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PERFORMATIVITY AND FINANCIAL MARKETS: OPTION PRICING IN THE LATE 19TH CENTURY

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Dimitris P. Sotiropoulos
Department of Accounting and Finance
The Open University

Janette Rutterford
Department of Accounting and Finance,
The Open University

Contacts for correspondence:

Dimitris Sotiropoulos
dimitris.sotiropoulos@open.ac.uk d.p.sotiropoulos@gmail.com

Janette Rutherford
janette.rutterford@open.ac.uk

www.open.ac.uk/ikd/publications/working-papers

PERFORMATIVITY AND FINANCIAL MARKETS: OPTION PRICING IN THE LATE 19TH CENTURY

Dimitris P. Sotiropoulos
Department of Accounting and Finance,
The Open University Business School
Emails*:* dimitris.sotiropoulos@open.ac.uk, d.p.sotiropoulos@gmail.com

Janette Rutterford
Department of Accounting and Finance,
The Open University Business School
Email*:* janette.rutterford@open.ac.uk

Abstract

The paper revisits the performativity thesis in economics stressing the plural character of knowledge, which includes not only scientific models but also every form of practical knowledge that systematizes the visible and the articulable experience of economic agents. To highlight the point, the paper examines the pricing of options in London in the late 19th century, long before the academic origin of modern option pricing models. The pamphlets of the time are valuable archives of existing option transactions performed on the basis of systematic practical techniques widely established among investors.

Keywords: *Performativity, financial markets, option pricing, Foucault, Higgins, Bachelier.*
JEL Classifications: *A14, G12, N23.*

1. Introduction

The performativity thesis has gained some credit in economic discussions, especially in the wake of Callon's attempt to emphasize the performative aspect of economics in the late 1990s (Callon 1998). Some authors even adopt the term "Callonistics" to refer to this approach (Fine 2003, Vosselman 2014). The latter is part of a wider project, the origin of which goes back to the 1980s when Callon (1986), along with Latour (1987) and Law (1986), put forward the so-called actor network theory (ANT): a "new social theory adjusted to science and technological studies" (Latour 2005: 10). One of the main insights of this theoretical tradition, maybe the most important one, is the role granted to non-humans (i.e. the 'objects' of science and technology) in their network fusion with human agents. In this context, the ANT emphasizes the idea of socio-technical agencements (Callon 2007: 140) referring to specific sets "of heterogeneous human, material, technical and textual devices which, depending on their combinations with one another, gain the capacity to act in various ways" (Roberts: 2012: 45). Every socio-technical arrangement is object to a performative definition. Non-humans are also actors in the sense that they are not "hapless bearers of symbolic projection" (Latour ibid.). This viewpoint gives a radically different meaning to social dimension and to scientific knowledge in general.

When it comes to economics, the argument simply implies that the 'economy' is not a pre-given social entity, already bounded, identifiable and knowable (Butler 2010, Latour 2005: 31-2). The 'economy' comes into being, becoming singular and monolithic, mostly because it is performed by the discipline of economics (Callon 1998). Nevertheless, the argument should be formulated with two important caveats. Both of them have been seriously underestimated in the subsequent debates. First, when Callon defines economics, it is always "in the broad sense of the term" (Callon 1998: 2). Economics is thus a *plural term* including not only different forms of scientific knowledge, but also different existing forms of practical non-systematized knowledge. As Callon (2007: 332) argued: "academic economics does not have a monopoly on performativity" (see also Callon 2010). Second, if economics actualizes economic practices, it does not retain any ontological primacy upon the latter. Callon's widely cited quotation that economics "performs, shapes and formats the economy" may be misleading if isolated from the analytical context of the ANT tradition. The very same can be said for MacKenzie's point that economics "does things" (MacKenzie 2007: 54). Callon very cautiously emphasized the "interdependence" between "economic activities" and economic "ideas" inviting an alternative agenda to study their subtle inter-relationship (Callon 1998: 2). This relationship should not be seen as one way causality, from economic ideas to reality, but as a complex condition of mutual presupposition. In other words, scientific and non-scientific knowledge has ontological implications in capitalist reality without maintaining any ontological primacy over social practices. Theoretical and practical ideas do not create reality. They make it possible being simultaneously provoked by it. This viewpoint suggests that the agent position is necessarily a discursive position since all experience relies upon the discursive conditions of the prevailing forms of knowledge.

Several authors have come up with more concrete applications of the above analytical agenda (see Callon 2007, MacKenzie et al. 2007). In the context of modern financial markets, the most influential one is definitely MacKenzie's attempt to reconsider the

importance of the standard option pricing formula on the construction of derivative markets (MacKenzie and Milo 2003). The approach of MacKenzie has triggered important discussions with regard to the nature of contemporary financial engineering, being proved a critical theoretical moment in the dissemination of the performativity agenda in the discipline of economics. On the other hand, by focusing solely on a particular pricing model of a particular financial product (options), the very same approach has downplayed the two abovementioned crucial caveats of performativity. If the effects of a particular scientific model are assessed against the complexity of economic reality, then two misunderstandings may easily arise. First, since no model can enjoy a full performative monopoly, someone may infer that the performativity thesis is inadequate to capture the range of economic ontologies. Second, someone may also argue that when it comes to the description of the mechanisms that actualize the existing economic practices, the role of non-scientific practical knowledge (which is innate in the experience of agents) may also be equally important. As a matter of fact, these two points capture the majority of the critiques of the performativity thesis.

The paper revisits the debates on the idea of performativity in economics, focusing on the workings of derivatives markets. Its main aim is to reformulate the performativity thesis addressing the misunderstandings that result from the case-specific definition of it. To clarify the analytical point, it returns to Foucault's theoretical intervention. Foucault not only offers a thorough understanding of the mutual immanence between economic practices (power relations) and knowledge but also puts forward a wide definition of the latter that is plural. It is not restricted to scientific forms but also encompasses every form of practical knowledge that systematizes the visible and the articulable experience of economic agents. Every isolated theoretical model by definition cannot enjoy the monopoly of performativity because it is only the plurality of knowledge that performs the complex economic reality. This is in line with Butler's suggestion that the failure of a scientific model is not against the account of performativity (Butler 2010). At the same time, the workings of economic practices can be performed by non-scientific forms of practical knowledge.

In order to clarify our point we refer to a historical case study: the London options markets in the late 19th century, that is, before any academic systematization of pricing techniques. Option markets existed and flourished long before the publication of Black and Scholes' famous paper in 1973. At the end of the19th century, in his influential pamphlet, Higgins tellingly explained one possible way of how experienced investors and brokers of the time priced option contracts. Higgins' text provides a thorough account of the established trading practices: investors were able to isolate and atomize risk by replicating portfolios with the same pay-offs, use a proxy close to average deviation to measure risk, rely on volatility trading to provide a pricing anchor, introduce several rules of thumbs to extend pricing to more exotic securities. This is a unique historical example which shows that sophisticated hedging practices were not academically led and, in general, do not necessarily presuppose scientific theoretical models for their workings. By saying so, we do not mean to underestimate the implications of academic knowledge in the workings of financial markets. Nevertheless, the complex reality of everyday transactions in the London option market was indeed actualized by a non-simplistic set of *practical* techniques and ideas. This case study supports the plural definition of the performativity approach.

