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Irving Fisher's Separation Theorem: Its Role in the Post-classical Impatience Theory of Interest

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This paper presents an investigation into the role of Fisher's Separation Theorem in the post-classical Impatience Theory of Interest. Antecedents, origins, motivations and intentions that underpinned conception of the theory are sketched. Essential aspects of Fisher's peers' published criticisms are summarised. Against this backdrop, the Separation Theorem's role at the core of the theory is outlined. Its dual function in the second approximation highlighted.

Introduction

As part of a research on the role of Irving Fisher's Separation Theorem in corporate finance theory and practice, this first paper outlines a preliminary investigation into its role in the post-classical Impatience Theory of Interest, as presented by Fisher in *The Rate of Interest: Its Determination and Relation to Economic Phenomena (1907)* (here: *The Rate of Interest (1907)*). Antecedents, origins, motivations and intentions that underpinned conception of the theory are sketched. Essential aspects of Fisher's peers' published criticisms are summarised. Against this backdrop, the Separation Theorem's role at the core of the theory is outlined. Its dual function is highlighted second approximation highlighted.

The Impatience Theory of Interest

In his post-classical theory of interest, Irving Fisher explained consumption choices over time in terms of individual's preference for present over future enjoyment, in an idealized world with certainty (Fisher 1907, 137-77, 402-11). In short, he showed that choices could be made using a rate of exchange for money, which expressed money in present time in terms of money in future time. Fisher defined this exchange rate as a rate of interest, and its principal determinants as time-preference or impatience and productivity. In Fisher's words, 'This slowness of Nature, in view of man's impatience to exploit her, will give rise to a rate of

interest' (Fisher 1907, 185). Moreover, Fisher defined the rate of interest as "an index of the preference...for a dollar of present over a dollar of future income' (Fisher 1907, 3). Accordingly, and perhaps not surprisingly, this theory became initially known as the Impatience Theory of Interest. More appropriately, the exchange rate mechanism became known as Fisher's Separation Theorem. In corporate finance theory and practice, this mechanism has become part of a framework for maximizing company value, which until recently has been uncontested wisdom.

Through a survey of antecedents, origins and motivations that underpinned conception of the Impatience Theory of Interest, its line of descent is traced. Its intentions are considered from the perspective of how the theory was received by some of Fisher's peers. Answers are sought to three questions. First, which were the received doctrines Fisher dismissed in favour of the Impatience Theory of Interest? Second, what aspects of the dismissed doctrines did Fisher expect to improve on? Third, why did the Impatience Theory of Interest initially fail to convince some of Fisher's contemporaries?

Misinterpreted, misunderstood and misnomered are labels that describe how the Impatience Theory of Interest was received by some Fisher's contemporaries. The essential aspects of the criticisms are summarised. These include published criticisms by Loria (1908), Flux (1909), Veblen (1909), Seager (1912, 1913), and Brown (1913).

Antecedents

This section sketches the first part of a two-part answer to the first question: which were the received doctrines Fisher dismissed in favour of the Impatience Theory of Interest? The short answer is that Fisher considered all antecedent theories of interest to be imperfect on two counts. First, their definitions of the rate of interest were not derived through scientific method, and were imprecise, and thus inadequate (Fisher 1906, 257). Second, their explanations of the mechanics of determination of the rate of interest were either unclear or absent (Fisher 1907, vii).

In the first three chapters of *The Rate of Interest (1907)* Fisher critiques and evaluates antecedent theories of interest that have sought to define the rate of interest, and explain its mechanism of determination. Fisher acknowledges the Böhm-Bawerk review of antecedent

