expenditure, licensing and knowledge partnerships, corporate venture capital, incubators and accelerators, and finally merger and acquisitions. The ordered disposition is not accidental though, but swings from the most internal growth strategy (R&D investments) to the most external one (M&A). Hence, the innovation meter has been created in order to keep reflecting this 5-incremental-innovation-stages distinction, and more in particular with the following structure:

$$DoI_i = 0.2 * IA + 0.2 * Licensing + 0.2 * M\&A + 0.2 * CVC_j + 0.2 * R\&D$$

where the subscript *i* represents all the single companies, *j= Banking, Pharmaceutical*, and with the variables defined as follows: IA is a dummy variable that indicates whether the firm has (1) or not (0) an incubator or accelerator. The licensing variable is obtained scaling the number of technical agreements and licensing partnerships for each company to the maximum amount of licensing deals made by a single firm. The CVC variable is again taking into account the number of CVC deals completed over the period, scaled for the maximum amount of deals closed by a single entity within the same industry. The R&D indicator measures more in details the research intensity, since it weights the research and development expenditures on the net sales, and then it is compared to the total cross-industry average. Finally, the M&A variable has been constructed as percentage distance of the company number of M&A deals from the maximum amount of deals completed by a single entity.

The second indicator is instead about the innovation intensity of each firm. It has been created as the number of patents scaled for the highest amount of patents registered by a single company.

The Figure 2 therefore aggregates all the information, and plots each company with respect to their degree of innovation and their innovation intensity, weighting each corporation for the number of companies in the corporate group (the bubble area).

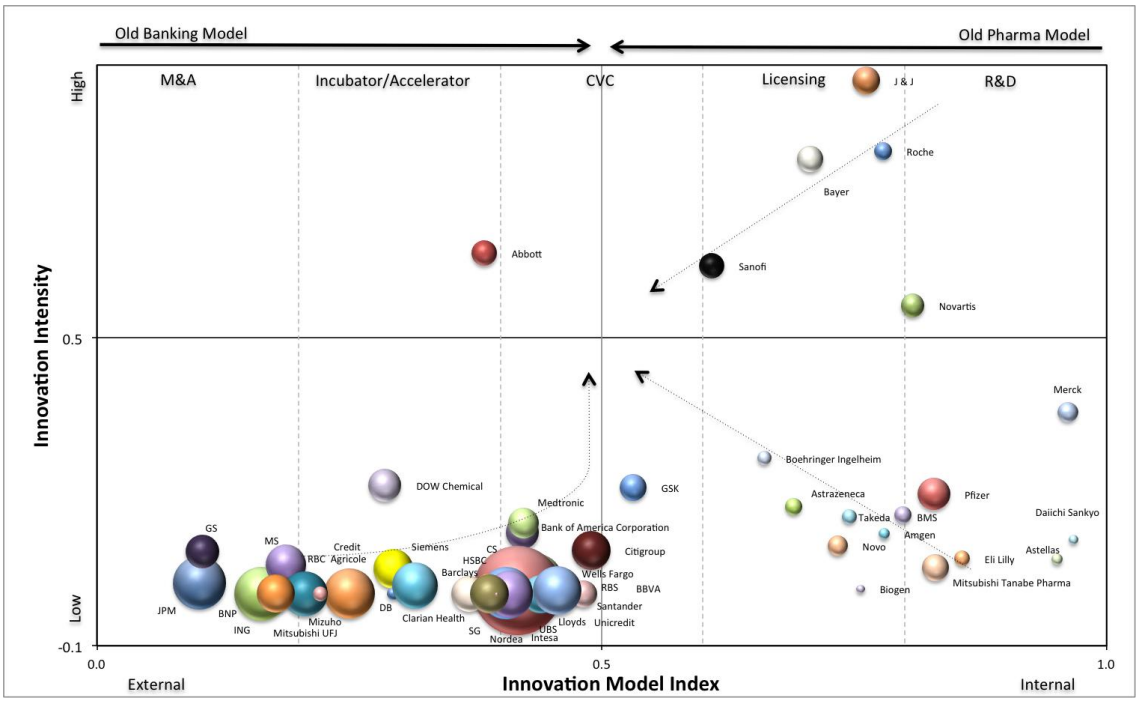


***Figure 2.*** *Business model innovation matrix.*

Hence, the degree of innovation has been set to the x-axis, and it goes from 0 (external growth) to 1 (internal growth) by construction. The y-axis is instead given by the innovation intensity – still from 0 to 1, where 0 means a low-level of innovation and 1 a high level. Appears as if the data confirms some of the initial assumptions above explicated: the banking sector mainly lies in the first quadrant, meaning that the innovation

instinct is quite low in the financial services industry, and it is driven mainly by mergers, accelerators, and some venture financing deal. The pharmaceutical sector has instead an inner innovative intensity, which occurs through internal R&D, licensing, and corporate venture capitals. Furthermore, the corporate complexity matters when it comes to innovation and growth. Intuitively, more complex hierarchical institutions have to do a greater effort with respect to more flexible company with a lean structure. It seems that less-high value patents are a better options than a larger portfolio of smaller deals, and the corporate venture capital may represent the best way to fund these alternatives.