Higgin's archival recording of market transactions offers a valuable account of OTC financial transactions. Derivatives transactions rarely left any historical trails before the post-Bretton Woods era (Weber 2009) and, in fact, we are covering a period that has been repeatedly characterized in the literature as "a statistical dark age" (Hannah 2007). The paper also argues that Higgin's insights foreran to some extent the seminal intervention of Bachelier on option pricing. In other words, according to Higgins, investors were solving in a practical way a similar pricing problem that was analytically approached by Bachelier's famous dissertation. Given the performativity thesis, this finding should not surprise : Bachelier's major analytical achievement was to provide a formalized expression of the established everyday practices. To put it in Foucauldian terms, in both cases of Higgins and Bachelier, the knowledge that was already performing the options transactions crossed a certain epistemological threshold being academically archived. A finding also in line with the performativity agenda.

2. On the issue of performativity

2.1 The agenda of performativity in financial (derivatives) markets

Discussions about the social dimension of modern financial markets, with a particular emphasis on derivatives markets, have taken an interesting twist after MacKenzie's idea to apply the performativity thesis to the developments in options markets in the wake of the appearance of Black, Scholes and Merton option pricing formula (BSM henceforth[1]) (MacKenzie and Milo 2003; MacKenzie 2007). MacKenzie in his analysis draws heavily upon Callon's theoretical intervention to introduce the idea of performativity in the study of economic phenomena: economics "in the broad sense of the term, performs, shapes and formats the economy, rather than observing how it functions" (Callon 1998: 2, see also Callon 2007). The concept of performativity actually has a long history in the analysis of social phenomena (especially in politics) and may take different meanings in the interventions of different authors. In general, the performativity thesis argues for an *immanent* relationship between statements and acts or theory and reality (Deleuze and Guattari 2013: 62). Or alternatively, as Butler (2010: 147) puts it, "performativity starts to describe a set of processes that produce ontological effects, that is, that work to bring into being certain kinds of realities."

The mutual immanence between theory and reality is the crucial link in the above line of thought. Scientific theories and models (like every other 'language' in general) are *already embedded* in the socio-technical context of the reality they attempt to describe (Callon 2007: 318, 320-21). Thus, the relation between theory and reality is neither one of 'creation' nor one of 'reflection', but *one of mutual presupposition and capture*. Here lies the standard misunderstanding of the argument by its critics (see Vosselman

[1] It is well known that Merton came to the same differential equation and the same solution quite independently from Black and Scholes. There were significant differences in the way they addressed the problem. The famous trio was not the first to derive option pricing equations. Samuelson should also be mentioned, because he revived Ito calculus and Merton should be also given some extra credit for putting Ito calculus to work in financial theory (he also "held off on sending his alternative approach to journals, so that Black and Scholes could receive appropriate credit for their discovery" Weatherall (2013: 114)). For more on the story see (MacKenzie 2007; Weatherall 2013; McCauley 2009).

2014). The performativity thesis argues for a theoretical representation that "progressively discovers its world" *and* the world that "is put into motion by the formula describing it" (Callon 2007: 320). In this sense, theoretical knowledge does not only transmit some content but conveys the way the subject relates to this content producing particular ontological effects in society (see Zizek 2006: 16).

In the context of financial markets, financial theory and mainstream modeling *let* the world they describe become actual. Financial economic theory is performed "by a combination of actors and technologies to produce a world similar to that outlined in the abstract economic theories" (Muellerleide 2013: 1632). This is exactly the viewpoint that MacKenzie (2007: 54) extends to options pricing: economics "does things" rather than "describing an external reality that is not affected by economics." To clarify his case-specific point, MacKenzie approaches the performativity thesis from the perspective of a particular model. An aspect of economic theory (model) may be: (i) performative in a *generic* way (generic performativity), when it is generally used in economic processes, (ii) performative in an *effective* way (effective performativity), when it has a considerable effect on economic processes, and (iiii) 'Barnesian' performative, when it brings about exactly a state of affairs it predicted and described in the first place (ibid.: 55, 66). This distinction between different levels of performative effectiveness of an economic model captures at the same time the different historical phases of the BSM pricing formula, which is the main focus of MacKenzie's intervention. The BSM pricing formula initially made just a simple difference (generic performativity) in the workings of options markets, but gradually gained a dominant position lessening the discrepancies between the model predictions and the actual market prices (Barnesian performativity). Nevertheless, after the 1987 financial crisis, while "option theory is still performed in the generic and effective sense," its "canonical model has lost its Barnesian power" (MacKenzie 2007: 76). The general conclusion from Mackenzie's analysis is that the performative power of a particular model is by no means stable and guaranteed: its performative strength may significantly vary.

This latter point raises the issue of the *breakdown* in the performative strength of a theory or a model. Performative inefficiency and/or breakdown is the major concern of the critics, who usually highlight discrepancies between anticipations based on theoretical models and real social outcomes (see Fine 2003: 480; Santos and Rodrigues 2009: 998; Mikes 2009; Svetlova 2012). The point is that, since a particular model or theory can hardly predict the workings of the complex market reality, the performativity agenda is either wrong (in its strong version) or falls into a naive truism (in its weak version). This issue has also been critically addressed by Butler in her defensive appraisal of the performativity thesis. For Butler, economic theories "do sometimes fail, and they are always brokering failure, whether or not they do actually fail" (Butler 2010: 152). The real challenge thus for the performativity agenda is to built fallibility into its analytical account (ibid.).

But, if fallibility is built into the very core of the performativity argument, how can it be properly theorized? MacKenzie (2007: 77) introduced the concept of "counter-performativity" to describe how the Barnesian stage of strong performativity may be also undermined by the very use of the same model: unilateral adoption of a model may easily backfire. This is a genuine indication of performative failure, but it is not adequate for a coherent explanation of the whole process. In order to understand the

latter, we must abandon the constrained singular perspective of a particular model when we discuss economic performativity. *If a model loses its performative power, it is because other theoretical aspects, practical knowledge and agents' worldviews become more strongly explanatory*. The reality of economic and social practices is complex and flexible and, thus, the nature of the performativity approach is necessarily multiple and plural, not model-specific. This is how Callon (2010: 165) attempts to get around the problem:

> Markets [...] are complex realities that can be configured differently, as each configuration can be designed to respond to particular orientations and requirements. This diversity − and on this point the performativity programme adds something essential − stems partly from, and to some extent is expressed in, the plurality of theoretical frameworks devised to account for the various aspects of market functioning.

Market reality is complex and, thus, the performativity approach "makes it possible to exhibit the struggle between worlds that are trying to prevail" (Callon 2007: 332); that is, struggle between different competitive forms of knowledge. The latter includes not only academically systematized theoretical forms, but all sorts of practical knowledge and individual viewpoints, which are embedded in the existing market practices (ibid.). In other words, the performativity agenda can incorporate the fallibility moment only when it approaches the issue of knowledge from the perspective of plurality: markets are actualized by a diverse setting of a knowledge that may take alternative and contradictory forms.