theories of interest (Fisher 1907, 3). Therefore, received doctrines reviewed by Fisher were limited to those that at the time had "greatest currency, either in economic literature or the unexpressed but none the less firmly rooted ideas of business or professional men" (Fisher 1907, 3), or were "most common" (Fisher 1907, 53). Fisher dismissed all definitions and attempts to explain its mechanics (Samuelson 1967, 27), and sought to "eradicate" (Fisher 1907, 3) these "crude and usually false ideas" (Fisher 1907, 4), since they are "superficial and inadequate" (Fisher 1907, 9). In so doing, Fisher bundled theories of interest into three groups. The first group of theories was as labelled as Crude Theories. This group included Claude de Saumaise's (or Claudius Salmasius) *De Usuris (1638)* (cited in Schumpeter 1987, 102), and John Locke's *Some Considerations of the Consequences of the Lowering of Interest, and Raising the Value of Money (1691)* (cited in Leigh 1974, 212). Both were jettisoned since they 'merely explain explicit interest in terms of implicit interest' (Fisher 1907, 6). The next to be discharged was the Supply and Demand for Loanable Money Theory, because 'we are very far from having an adequate explanation' (Fisher 1907, 6, 8). Lastly, the Price Paid for the Use of Money Theory was discarded since it is 'payment for the use, not of the borrowed money, but for that for which the borrowed money is expended' (Fisher 1907, 8). In spite of dismissing the group of Crude Theories, Fisher did acknowledge natural interest 'implicit...in every capital-good', and its importance in explaining explicit interest (Fisher 1907, 11).

The second group of theories was labelled as Productivity Theories. This group included Jacque Turgot's theory of natural or implicit interest, as outlined in *Reflections on the Formation and Distribution of Wealth (1766)* (cited in Groenewegen 2007, 258). Turgot's theory was put aside as it did not provide an explanation of interest but instead transferred 'onus of the problem on to land' (Fisher 1907, 11), as the Physiocrats claimed that only agriculture yields surplus value. Moreover, by way of an apple orchard example, Fisher pointed out that the key inconsistency of productivity theories is their 'reversal of causality' between capital and income, as measured in value terms and in quantity terms (Fisher 1907, 14). Use Theory was cast out by a similar argument (Fisher 1907, 16). Moreover, by way of a timber plantation harvest timing example, Fisher rejected Alexander Del Mar and Henry George's Organic Theory (Fisher 1907, 22). Not because of its reliance on the "fecundity of plans and animals" (Fisher 1907, 3), but because Del Mar and George "have not escaped the fatal error of assuming a rate of interest in order to prove it" (Fisher 1907, 3). In spite of dismissing productivity theories, Fisher did acknowledge some "small grains of truth" (Fisher

1907, 28), including a causal link between productivity of capital and the rate of interest because productivity "affects the relative valuation of present and future goods by affecting the relative endowment of the present and the future" (Fisher 1907, 3).

The third, and final, group of theories was labelled as Cost Theories. These were "subject to many of the objections which apply to the productivity theories" (Fisher 1907, 29). Fisher showed the fallacy of the Cost of Production of Capital Theory, by way of an example from textiles manufacturing and forestry, to be its "reversal of direction of causality" between cost and interest (Fisher 1907, 29). Hence, it had to go. Next was the Cost of Labor Theory (Fisher 1907, 35), which was rejected by way of an example on diminishing returns, borrowed from William Roscher's *Principles of Political Economy (1878)* (cited in Groenewegen 2007, 258). Lastly, the Abstinence Theory (or Waiting or Labour of Saving Theory) was disposed of because it is a "fallacy exactly the inverse of the fallacy that saving is income" (Fisher 1907, 43), and as "waiting has no independent existence as a cost" (Fisher 1907, 50).

To sum up, Fisher dismissed antecedent theories of interest as they on the whole offered imprecise, and thus inadequate definitions of the rate of interest (Fisher 1907, 9), and as they "do not reach the root causes of interest" (Fisher 1907, 9). Yet, he acknowledged that some aspects of the productivity, abstinence and time-preference theories (Runyon 1959, 216) do "contain a modicum of truth" (Fisher 1907, 9).

Origins

This section sketches the second part of a two-part answer to the question: which were the received doctrines Fisher dismissed in favour of the Impatience Theory of Interest? The short answer is that in spite of dismissing antecedent theories of interest, as they did not met the dual requirement of a precise, and thus adequate, definition of the rate of interest, and a clear explanation of its mechanics of determination, Fisher chose to build The Impatience Theory of Interest in the tradition of the Marginalist Revolution 1871-4 (Fisher 1907, vii). Fisher chose this foundation because it was the least "imperfect" (Samuelson 1967, 27), and thus best suited his motivations and intentions (Fisher 1907, viii).