Unfortunately the chart is a static representation of the sectorial innovation, and this is why a further adjustment is needed. In order to verify whether a shift within the business model for both the sectors can be observed, the innovation model has been modified no longer taking into account the R&D intensity, but rather the R&D 1-year growth. This would allow to capture some time dynamics, and the results are shown in Figure 3. It should be pointed out that the vertical axis has been changed, in order to spot at the same time the relation between the innovation impulse and the overall index.

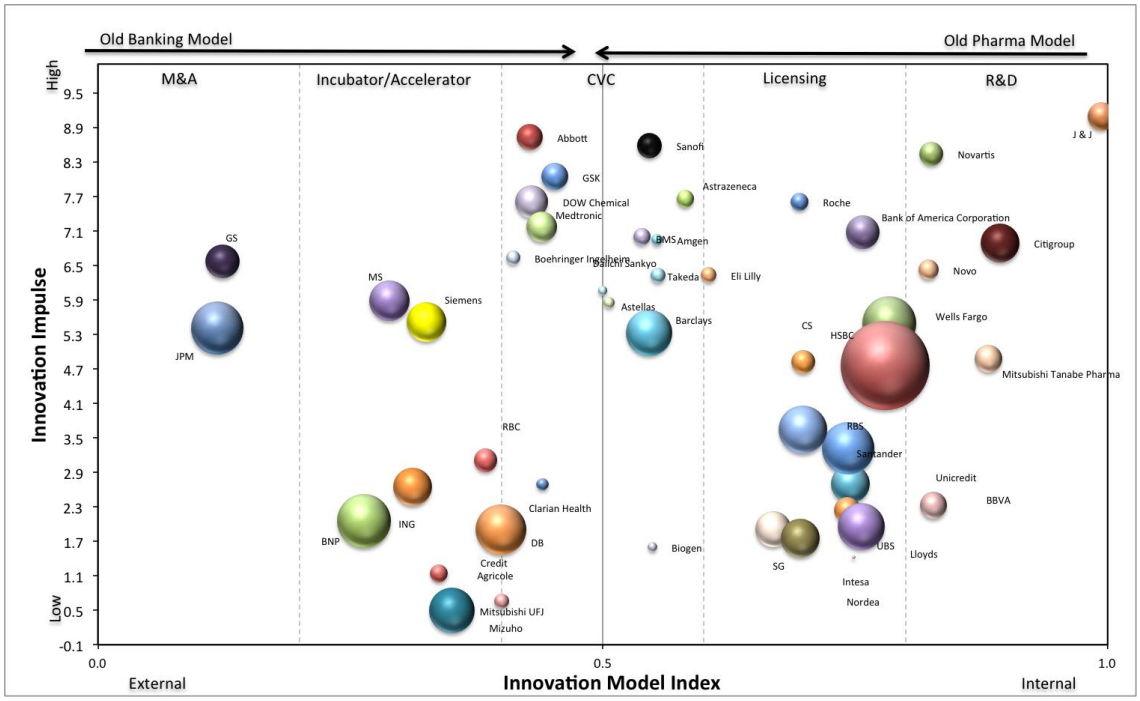


***Figure 3**. Business model dynamic transition matrix*.

The outcome confirms the initial expectations: regardless of the sector considered, internal and external innovation pressures push the growth models to migrate toward the central section of the matrix, i.e., toward more innovative approaches, and in particular they tend to CVC as preferred instrument. Old-banking models were indeed mainly based on merger and acquisition deals, while pharmaceutical sector on internal research and development, but they are commonly converging toward a mid-point. The chart shows the change of the distribution based only on the R&D 1-year change, but it looks completely different from the static case, and suggests that the financial sector is quickly trying to evolve to become more competitive.