Knowledge is always performative in the sense that it does actualize a complex reality. In fact, knowledge is immanent in the latter. Nevertheless, *it is crucial for the performative agenda to keep the content and scope of 'knowledge' as wide as it actually gets in reality*. In this regard, we should abandon the micro-perspective of a particular model in favor of a macro-viewpoint of knowledge as system as a whole. Knowledge is a plural, diverse, complex and contradictory set of statements and visibilities (perceptions) under different forms of systematization, which does not always cross the threshold of 'scientificity' (theoretical and empirical knowledge). This formulation invites, indeed, a Foucauldian type of reasoning.

2.2 On the Foucauldian nature of performativity

In what follows, we draw upon Deleuze's reformulation of Foucault's theoretical project (Deleuze 2012). Foucault's performative approach stresses the *mutual immanence* between knowledge and social relations (Deleuze 2012: 62). The former must be seen as something plural and generic: it comprises combinations and different forms of the *visible* (perceptions) and the *articulable* (statements) of agents' experience. Put simply, the domain of knowledge captures not only scientific (academic) production in the form of theories and models, but also any possible form of *practical* knowledge including "even the experience of perception, the values of the imagination, the prevailing ideas or commonly held beliefs" (ibid.: 44). In this sense, there is practically nothing outside and prior to such definition of knowledge. The performative part of Foucault's argument emphasizes the mutual capture and presupposition between social practices and knowledge. Different forms of knowledge are "always already completely caught up within power relations which they presuppose and actualize" (ibid.: 69). Knowledge is inseparable from the diagram of social relations which make it possible, and social practices are not

independent from the forms of knowledge which actualize them. Social practices invoke theoretical and/or empirical forms of knowledge, while the latter can only become recognizable in relation to the corresponding social relations (Foucault 1977, 2003; see also Deleuze 2012: 33, Balibar 1997).

Hence, a social institution can be seen as the complex coupling, co-existence, and co-integration between social relations and particular forms of knowledge. The latter passes through scientific, systematic and/or spontaneous forms of individual experience (seeing, speaking, thinking) in order to actualize the former (Deleuze 2012: 65). It is this particular coupling that makes up social institutions, like financial markets. A social institution is the *concrete assemblage*, in which certain forms of knowledge bring to life the abstract social technology (diagram) which is embedded in the social relations.

This short diversion through Foucault's conception of performativity adds a different angle to the above-mentioned discussions. Modern derivatives markets are definitely an institutional coupling between related practices of risk trading and particular forms of knowledge (theoretical or practical), in the way described above. Financial markets are made possible when a certain set of financial knowledge is performed by a proper conjunction of actors and technologies. MacKenzie's intervention is brilliant without, nevertheless, avoiding analytical limitations. The BSM option pricing model heralded, actualized and to some extend led actors performance in the brand new landscape of modern risk trading. The model formalized and refined practices of dynamic hedging that were already in place in the increasingly liquid financial markets (Mixon 2009: 171, Weatherall 2013). It was a genuine no-arbitrage model for pricing in a financial world built upon the principle of arbitrage and liquidity. The performative strength of the model could not be perfect and guaranteed, since it was only just one aspect in the new plural setting of modern financial knowledge. In this sense, it could not but be *immanent fallible*. But this result does not contradict the performativity thesis. It is totally in line with the overall argument. Market reality is actualized by a plurality of forms of knowledge; different individual elements (models, practical techniques, prevailing ideas and beliefs) within this plural diversity necessarily loses more or less their individual performative efficacy.

This type of reasoning anticipates and answers to a significant extent some of the critiques of the performativity thesis.[2] Santos and Rodrigues (2009: 992) find the strong notion of performativity "too demanding" and the weak version "trivially true" (see also Fine 2003 for a similar point). For them, "the weak version makes the milder claim that economics is actively engaged in market building" (ibid.: 998). Nevertheless, they miss the basic point of performativity that the complexity of market engineering does not rely on single theoretical models and their 'manipulative' use by agents, but on a set of different forms of knowledge that actualize the conjunction between actors and existing technologies. These forms of knowledge are not external instruments to actors but shape the visible and articulable experience of the latter calling forth particular norms of behavior. In this line of reasoning, every theoretical model and/or practical technique is necessarily *immanent* in the material reproduction of social practices and not extraneous 'virtual' ideological models that runs contrary to the 'real' economic transactions (as argued by Miller 2003, see also Fine 2003).

[2] For relevant debates see Callon (2007), Vosselman (2014).

Neither is the idea of "calculable cultures," put forward by Mikes (2009, 2011) and Svetlova (2012), enough to reject the performativity argument. For this theoretical literature, a model loses its monopoly on performativity because there are different institutional designs and rules ("calculative cultures") that determine "how models are used and made to account for decisions" (Svetlova 2012: 420). Risk management decisions by portfolio managers are not solely based on particular models, regardless of how prevailing and popular the latter may be. Decision makers use the model output as only a starting point "for further inquiries and exercise of judgment" (Mikes 2009: 33). Managers have their own understanding, personal knowledge and expectations, a valuable practical knowledge of the existing financial practices, which is also a crucial determinant of decisions and related actions: "model users account for unrealistic assumptions and neglected factors by applying their own judgments" (Svetlova 2012: 422; see also Mikes 2009). This is a good point but not a genuine critique to the performativity thesis because the latter already includes the practical non-scientific element of agents´, experience. Model-specific performativity fails because in practice it is just one form of knowledge along with other practical forms that also inform and guide the decision making. The performative fallibility of a particular fragment of knowledge means that only the whole setting of the existing forms of knowledge (in its plurality) is substantially performative in the strong sense of the term.[3]

In order to clarify our viewpoint, we examine evidence from a particular historical case study in financial markets that has been only marginally discussed in literature: option pricing at the end of 19th century, that is, before the modern formalization of stochastic calculus embedded in the BSM option pricing model.

3. A case study: option pricing before stochastic calculus

In recent financial studies and textbooks, one can easily find many historical illustrations of the use of derivatives that go back in time, even in the distant past (Markham 2002: 4-5; Haug and Taleb 2011: 100). Nevertheless, besides some rare quotations and infrequent historical references, there is "widespread ignorance concerning the history of derivatives," a fact that is indicated by the relative "dearth of research in the history of derivative trading" until recently (Weber 2009: 432). This 'dearth' in the historical research can be explained (to some extent) by the fact that until recently "there are few historical records of derivatives dealings. Derivatives left no paper trail because they are private agreements that have been traded in over-the-counter markets for most of their history" (ibid.). Nevertheless, one can refer to many intriguing historical illustrations:[4] primary forms of derivatives on sovereign debt can be found as early as 1390 in Venice; futures contracts were common on the Amsterdam Exchange by 1610, playing a crucial role in the famous Tulip Mania that arose around 1636; put options and 'refusals' (call options) were being widely traded in London by the end of 17th century; in 1821, a broker from the London stock

[3] The discussion about performativity cannot be exhausted in the context of a single paper. We do not examine here the nature of the mutual immanence between knowledge and social relations. While our argument builds on the Foucauldian idea of performativity, we do not fully agree with the way that Foucault himself theorizes the unity between power and knowledge. In this respect our argument is informed by Balibar (1997). See also Sotiropoulos et al. (2013), LiPuma and Lee (2012), Roberts (2012).