Fisher drew much of his inspiration for the Impatience Theory of Interest from the Marginalist Revolution 1871-4, but in particular John Rae 1796-1872, an early British Pro-Marginalist; especially the work *Statement of Some New Principles on The Subject of Political Economy, Exposing The Fallacies Of The System Of Free Trade And Some Other Doctrines Maintained In The 'Wealth Of Nations*. In fact, Fisher dedicates *The Rate of Interest (1907)* to Rae "who laid the foundations upon which I have endeavoured to build" (Fisher 1907, v). It appears that his only objection to Rae's work is its absence of a theory of income. In all other respects, Fisher incorporated Rae's ideas into the Impatience Theory of Interest. He writes "Every essential part of it was at least foreshadowed by John Rae" (Fisher 1930, ix).

Notably, Blaug (1986) questions the existence of a Marginalist Revolution 1871-4. He concludes that "[Marginalist Revolution] was a process, not an event... [but a] temporal coincidence of three or more singletons... [its success is] intimately associated with the professionalization of economics in the last quarter of the nineteenth century" (Blaug 1986, 217).

The foremost of three additional influences in the Marginalist tradition was Eugen Ritter von Böhm-Bawerk 1851-1914, of the Austrian (or Vienna) School; especially the two works *Capital and Interest: History and Critique of Interest Theories (1884)* and *The Positive Theory Of Capital (1889)*. Fisher incorporated Böhm-Bawerk's ideas into *The Rate of Interest (1907)*. At the time of Fisher's revision of antecedent theories of interest, Böhm-Bawerk's theory of interest was the prevailing doctrine. As Samuelson points out "Fisher was writing against the backdrop of the Böhm-Bawerkian influence" (Samuelson 1967, 27). In the fourth chapter of *The Rate of Interest (1907)*, Fisher reviews Böhm-Bawerk's theory.

Michel Auguste Adolphe Landry 1874-1956, of the French Historical School, was a second additional influence, especially the work *L'interet du capital (1904)*.Thus far I have unsuccessfully sought a translation to English. Accordingly, I can at this stage only speculate on whether it was the substance of Landry's work on cost theory (Fisher 1907, 37-8), or Landry's restatement of Böhm-Bawerk's theory, or both, that made Fisher acknowledge Landry, together with Rae and Böhm-Bawerk.

To sum up, from Fisher's perspective the essential aspect of a successful transformation of economics into a science was its professionalization, which required use of scientific method and mathematical tools.

Motivations

This section sketches an answer to the second question: what aspects of the dismissed doctrines did Fisher expect to improve on? The short answer is that Fisher provided a more precise, and thus adequate, definition of the rate of interest, and a clearer explanation of the mechanics of its determination. Fisher accomplished this through use of scientific method and mathematical tools, which in his view were the two essential means in establishing economics as a science, thus reflecting a "scientific method and spirit" (Fisher 1907b, 257).

Motivations are illuminated against the backdrop of major life events, professional and private. In Fisher's early professional life at Yale University, significant influences included Josiah Willard Gibbs, a mathematical physicist (Tobin 2005, 22). The association with Gibbs may explain Fisher's initial ambition to become a professor of mathematics. In the period 1890 through 1893 Fisher taught and tutored mathematics, and in 1984 he held the position of assistant professor of mathematics (Runyon 1959, 8). Fisher would retain a strong interest in mathematics, which was a significant aspect of his 1891 doctoral thesis: an investigation into the theory of value and prices. Early inspirations mathematical economics included works by Cournot, Walras, Jevons, Auspitz and Lieben (Barber 1999a, 4; cited in Runyon 1959, 5-6).

Moreover, the two Yale economists Arthur Twining Hedley and William Graham Sumner were additional influences in Fisher's early professional life. Sumner became the principal influence (Tobin 2005, 22). He was a German educated 'Social Darwinist' and a proponent of laissez faire economics, who later became President of Yale University (Runyon 1959, 5). While Fisher's political affiliation at the time of establishing an academic relationship with Sumner was already leaning more toward laissez faire than socialism (Fisher 1907b, 19), he would eventually "distance himself from Sumner's views on the futility of social reforms... [yet he] hailed Sumner as the inspirer" (Barber 1999a, 3).