## 5. Concluding Thoughts

In this study, a unique dataset has been created ad hoc to test the similarities between the biotech/pharma industry and the fintech/banking one. It has been empirically verified that the financial sector is less innovative with respect to the pharmaceutical one, and that, at present, corporate venture capital represents an important innovation driver. This is extremely relevant for managers to understand the future directions and identify successful strategies to innovate minimizing the costs and maximizing the investments impact.

Indeed, it has previously been exposed how cross-sectors innovation is converging to CVC as preferred mean of innovation, and different matrices for innovation have been explained. The first indicator of the above-claimed can be observed in recent market news, e.g., the launch of Santader's VC fund. In addition to that, it

seems that one of the greatest lessons the finance industry can learn from the biopharma one is the value of networking and strategic partnerships. The network effect amplifies each process and enhances the resonance of any single innovation, no matter how small or disruptive it may be. A new integrated ecosystem structure represents indeed the future of the innovation model for financial services.

The study is limited to the comparison between fintech and biotech spaces, but further sectors can be taken into account, such as energy or exponential technology. Moreover, future research may involve a higher spectrum of companies within fintech/biotech sectors. In spite of any conclusion or future research direction, the main limitation of this work lies in the definition of innovation, which still is subjective. In the study, it has been considered the product (technology-intensive) innovation, but the outcomes may vary depending on different definitions.

There are two additional interesting aspects that would be considered in the future, and that may affect the results. First of all, the regulatory environment plays an important role in this scenario: fintech companies are usually less regulated than banks, while biotech and pharmaceuticals are equally controlled. Furthermore, the law changed over time adapting to research developments in the biotech industry, and it poses a stronger set of constraints with respect to many other sectors. On the other hand, the banking space has tight boundaries to respect, although less strict than the biopharma one. This may result into a longer wave of innovation once the best path is identified.

The second relevant feature is the governmental subsidies, much more common in the biopharma industry than in the banking one. It is intuitive that subsidies and innovation are correlated to some extents, but the causation is not clear and needs further investigation: do subsidies incentive innovation, or is successful innovation that demands for more incentives and investments? If the first case applies, the results have to be modified accordingly, and the innovation push of the biotech industry has to be scale down. If the second case turns to be verified, the study will require taking into account a multi-stage innovation model, where a higher importance has to be assigned to breakthrough discovery that triggers the innovation cycle. Finally, incentives and subsidies implicate a moral hazard problem, inasmuch companies invest money that are not their own ones. This may push them to look for highly risky investments with a really high payoff in case of success, and thus might misrepresent the innovation appetite and research impulse.

In conclusion, technological breakthroughs are demanding a faster-pace innovation, and in financial sectors this innovation is neither horizontal nor vertical, rather it is completely disruptive. The banking industry needs therefore to learn from anything and anyone how to manage this innovation efficiently, and the pharmaceutical sector could be only one of the possible instructors.

## 6. References

Baker, A., 2003. Biotechnology's Growth-Innovation Paradox and the New Model for Success. *Journal of Commercial Biotechnology*, 9 (4), pp. 286-88.

Baum J. A. C, Calabrese, T. and Silverman, B.S, 2000. Don't go it alone: Alliance network composition and startups' performance in Canadian technology. *Strategic Management Journal*, 21: 267-294.

Chin, J., 2004. Biotechnology's Special Forces: Field Based Medical Science Liaisons. *Journal of Commercial Biotechnology*, 10 (4), pp. 312-18.

Cohen, W., 1995. Empirical Studies of Innovative Activity, in *Handbook of the Economics of Innovation and Technological Change*, edited by Paul Stoneman. Cambridge, Mass.: Blackwell. Ch. 6, 182-264.

Cohen, W., Levin, R., 1989. Empirical Studies of Innovation and Market Structure, in *Handbook of Industrial Organization*, Vol. 2, edited by Richard Schmalensee and Robert Willig. Amsterdam: North-Holland. Ch. 18, 1059-1107.

Delois, A. and Beamish, P., 2004. R&D Risk Taking in Strategic Alliances: New Explanations for R&D Alliances in the Biopharmaceutical Industry. *Management International Review*, 44 (1), pp. 53-68.

Faulhaber, G. and Baumol, W., 1988. Economists as Innovators: Practical Products of Theoretical Research. *Journal of Economic Literature*, 26: 577-600.

Frame, W. S. and White, L. J., 2002. *Empirical studies of financial innovation: lots of talk, little action?*. Working Paper, Federal Reserve Bank of Atlanta, No. 2002-12.

Fuchs, G. and Krauss, G., 2003. Biotechnology in Comparative Perspective. In: *Biotechnology in Comparative Perspective*. G. Fuchs (ed.). New York: Routledge, 1-13.