[4] See Markham (2002) and Allen (2001).

exchange complained that the trade in options was “now so frequent as to constitute the greater part of the business done in the House” (cited in Chancellor 2000: 97).

The revival of interest in derivatives trading has drawn attention to some early approaches to option pricing (in English, French and German), which were hitherto neglected and forgotten (see Weber 2009, Haug 2009, Haug and Taleb 2011, Hafner and Zimmermann 2009, Kairys and Valerio 1997, Mixon 2009, Sotiropoulos 2015, Jovanovic and Le Gall 2001, Poitras 2009). All these early approaches to derivatives can be seen as evidence in favor of the version of performativity developed above. Derivatives markets involve practices that have been actualized by corresponding forms of knowledge. Before the rise of modern financial theory at the beginning of the 1950s, this financial knowledge existed mostly in practical and non-formalized state. *All the early approaches to derivatives are theoretical outcomes appearing when the existing practical knowledge crossed a certain threshold of scientificity and formalization gaining historical visibility*. As Leonard Higgins emphasized in the preface of his influential treatise on option pricing in the end of the 19th century:

> The writer of the following pages feels that, in publishing this little book on Options, *he may be telling many of his professional friends what they already know perhaps better than the author*. If, however, he succeeds in supplying in a readable form an answer to the question which has so often been put to him by the uninitiated, *viz.*, "What is an Option?" and in placing before those who have mastered the intricacies of Option dealing the Theory of the "Value of the Put-and-Call" in a somewhat new light, the object of his little book will be attained (Higgins 1896, preface; emphasis added).

In the above introductory passage, Higgins actually feels that he does not add a single new element to the everyday practical knowledge of his professional colleagues in option trading. He merely attempts a systematization hoping to approach the very same question in a new light. The rest of the paper will focus on Higgins´, intervention for several reasons. Higgins was describing option transactions in the London market, the "par excellence" option market of the world (Higgins 1896: 58; Filer 2013). His approach was quite influential in the English-speaking literature among market experts on both sides of the Atlantic (for instance Nelson (1904) draws heavily upon it). He was also drawing heavily upon the dominant trading practices of the time and thus his approach is not just a systematization but also a valuable historical archive to study.

The following analysis explains why this neglected historical case is intriguing and significant in its own right. It is also related to the above discussions on performativity in an important way. It supports the broader definition of the performativity thesis, as opposed to the restricted model-specific one which is usually preferred and debated in the literature (e.g. Mackenzie et al. 2007). Pricing techniques in financial markets have been systematically developed in practice long before the academic publication of related formalized models (Rutterford 2004). And sophisticated option trading was possible long before the perfecting of the BSM pricing model in the 1970s on the basis of a knowledge spontaneously developed in a practical form in the everyday experience of market participants.

4. Higgins' pricing approach

Of the few existing accounts of option trading before the First World War in the Anglo-Saxon world, Leonard Higgins' pamphlet, initially published in London in 1896, was the most influential (Higgins 1896). This pamphlet was not the first of its kind in circulation. Two decades earlier, in 1877, Charles Castelli had published a relevant book on options trading (Castelli 1877). While Castelli focused mostly on the definition of different types option securities and the description of their basic workings, Higgins additionally provided a thorough analysis of existing pricing techniques. Higgins was not only interested in informing the public about the available risk hedging strategies, but also attempted to advise brokers on the proper pricing rules they should comply with. Less than a decade after Higgins' publication, in 1904, Nelson attempted to describe options markets from the other side of the Atlantic, also dealing with transatlantic abritrage (Nelson 1904). His analysis drew heavily upon the work of both Castelli and Higgins, but was undoubtedly most influenced by the latter (indeed, on pricing, Nelson reproduces Higgins' entire chapter on this). All three authors explicitly state that they do not bring anything new to the existing established hedging practices in the market, but they just systematize this practical knowledge offering new perspectives for practical use.

The following analysis is focused on Higgins' approach on London option transactions. The time period of the issued options (the "option period") "may be said to range from a few hours to six months" (Higgins 1896: 2). In London at the time, the standard contract was the European-style option issued at-the-money (Haug 2009: 476),[5] usually covering 100 shares and being negotiated in the OTC market. Out-of-the money options, known as 'special options', were not traded often while there is no indication in the writings of the period that there was a secondary market (Haug 2009: 476). Given the shape of equity markets of the time (Rutterford 2004), options were held until maturity.

Higgins describes a complex pricing mechanism connecting the value of option with the volatility of the underlying security. Investors could isolate and atomize risk by replicating portfolios with the same pay-offs, use a proxy close to average deviation to measure risk, rely on volatility trading to provide a pricing anchor, apply several rules of thumbs to extend pricing to more exotic securities, allow for a discount rate and a counterparty risk, and finally include a fair profit for the broker's market making service.

4.1 Atomization of risk

In the first four chapters of his pamphlet, Higgins provided the standard definitions of options along with simple practical examples highlighting different aspects of their workings. As well as call and put options,[6] he also introduced, inter alia, so-called

[5] In practice, options were issued at a strike price that was adjusted from the spot price to reflect the option premium of the contract as well as the time value of money expressed through the discount rate (Mixon 2009: 176).

[6] In general, an option gives the holder the right (not the obligation) to buy or sell the underline asset at a future date and an agreed strike price. This right costs something, therefore unlike futures the purchase of an option requires an up-front payment. There are briefly two basic types of options: rights to buy are named call options (or simply calls) while rights to sell are called put options (or simply puts).

'put-and-call' options (the title of his pamphlet) or straddles.[7] Higgins also associated options with a certain conception of risk. He approached them as *sui generis* forms of private insurance: as insurance "against unlimited risk" (Higgins 1896: 64). The value of an option was defined, thus, as an insurance premium.

Higgins devoted a significant part of his analysis (chapters V to VIII) explaining how to replicate payoffs between different portfolios made by options and the underlying shares. For instance, describing simple "hedging operations" between puts, calls and shares with the same strike price, he summarizes some standardized market transactions (Higgins 1896: 26):

> That a call of a certain amount of stock can be converted into a put-and-call of half as much by selling one-half of the original amount. [...] That a call can be turned into a put by selling all the stock. [...] That a put-and-call of a certain amount of stock can be turned into either a put of twice as much by selling the whole amount, or into a call of twice as much by buying the whole amount.