Accordingly, during his Wanderjahr in Europe, Fisher enjoyed discussions with likeminded economists with a mathematical orientation, including: Pantaleoni (Rome); Pareto and Walras (Lausanne); Menger, Böhm-Bawerk and Lieben (Vienna); and, Edgeworth (Oxford) (Barber 1999a, 5). In 1895 Fisher transferred from the mathematics to the economics department at Yale University, were he remained for the remainder of his professional life. The transformation was complete, from this time forward "Fisher considered himself as an economist with a mathematical background rather than a mathematician" (Runyon 1959, 10). Fisher's significant private life events include spending his impressionable early years of life in modest circumstances. Added to this was the loss of his father to illness, which in his late teens made Fisher the principal carer for his mother and younger brother. In early adulthood, another private life event would further define his character. Shortly after appointment to professorship in economics in 1898 Fisher contracted tuberculosis, the same illness that claimed the life of his father. He endured an extended period of illness and convalescence and was sufficiently recovered to return to professional life by 1904 (Runyon 1959, 12-13).

More significantly, following the period of illness and convalescence, Fisher's attention in his professional life shifted away from what he claimed to be "selfish indulgence" (Barber 1999a, 6), to a "partaker in public movements for the betterment of mankind" (Barber 1999a, 6) or "the betterment of the masses" (Barber 1999a, xv). Clearly this provided Fisher with a broader purpose "the task of bettering the human condition" (Barber 1999a, 8). Much later in life, Fisher reflected on this transformation thus "perhaps there was born in me the yearning of a reformer" (Barber 1999a, 6). Fisher's self-reflection is described by Tobin (2005, 21) "[Fisher] was the consummate pedagogical expositor, always clear as crystal. He hardly ever wrote for fellow experts. His mission was to educate and persuade the world." This describes a principal trait in Fisher's character in professional life.

Fisher's background in mathematics "predisposed him in favour of abstract reasoning and persuaded him that mathematical tools were essential if the discipline of economics were to acquire genuine scientific standing" (Barber 1999a, p.3). Moreover, Fisher writes "I believed that economics was not yet a science but could be made one and that there was fundamental spadework which needed to be done and which I believe I could do in some measure" (cited in Runyon 1959, 10). The professionalization of economics by use of scientific method and mathematical tool were a means to an end, which from Fisher's perspective was the making of economics into a science.

To sum up, Fisher's two principal professional motivations were social reform and the recognition of economics as a science. Accordingly, he championed the betterment of humanity. Moreover, Fisher developed a more precise and, thus adequate, definition of the rate of interest, and a clear explanation of its mechanics of determination. Without these, the theory of interest would remain imperfect and inadequate.

Intentions

This section sketches an answer to the third question: why did the Impatience Theory of Interest initially fail to convince some of Fisher's contemporaries? The short answer is that Fisher's peers misinterpreted, misunderstood or misnomered the theory. This in turn led to their robust and persistent criticisms of The Impatience Theory of Interest.
Fisher's stated intention with *The Rate of Interest (1907)* was to explain the mechanics of the determinants of the rate of interest or "upon what does that agio [premium] depend and in what manner?" (Fisher 1907a, vii). He answered this question as follows. The agio or premium "depends on the character of the income stream, its size, composition, probability, and above all, its distribution in time. It might be called a theory of prospective [expected] provision of income" (Fisher 1907a, viii).

The unstated intention of *The Rate of Interest (1907)* was to provide a bridge to price and distribution theory (Fisher 1907, 225). Fisher recognised the importance of a precise definition of the rate of interest and a clear explanation of its mechanics of determination, as "The rate of interest plays a central role" (Fisher 1907, 225). From Fisher's perspective, in price theory the rate of interest applies to the "determination of the prices of wealth, property, and services" (Fisher 1907, 225). Similarly, in the theory of distribution it applies to "determining the amounts of capital and income possessed by different individuals in society" (Fisher 1907, 231).

Misinterpreted, misunderstood and misnomered are labels that describe how the Impatience Theory of Interest was received by Fisher's contemporaries. Within six years of publication, six robust criticisms of *The Rate of Interest (1907)* had been published including: Loria (1908); Flux (1909); Veblen (1909); Seager (1912, 1913); and Brown (1913). Perhaps this is not so surprising. After all, Fisher's theory of interest was known as the Impatience Theory of

Interest. However, this labelling by some Fisher's contemporaries, and later by Fisher' himself, is not due to the theory being incomplete. A more likely explanation is that criticisms focused on only part of the theory. That part being the time-preference. Accordingly, the production side as a determinant of the rate of interest was, perhaps inadvertently, ignored.