Gans, J. and Stern, S., 2003. Managing Ideas: Commercialization Strategies for Biotechnology. *Intellectual Property Research Institute of Australia Working Paper* 01/03: 1-24.

Gassman, O., Reepmeyer, G. and Zedwitz, M.V., 2004. *Leading Pharmaceutical Innovation: Trends and Drivers for Growth in the Pharmaceutical Industry.* New York: Springer-Verlag.

Gulati, R. and Singh, H, 1996. The Architecture of cooperation: managing coordination costs and appropriation concerns in strategic alliances. *Administrative Science Quarterly*, 43: 781-814.

Hall, B., 2002. The Financing of Research and Development. *Oxford Review of Economic Policy*, 18: 35-51.

Hall, B. and Lerner, J., 2009. The Financing of R&D And Innovation. *NBER Working Paper*, 15325.

Hernandez, H., Tübke, A., Hervás, F., Vezzani, A., Dosso, M., Amoroso, S. and Grassano, N., 2014. The 2014 EU Industrial R&D Investment Scoreboard. *EU R&D Scoreboard Report*.

Khilji, S. E., Mroczkowski, T. and Bernstein, B., 2006. From Invention to Innovation: Toward Developing an Integrated Innovation Model for Biotech Firms. *The Journal of Product Innovation Management*, 23: 528-540.

Li, J. and Halal, W. E., 2002. Reinventing the biotech manager. *Nature Biotechnology*, 20 Suppl (6), pp. 61-3.

Lichtenthaler, U., 2008. Open Innovation in Practice: An Analysis of Strategic Approaches to Technology Transactions. *IEEE Transactions on Engineering Management*, 55 (1), pp. 148-157.

Linder, J. C., Perkins, S., Rangan, U. S. and Dover, P., 2003. The Drug Industry's Alliance Archipelago. Babson Insight:. Babson College, n.d. Web. 20 Oct. 2015.

Lippitt, R. and Watson, J. and Westly, B., 1958. *The Dynamics of Planned Change*. New York: Harcourt.

Mayer, C., 1986. Financial Innovation: Curse or Blessing?. *Oxford Review of Economic Policy*, 2 (4), pp. 1-17.

Meyer, M. H. and Mugge, P.C., 2001. Make Platform Innovation Drive Enterprise Growth. *Research Technology Management*, 44, (1), pp. 25-39.

Meyer, F. J., 2002. Business Models That Biotech Companies Employ. *Enterprise Development KFBS Biotech Speakers Series*, November 25, 2002

Merton, R. C., 1992. Financial Innovation and Economic Performance. *Journal of Applied Corporate Finance*, 4, pp. 12-22.

Merton, R. C., 1995. Financial Innovation and the management and regulation of financial institutions. *Journal of Banking and Finance*, 19: 461-481.

Miller, M. H., 1986. Financial Innovation: The Last Twenty Years and the Next. *Journal of Financial and Quantitative Analysis*, 21 (4), pp. 459-471.

Miller, M. H., 1992. Financial Innovation: Achievements and Prospects. *Journal of Applied Corporate Finance*, 4, 4), pp. 4-12.

Perez, C., 2002. *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. London: Elgar.

Perez, C., 2010. Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics*, 34 (1), pp. 185-202.

Powell, W., White, D., Koput, K., Owen-Smith, J., 2005. Network Dynamics and Field Evolution: The Growth of Interorganizational Collaboration in the Life Sciences. *American Journal of Sociology*, 110 (4), pp. 1132-1205.

Rothwell, R., 1994. Towards the Fifth-Generation Innovation Process. *International Marketing Review*, 11 (1), pp. 7-31.

Santander InnoVentures, Oliver Wyman, Anthemis Group, 2015. The Fintech 2.0 Paper: rebooting financial services. [online] Available at: http://www.oliverwyman.com/content/dam/oliver-wyman/global/en/2015/jun/The_Fintech_2_0_Paper_Final_PV.pdf

Teece, D. J., 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, 15 (6), pp. 285-305.

Zepeda, R., 2015. The Industrialization Blueprint: Re-engineering the Future of Banking and Financial Services, in Industrialization and Technological Innovation in Finance, *Capco Institute Journal of Financial Transformation*, 42, pp. 9-30.

**Acknowledgments**

A particular mention and acknowledgement goes to Susan Kish, for the inspiration and continuous help, to Gaia Fasso, for the support in framing the problem, and Monty Montanez, for his corrections and comments.