This passage along with some of Higgins' illustrations are extensively quoted by Nelson. Haug and Taleb (2011: 103) have already picked up this point. In the analysis provided by Higgins and Nelson, one can easily see a practical but thorough understanding of the co-called put and call parity: that is, a certain pricing relationship between simple portfolios including a put and a call. Moreover, one can also find a series of relevant rules based on the portfolio replication idea, quite similar to those in the above quotation (ibid.). In other words, quite spontaneously and on the basis of the system of their hedging positions as a whole, investors were actually defining and trading risks in the context of a metonymic process by replicating portfolios with the same payoffs.

The above process is definitely a process of *atomization of risk*. The numerous examples offered by Higgins reflect the fact that the complex and multi-faceted financial transactions of the time un-bundled and re-bundled the payoffs of different portfolios and therefore isolated, singled out and traded different risks associated with the underlying securities.[8] As we shall further see below, the option pricing technique offered by Higgins is based on volatility trading, that is on buying and selling portfolios made by a put and a call of the same maturity and strike price. Investors may have not been fully aware of this aspect of their everyday practices, but their ordinary hedging techniques were modes of performing and actualizing a particular abstract technology of risk atomization.

The way that risks are defined and atomized is associated with the institutional context of the market. There are different ways that the risk atomization can be performed, that is, different institutional settings of portfolio replication. This is clear if we compare option markets at the time Higgins was writing with relevant contemporary transactions. Contemporary stock option markets are extremely liquid, with quotation frequency being a large subdivision of the second (Durbin 2010). This

[7] Straddle was the US term of the same financial contract, which is now the universal term for this combination of a put and call option at the same strike price.

[8] Following contemporary literature, we shall call "atomization of risk" the "unbundling and re-bundling of the payoffs and hence of the risks associated with primitive financial products and primitive securities" (Borio 2007: 2). See also Steinherr (2000) and also Sotiropoulos et al. (2013) for a thorough analysis of this aspect of risk trading.

was not the case at the end of the 19th century when options markets were relatively small in size, over-the-counter negotiated and contracts were mostly issued at-the-money and held until maturity. BSM option pricing is fundamentally based on continuously dynamic hedging, so that a portfolio made by an option and its underlying share could always adjusted in order to replicate a hypothetical risk-free security (McCauley2009, MacKenzie 2007, Sutton 2000). This type of hedging was unthinkable when Higgins was writing. The BSM option pricing model performs a different risk atomization based on the no-arbitrage condition in a financial landscape dominated by dynamic arbitrage investment strategies.

4.2 Marketization of risk

Following contemporary financial jargon, we shall call *marketization of risk* (Borio 2007) the particular solution to the pricing problem within the existing institutional framework. In terms of the above analysis, we can say that risk marketization is the historic-specific (institution-specific) solution to a pricing problem as performed by the prevailing theoretical or practical models.

Higgins, from the very first moment in this analytical account, linked the pricing of options to the measurement of risk.[9] The calculation of "probable risk" (and, thus, the price of an option) is, in fact, a statistical exercise that can offer a "fair" value. In practice, however, prices may be slightly different according to bargaining on the basis of the "speculative impulse of the moment" (Higgins 1896: 65). For Higgins, the estimation of the option premium is much more complex that the actuarial insurance calculations,[10] mostly because of the erratic, unstable and changing character of financial markets. This is a prelude to a primitive version of the (discrete) random walk hypothesis:

> in nearly every instance in active speculative stocks, the chance of a rise or a fall is, to borrow a sporting expression, "even money betting" (Higgins 1896: 36).

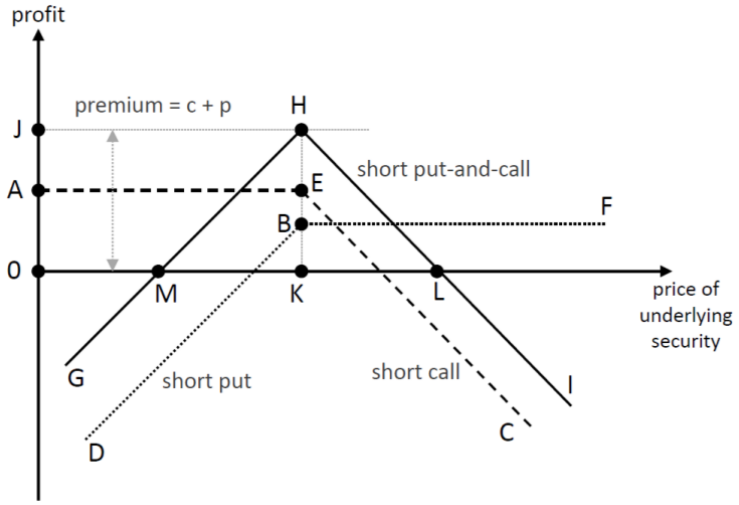
The next crucial step in his pricing technique is volatility trading. Higgins understood that the anticipated price of the put-and-call at maturity is a fair estimation of the expected price volatility of the underlying security. Put-and-call is the simple combination of a put and a call with the same strike price and expiration date. The profit from writing (selling) a single put-and-call is depicted in Figure 1. This figure cannot be found in Higgins' analysis but it is clear that he is fully aware of the workings of this contract. Line AEC shows the profit for the short call. With this, the investor sells someone else the right to buy the underlying security at a pre-specified date in the future (expiration date) and at an agreed exercise price *K*. At the maturity day, the other party will not exercise this right if the spot price *S* is lower than *K* (it is totally unreasonable to buy something at a higher price *K* than the spot price *S*). In that case, the investor's gain would be the up-front premium *c* (equal to OA in the

[9] Castelli (1877) does not offer a pricing technique in his analysis. He just describes alternative hedging methods given option prices. Higgins devoted chapter XI to calculating a fair value for options. He is clear on the distinction between fair value and price (Higgins 1896: 64). Nelson quotes Higgins' entire chapter XI on option pricing in his own pamphlet.

[10] The difference is merely the amount of available data, how many people over how many time periods, which is more difficult to get for shares than for life expectancy. Given these limitations, any kind of risk assessment is acceptable, provided that "it can do sufficient business to establish an average" (Higgins 1896: 67).

figure) he had received when he issued the call. On the other hand, if the spot price *S* is *higher* than the strike price *K*, our investor's counterparty will exercise the call option, buying the underlying security at the pre-specified price *K* which is now lower than the spot price *S*. In that case, our investor will face losses equal to: *c-(S-K)*, given by the line EC. In quite the same way, it is easy to show that the profit from the short put will be given by line DBF: for spot prices higher than *K* the counterparty will not exercise the put option, selling something at a lower price than the existing one. We get the final profit from the short straddle position (line GHI) if we add the two option profits. What is important for our analytical scope is to see that a fair premium of the put-and-call (the money that the issuer would receive) should be equal to price volatility: *c+p* = KL or MK. The price of the put-and-call reflects the anticipated price dispersion of the underlying security.