Essential aspects of published criticisms are summarised as follows. First, the criticisms by Loria (1908) and Veblen (1909) are examples of how the Impatience Theory of Interest was misinterpreted by Fisher's peers. Loria criticised the "method of determining the value of capital by capitalizing its income at the current rate of interest" (Loria 1908, 531). In short, he claimed that valuation "of capital by means of the cost of production of the product of which it is composed" would remove the inconsistency (Loria 1908, 531). Moreover, Loria by way of a rate of exchange between grain and gold example rejected Fisher's thinking on the "influence of the variation in the value of money on the rate of interest" Loria (1908, 532). Next, Veblen (1909, 298) states the essence of his criticism as follows:

> Apart from all question of consistency or conclusiveness within the premises of the marginal-utility school, the test to which Mr. Fisher's theory of interest must finally be brought is the question of its adequacy as an explanation of interest in modern business...[it] is eminently a pecuniary phenomenon, and its rate is a question of business adjustments...it is therefore an inversion of the logical sequence when Mr. Fisher...explains pecuniary interest and its rate by appeal to non-pecuniary factors.

Second, the criticisms by Flux (1909), Seager (1912, 1913) and Brown (1913) are examples of how the Impatience Theory of Interest was misunderstood by Fisher's peers. Flux (1909, 308) writes "We quarrel about words", especially the "new set of definitions of terms", and:

> What here is involved is no mere question of words and their property, for, in the view of the writer, it is on this selection of a highly specialized, strictly limited connotation for the word income that that an apparent important conflict of views between Professor Fisher and some of his admiring colleagues depends. The attitude towards the mystic question, Are savings income? serves as a kind of crucial test to distinguish those who are sound in their views from the others. This problem is Professor Fisher's pons asinorum for economists.

The use of mathematical terms probably most evident in some chapter headings in *The Rate of Interest (1907)*. For example, Fisher uses the mathematical terms first-, second- and third approximations to describe the number of assumptions (Fisher 1907, 117, 137, 207). To illustrate, a second approximation has fewer assumptions than a nil or first approximation. The third approximation assumes uncertainty. Alternative terms are linear-, quadratic- and so on.

Furthermore, Flux (1909, 312-3):

> We merely protest, that, in our view, Professor Fisher has unearthed a mare's-nest by means of his application of a special and limited meaning to the word income...when the words have the meanings which they involuntarily suggest to the ordinary citizen, or that, for lack of a refined metaphysical apparatus, the ordinary citizen blunders into fundamental error.

The criticisms by Seager (1912, 836) revolve around the absence of "any account of the production of wealth". Therefore, Seager (1912, 837) writes:

> the whole productive process, without which men would have no income streams to manipulate, is ignored...By denying the importance of the productivity aspect of capital, Fisher, on the other hand, has freed himself from the necessity of saying anything about the part capital plays in production.

Seager (1913, 618) restates his criticism that Fisher's theory of interest denied productivity "its proper place...among the causes of interest". Moreover, Seager (1913, 619) judged Fisher's efforts to professionalize economics, by way of scientific method and use of mathematical tools:

> I cannot agree that there is any sovereign virtue in mathematical modes of thought that makes the mathematical economist less liable to overlook important aspects of the problem he is discussing than equally logical thinkers whose training has not been along mathematical lines.

Perhaps the most revealing examples of how Fisher's contemporaries misunderstood the theory of interest are found in criticisms by Brown (1913, 633) as follows: "This impatience or time preference theory of interest...is at fault, in the opinion of the present writer, because it makes all determining influences, including productivity, act upon interest only by first acting on impatience."

In particular, Brown (1913, 634) argues that impatience is not the only determinant that directly has an effect on the rate of interest. He writes:

> This emphasis...on impatience, as the universal immediate cause...perhaps explains why his theory has apparently been somewhat misunderstood by so able a thinker and writer as Professor Saeger, who has even gone so far as to assert that Professor Fisher entirely excludes productivity as a determining factor.

Third, the criticisms by Flux (1909) and Seager (1912) provide examples of how the Impatience Theory of Interest was misnomered, not only by Fisher's peers but by Fisher himself. Flux (1909, 311) writes:

> Attach a different meaning to your word-symbols from that which they bear in other people's minds, and you may readily find that they deny what you find obviously true, and assert what you cannot but declare to be false. That is one serious danger of starting out, as our author does, with a set of new definitions for the most fundamental terms in the particular field in which he is engaged.

Moreover, Seager (1912, 836) writes: [Fisher] believes the determination of interest to be a psychological process and like Böhm-Bawerk he feels under obligation to bring in from the business world only the factors that influence preference rates.

Samuelson (1967, 27) dismisses this line of enquiry, and writes: "In my view he [Fisher] laid himself open to such criticisms by virtue of many of his lines of exposition. And I find it unrewarding to review his arguments with his critics and predecessors." In spite of Samuelson's view, or perhaps because of it, the literature leaves this question unanswered. Therefore, it remains an unresolved aspect of events surrounding publication of the *Rate of Interest (1907)*.

Fisher's Separation Theorem

It is against this backdrop that the Separation Theorem's role at the core of the Impatience Theory of Interest is illuminated. Its dual function in the second approximation is highlighted.

At the core of the Impatience Theory of Interest, Fisher introduced a mechanism that determines an exchange rate for money in present time in terms of money in future time (Fisher 1907, 137-77, 402-11). Subsequently, in corporate finance theory and practice, this mechanism has become part of a framework for maximizing company value, which until recently has been uncontested wisdom.

In literature some sources refer to this structure as the Fisher Separation Theorem (Bishop et al. 1984, 30; Hochstein 2001, 470). In others, it is Fisher's Separation Theorem (Emery and Finnerty 1991, 84). Perhaps this inconsistency is the result of a misinterpretation, or an early accidental mislabelling. Perhaps, it is semantics or simply circumstance. Yet, it is a curious label, as the Separation Theorem is one of several parts that make up the framework.

Fisher's framework has provided an elegant and adaptable structure for analysis of inter-temporal choices about company investment, funding and dividends to maximise shareholder wealth, in an idealized world. In fact, the Fisher two-period model is sufficiently flexible can be laid onto Debreu's multi-period model presented in The Theory of Value (1959): 'the two [interest and value] can be one and the same' (cited in Rogers 2007, 142). In the Second Approximation discussion, on preferences for alternative levels of income, Fisher outlines the 'double choice' (Fisher 1907, 409), on preferences for alternative levels of income. The analysis is set in an idealized world with certainty and a complete market, where wealth transfers perfectly and causelessly over time by the use of a financial security. Crockett (1980) suggests that Fisher was "aware of the conceptual level of the complexities introduced into financial decision making by the existence of uncertainty" and the "critical role played by the simplifying assumption of certainty" (Crockett 1980, 71). This is evidenced in the Third Approximation. Moreover, Dimand (2007, 156) writes that "Fisher was very conscious that future income flows and rates of return are expectations, not known with certainty."

The Separation Theorem's principal result and three main implications are as follows. The principal result is that the aim of a company should be to maximize the present value of its economic profits, subject to its budget constraint, thus maximizing shareholder wealth. The three main implications are: first, a company's investment policy is independent of shareholders consumption preferences. Hence, all shareholders agree with the company's investment choices; second, a company's value is independent of its capital structure, therefore, whether debt or equity funds its investment becomes irrelevant; third, a company's dividend policy is independent of shareholder wealth, thus it too is irrelevant. Accordingly, from the perspective of maximizing shareholder wealth the investment decision is the essential consideration.

Conclusions

As part of a research on the role of Irving Fisher's Separation Theorem in corporate finance theory and practice, this first paper outlined a preliminary investigation into its role in the post-classical Impatience Theory of Interest, as presented by Fisher in *The Rate of Interest: Its Determination and Relation to Economic Phenomena (1907)* (here: *The Rate of Interest*). Antecedents, origins, motivations and intentions that underpinned conception of the theory were sketched. Essential aspects of Fisher's peers' published criticisms were summarised. Against this backdrop, the Separation Theorem's role at the core of the theory was outlined. Its dual function was highlighted.

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