Figure 1
The straddle (put-and-call)



Unlike contemporary financial theory, Higgins does not use standard deviation (or variance) as a proxy for market price dispersion but another similar measure which is close to the so-called average deviation. Of course, there is a very close connection between these two statistical variables. But the average deviation captures better the distance *KL* in Figure 1 which is the "average value" for the put-and-call reflecting the "average past fluctuations" (Higgins 1896: 70). Anticipated average deviation based on past data is, thus, a good proxy for the price of the put-and-call. In fact, Higgins traces share price fluctuations:

> from week to week over a period of seven years from January, 1888, to December, 1894. The price of each week has been compared with those of the previous week, fortnight, month, two months, and three months (the fluctuations being carried out in columns), and averages have been taken over the whole period in question (Higgins 1896: 66).

Since stock prices follow a random walk (see above), Higgins warns that the anticipated average deviation has a time dimension and varies according to the period until maturity: the longer the period to maturity, the higher the average value of put-and-call (Higgins, ibid.). If past data are to be used for estimation of the average

deviation, the calculations should take different time frequencies into consideration: the expected average deviation for a two month contract should be the average of a series of past two-month deviations and so on. In his calculations he uses seven years of historical data and provides a table with results for different shares and times to maturity (see Figure 2). He sees that as a safe method − a "fair basis" − that takes into consideration the average influence of many different sources (risks) of price volatility (Higgins 1896: 66).

Figure 2

Expected average deviations on the basis of past data as estimated by Higgins to price put-and-call contracts.

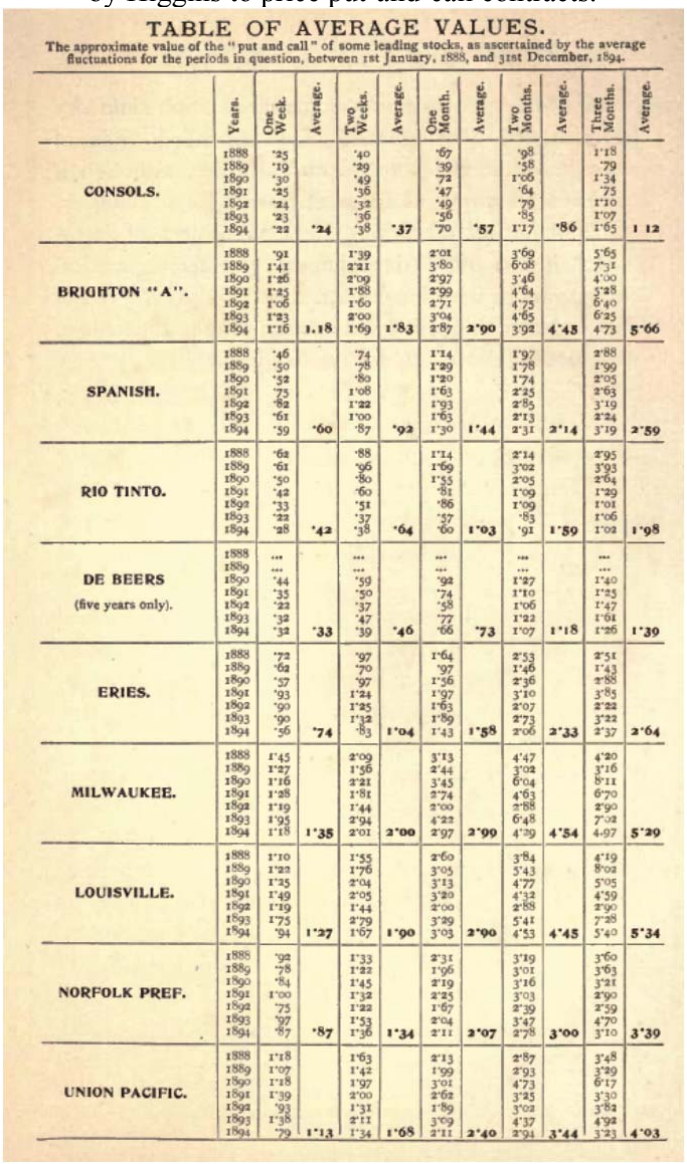


TABLE OF AVERAGE VALUES.

The approximate value of the "put and call" of some leading stocks, as ascertained by the average fluctuations for the periods in question, between 1st January, 1888, and 31st December, 1894.

	Years.	One Week.	Average.	Two Weeks.	Average.	One Month.	Average.	Two Months.	Average.	Three Months.	Average.
CONSOLS.	1888	·25		·40		·67		·98		1·18	
	1889	·19		·29		·39		·58		·79	
	1890	·30		·49		·72		1·06		1·34	
	1891	·25		·36		·47		·64		·75	
	1892	·24		·32		·49		·79		1·10	
	1893	·23		·36		·56		·85		1·07	
	1894	·22	·24	·38	·37	·70	·57	1·17	·86	1·65	1 12
BRIGHTON "A".	1888	·91		1·39		2·01		3·69		5·65	
	1889	1·41		2·21		3·80		6·08		7·31	
	1890	1·26		2·09		2·97		3·46		4·00	
	1891	1·25		1·88		2·99		4·64		5·28	
	1892	1·06		1·60		2·71		4·75		6·40	
	1893	1·23		2·00		3·04		4·65		6·25	
	1894	1·16	1.18	1·69	1·83	2·87	2·90	3·92	4·48	4·73	5·66
SPANISH.	1888	·46		·74		1·14		1·97		2·88	
	1889	·50		·78		1·29		1·78		1·99	
	1890	·52		·80		1·20		1·74		2·05	
	1891	·75		1·08		1·63		2·25		2·63	
	1892	·82		1·22		1·93		2·85		3·19	
	1893	·61		1·00		1·65		2·13		2·24	
	1894	·59	·60	·87	·92	1·30	1·44	2·31	2·14	3·19	2·59
RIO TINTO.	1888	·62		·88		1·14		2·14		2·95	
	1889	·61		·96		1·69		3·02		3·93	
	1890	·50		·80		1·55		2·05		2·64	
	1891	·42		·60		·81		1·09		1·29	
	1892	·33		·51		·86		1·09		1·01	
	1893	·22		·37		·57		·83		1·06	
	1894	·28	·42	·38	·64	·60	1·03	·91	1·59	1·02	1·98
DE BEERS (five years only).	1888	...		...		...		...		...	
	1889	...		...		...		...		...	
	1890	·44		·59		·92		1·27		1·40	
	1891	·35		·50		·74		1·10		1·25	
	1892	·22		·37		·58		1·06		1·47	
	1893	·32		·47		·77		1·22		1·61	
	1894	·32	·33	·39	·46	·66	·73	1·07	1·18	1·26	1·39
ERIES.	1888	·72		·97		1·64		2·53		2·51	
	1889	·69		·70		·97		1·46		1·43	
	1890	·57		·97		1·56		2·36		2·88	
	1891	·93		1·24		1·97		3·10		3·85	
	1892	·90		1·25		1·63		2·07		2·22	
	1893	·90		1·32		1·89		2·73		3·22	
	1894	·56	·74	·83	1·04	1·43	1·58	2·06	2·33	2·37	2·64
MILWAUKEE.	1888	1·45		2·09		3·13		4·47		4·20	
	1889	1·27		1·56		2·44		3·02		3·16	
	1890	1·16		2·21		3·45		6·04		8·11	
	1891	1·28		1·81		2·74		4·63		6·70	
	1892	1·19		1·44		2·00		2·88		2·90	
	1893	1·95		2·94		4·22		6·48		7·02	
	1894	1·18	1·35	2·01	2·00	2·97	2·99	4·29	4·54	4·97	5·29
LOUISVILLE.	1888	1·10		1·55		2·60		3·84		4·19	
	1889	1·22		1·76		3·05		5·43		8·02	
	1890	1·25		2·04		3·13		4·77		5·05	
	1891	1·49		2·05		3·20		4·32		4·59	
	1892	1·19		1·44		2·00		2·88		2·90	
	1893	1·75		2·79		3·29		5·41		7·28	
	1894	·94	1·27	1·67	1·90	3·03	2·90	4·53	4·45	5·40	5·34
NORFOLK PREF.	1888	·92		1·33		2·31		3·19		3·60	
	1889	·78		1·22		1·96		3·01		3·63	
	1890	·84		1·45		2·19		3·16		3·21	
	1891	1·00		1·32		2·25		3·03		2·90	
	1892	·75		1·22		1·67		2·39		2·59	
	1893	·97		1·53		2·04		3·47		4·70	
	1894	·87	·87	1·36	1·34	2·11	2·07	2·78	3·00	3·10	3·39
UNION PACIFIC.	1888	1·18		1·63		2·13		2·87		3·48	
	1889	1·07		1·42		1·99		2·93		3·29	
	1890	1·18		1·97		3·01		4·73		6·17	
	1891	1·39		2·00		2·62		3·25		3·30	
	1892	·93		1·31		1·89		3·02		3·82	
	1893	1·38		2·11		3·09		4·37		4·92	
	1894	·79	1·13	1·34	1·68	2·11	2·40	2·94	3·44	3·23	4·03

Source: Higgins (1896: 76).

Figure 2 presents the expected volatilities for different types of securities as estimated by Higgins. These volatilities are interpreted as "average values" for the put-and-call contracts. Since underlying security prices are assumed to follow a random walk, we

expect the volatility to increase with time to maturity. At the same time, less risky securities like Consols experience lower price volatility. In other words, the riskier the stock, the higher the expected price volatility.

The final step in Higgins' pricing solution is to allow for some additional 'costs' that the broker may encounter. Some of these costs appear in Figure 3. Anticipated average deviation gives us the "average value" of the contract, mostly reflecting the risk of underlying security. But this is not the end. The dealer should take into consideration a series of transaction costs, such as: dealer's working cost (1/8%), a reasonable profit margin (1/2%), interest expenses (1/8%) and an extra risk premium for "other contingencies" (1/8%), which may include unexpected changes in volatility or interest rates and counterparty risk ("provision for possible default on the part of the giver," Higgins 1896: 70). On the top of these regular costs (this does not appear in Figure 3), the dealer may have to exploit special circumstances in the market – i.e. a "financial strain" or special economic and "political complications" (ibid.: 70).

Figure 3

The final price of a put-and-call

(1) The "average value," say - -	$4\frac{1}{2}$%
(2) Proportion of working cost £1300	$\frac{1}{8}$%
(3) Proportion of 5% interest on a capital of £26,000 - - -	$\frac{1}{8}$%
(4) Other contingencies - - -	$\frac{1}{8}$%
(5) Margin of profit - - -	$\frac{1}{2}$%
Total - - - -	$5\frac{3}{8}$%

Source: Higgins (1896: 73).

The calculation of the price of the put-and-call offers Higgins an 'anchor' for the overall pricing of options. Investors can price put-and-calls using volatility estimations. Similar transaction in our days are known as volatility trading. The abovementioned straddles along with other standard simple combination of puts and calls (under other 'exotic' names as: strangles, butterflies etc.) are so common in contemporary markets that "they are quoted and priced as if each was its own security even though each is really a set of multiple securities" (Durbin, 2010, p. 82). This was also the case in London option market at the end of 19th century. On the basis of volatility trading, investors could then replicate various portfolios made up of combinations of put-and-calls together with ordinary puts or calls (risk atomization process). The latter could thus be priced.[11]

[11] Although the standard practice was to issue options at-the-money, Higgins also offers a practical rule to give a proxy for out-of-the money option writing. While he understands that an out-of-the money put-and-call will have a different premium from the standard at-the-money one, he assumes that the put-and-call price should be treated as unaffected if the difference between the share price and the strike price *K* is less that 25% of the anticipated average deviation.

4.3 A brief diversion: Higgins and Bachelier

The above steps in Higgins's analysis comprise a pricing technique, which, in *practical terms*, gets quite close to the famous option pricing formula of Bachelier.

It is widely known that Louis Bachelier submitted in 1900 to the University of Paris his dissertation thesis under the supervision of Henri Poincaré. The title of the dissertation was: *Théorie de la Spéculation*, and its theme focused on financial pricing (options on French government bonds), significantly diverging from the standard mathematical areas of interest of the time. This is the basic reason why the dissertation did not get a distinction: "the grade was a respectable '*mention honorable*', not the '*très honorable*' that would have assured Bachelier a first-class ticket to an august mathematical career" (Mandelbrot and Hudson 2008: 45). Poincaré recognized some original insights in the thesis but actually observed that: "the subject chosen by M. Bachelier is a bit distant from those usually treated by our candidates" (cited in ibid.: 45). The other professors did not find the analysis sufficiently rigorous (Sutton 2000: 39). After the rediscovery of the thesis by Savage (who informed Samuelson) in the mid-1950s, Bachelier's dissertation is now considered as one of the most remarkable PhD theses ever written in economics, heavily anticipating modern financial theory (Sutton 2000: 35).

The basic insight of Bachelier was the random walk hypothesis: stock prices are equally likely to rise or fall, thus the best forecast of tomorrow's price is today's price. Higgins adopted the very same condition as entry point in his analysis. He was describing real trading practices in illiquid option markets and, therefore, he had a discrete version of a random walk in mind (see above). The major accomplishment of Bachelier was that he developed the mathematics of continuous-time random-walk processes, known today as Wiener processes. Bachelier's thesis "predates by five years the paper by Einstein, who independently developed the analysis of such a process and applied it to the modeling of Brownian motion (the movement of small particles in a liquid)" (Sutton 2000: 36). On the basis of this mathematical formalization, Bachelier could estimate the premium of a European option *c* (like those traded in London at the time of Higgins). This premium is given by the following expression (contrary to the contemporary solutions to option pricing, the formula below assumes risk neutral investors[12]):

$$c = e^{-r \cdot T} \cdot E\left[\max\left(p(T) - K, 0\right)\right] \tag{1}$$

where *p(T)* denotes the stock price at expiration date at time *T* in the future, *K* is the strike price and *r* is a discount rate (continuously compounded). Equation (1) simply says that value of a call today should be equal to the discounted future payoff of the contract at maturity. The call will not be exercised if $p(T)<K$, otherwise its payoff will be given by the different $p(T)-K$. The only unknown is the price at maturity of the underlying share *p(T)*. Bachelier assumed that this price "could be described by a normal distribution whose standard deviation increased proportionally with the square root of T" (Sutton 2000: 38). That is:

$$\sigma(T) = a \cdot \sqrt{T} \tag{2}$$

[12] The BSM solution, on the other hand, assumes the more fundamental condition of risk-averse agents.

Equation (1) could be mathematically solved, but the resulting prices depends on the parameter *a* in equation (2). Bachelier estimated *a* by calculating "the standard deviation of the 'day to day' changes in the stock price over some period in the recent past" (Sutton 2000: 38).

British option traders of the time were not aware of the mathematical tools that Bachelier introduced in the pricing solution.[13] The systematic fusion of financial theory and advanced statistics did not happen before the 1950s. In illiquid markets where options are issued at-the-money and held until maturity (and in the absence of advanced computing machines), investors tend to think in discrete terms and not in the context of the Wiener process. Nevertheless, in the institutional conditions of the time investors worked out a practical solution to option pricing that shares the same basic insights with Bachelier's formalized approach.

The crucial link in Higgins' pricing technique was the value of the put-and-call. Volatility trading in random markets was the starting point. On the basis of the above notation, the value of the put-and-call can be expressed by equation (3):[14]

$$c + p = e^{-r \cdot T} \cdot E\left[\max\left(p(T) - K, 0\right)\right] + e^{-r \cdot T} \cdot E\left[\max\left(K - p(T), 0\right)\right] \Rightarrow$$

$$c + p = e^{-r \cdot T} \cdot E\left[\max\left(p(T) - K, K - p(T)\right)\right] = e^{-r \cdot T} \cdot E\left[\left|p(T) - K\right|\right] \qquad (3)$$

When Higgins' estimates average deviations on the basis of past data, *he is practically solving a pricing problem similar to that of Bachelier*. He lacks the mathematical formalization to deal directly with equation (1), that is why he places the put-and-call at the centre of his pricing technique. The value of the put-and-call is given by the expected market volatility of the underlying stock as captured by the anticipated average deviation. That's why he estimates from historical market data the last term in the equation (3) above: the expected size of the average deviation, $E[|p(T)-K|]$.[15] He assumes price randomness, but, since his approach is not mathematical, he does not rely on any (restrictive) price distribution as Bachelier (who adopted normal distribution). He simply assumes any standard deviation that past data imply:

$$E\left[p(T) - K\right] \rightarrow \sigma(T) \qquad (4)$$

In plain terms, Higgins describes a practical version of option pricing that anticipates the basic analytical assumptions of Bachelier's subsequent formalization. This by no means understates the analytical importance of the latter. Investors were performing practices of risk atomization and marketization, substantiating a particular version of a sophisticated financial technology. They were isolating risk, unbundling, re-bundling and replicating portfolios, trading volatility, inventing practical pricing rules of thumb and setting forth complex hedging option transactions. In the intervention of Higgins, and primarily of Bachelier, aspects of this practical knowledge marginally crossed a

[13] Jovanovich's bibliometric analysis shows that the overall mathematical contribution of Bachelier was by no means negligible but only in the discipline of mathematics. Its rediscovery by economists "provided not so much an analytical support as a kind of handy 'off-the-shelf' historical ancestry for the nascent field of modern finance" (Jovanovish 2012: 444).

[14] This is the standard textbook payoff formulas for long puts and calls.

[15] Under the assumption of random walk, the strike price of the put-and-call is equal to the expected price in the future.

certain scientific threshold, being expressed henceforth, not only in terms of market statements and visibilities (in everyday practices), but also as archived and systematized forms of knowledge (to put in Foucauldian terms).

5. Conclusion: Option pricing then and now

In this paper we have revisited the performativity thesis in economics. We particularly focused on MacKenzie's seminal intervention to apply the analysis of Callon to option pricing theory. MacKenzie's version of the performativity thesis is model-specific: it stresses the different degrees of performative strength that a particular aspect of an economic theory (model) may have. In this paper we have argued that some of the critiques of this approach can be incorporated into the performativity agenda in the context of an alternative approach, which abandons the model-specific emphasis. Economic institutions in general, and options markets in particular, are social condensations of assembling social practices *and* forms of knowledge that actualize them. This paper adopts a wider definition of knowledge following Foucault's writings. Knowledge is a social set that contains not only the plurality of scientific (academic) formulations, but also all sorts of (systematic or not) practical experience. As a historical illustration of our point (case-study), we focused on option pricing at the end of the 19th century.

Option markets existed and flourished long before the publication of Black and Scholes' famous paper in 1973. At the end of the 19th century, Higgins tellingly explained one possible way of how experienced investors and brokers of the time priced options. This is a unique historical example which shows that sophisticated pricing and hedging practices do not necessarily presuppose formalized scientific models. The complex reality of everyday option transactions was actualized by a non-simplistic set of practical techniques and ideas, which only marginally crossed the threshold of 'scientificity' (being properly 'archived') in the few pamphlets published by practitioners. In the Anglo-Saxon discussions, the most influential intervention was that of Higgins. The latter anticipated the major insights of the now famous Bachelier's thesis (but not the brilliant mathematical formalization) and used these insights to put forward a practical pricing technique. Until now, this analytical connection has not been discussed in the literature. Yet, it also works in favor of the performativity agenda and runs against the mainstream (mis-)representation of the history of derivatives markets (see Weber 2009). Bernstein (1996: 247) has argued that before the rise of modern financial theory: "it never occurred to anyone to define risk with a number. [...] Risk was in the gut, not in the numbers." Higgins's text is a glorious proof against this line of reasoning.

The paper might be the first one to decipher and emphasize Higgins' stand-alone approach but it is not the only one to discover and discuss it. A few authors do mention him *in passing* in the context of early contributions to option theory. Nevertheless, this paper, being loyal to the performativity agenda, does not read Higgins' argument through the lens of modern financial theory. Higgins pamphlet is a unique archival recording of the established forms of practical knowledge that helped investors to perform the economy before the rise of modern financial theory. In this regard, the analytical connection between Higgins and Bachelier should not come as a surprise: they both drew upon the same financial landscape which was becoming

concrete, visible, measurable and, thus, performable through deeply rooted practical forms of knowledge one could not reach in library shelves. Therefore, we do reject the teleological perspective according to which every early systematic account of derivatives should be appraised in relation to the BSM canonical model.[16]

[16] This methodological approach is clear in the intervention of Kairys and Valerio (1997). Other authors, like Mixon (2009) or Haug and Taleb (2011; see also Hah 2009) argue that the early works on options reveal that "option traders and academics in the past were much more sophisticated than most of us would have thought" (Haug 2009: 472). Nevertheless, in either case, the canonical BSM models is the ultimate measure of analytical comparison. This perspective looses the institutional footing of financial practices.

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