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**How Wicksell Defined the Natural Rate and How Academic Literature Fragments
and Misinterprets It: A Statistical Study**

Ph.D. dissertation prepared under the supervision of

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Streszczenie

Definicja Stopy Procentowej Knuta Wicksella Oraz Jej Dezintegracja i Błędna Interpretacja w Literaturze Akademickiej: Statystyczne Opracowanie Naukowe

Mark Biernat

Niniejsza praca ma na celu zidentyfikowanie i wyjaśnienie pierwotnej definicji naturalnej stopy procentowej Knuta Wicksella oraz jej zastosowanie we współczesnym kontekście poprzez porównanie literatury akademickiej z oryginalną definicją Wicksella. Ta wznowiona analiza jest niezbędna, ponieważ teoria Wicksella stanowi podstawę teorii i polityki monetarnej.

Metodologia zastosowana w niniejszym opracowaniu jest metodologią mieszaną. Składa się ona z trzech systematycznych przeglądów literatury wraz ze statystyczną i porównawczą analizą tekstu tych przeglądów. W pierwszym przeglądzie ustalono, w jaki sposób Wicksell zdefiniował naturalną stopę procentową w oparciu o wszystkie dostępne tłumaczenia angielskojęzyczne z oryginalnych dokumentów źródłowych. Rezultatem były trzy podstawowe kategorie definicyjne, z „oczekiwaną stopą zwrotu z nowo utworzonego kapitału” jako najczęściej wymienianą definicją Wicksella. Drugi przegląd porównuje pierwotną definicję Wicksella z jej prezentacją w literaturze akademickiej i określa, czy współczesna literatura rozszepiła lub błędnie zinterpretowała jego teorię. Niniejszy przegląd analizuje również fragmentację i dezintegrację definicji, prezentacji i cytatów w 167 recenzowanych pracach akademickich. Rezultaty analizy demonstrowają wysoki procent rozszepienia w każdej z omawianych kategorii. Kategorią definicyjną o najwyższej częstotliwości był „brak definicji”. Trzeci przegląd bada

podzbiór przytoczonych prac akademickich. Prac, które są najczęściej cytowane i dokonują rewizji naturalnej stopy procentowej Wicksella. Analiza ta koncentruje się na komponencie definicyjnym „stabilnych cen” i związanej z nim idei neutralności pieniądza. W rezultacie te często cytowane publikacje zasadniczo zmieniły istotę definicji Wicksella i przeoczyły jego teorię dotyczącą ruchów cen zagregowanych poza ramami stopy naturalnej. Podstawowe założenie niniejszego badania jest takie, że literatura akademicka przedstawia fragmentaryczną, błędną interpretację definicji i teorii naturalnej stopy procentowej Wicksella. Dialektyka potwierdza owo założenie. Ten brak precyzji przyczynił się do rewizji idei Wicksella w historii myśli ekonomicznej. Co więcej, teoretycy, budujący modele na podstawie tej rewizji, tworzą potencjalnie mniej niż optymalne kompas polityczne, ponieważ pomijają rygory i istotę teorii definicyjnej Wicksella. Głównym ograniczeniem tego badania jest to, że analizuje ono tylko opublikowane i przetłumaczone prace Wicksella w języku angielskim. Na podstawie dowodów z systematycznych przeglądów literatury i analiz statystycznych stwierdza się, że współczesne rozumienie naturalnej stopy Wicksella jest fragmentaryczne, nieprawidłowo interpretowane i wymaga rewizji polityki pieniężnej.

Słowa kluczowe: Naturalna stopa procentowa, Knut Wicksell, Polityka pieniężna, Inflacja, Deflacja

Abstract

How Wicksell Defined the Natural Rate and How Academic Literature Fragments and Misinterprets It: A Statistical Study

Mark Biernat

This work aims to identify and clarify the original definition of the natural rate of interest of Knut Wicksell and its application to a modern context by comparing academic literature with Wicksell's original definition. This reexamination is essential because Wicksell's theory is a foundation for monetary theory and policy. The approach in this study is a mixed methodology. It consists of three systematic literature reviews with a statistical and comparative text analysis of those reviews. The first review determined how Wicksell defined the natural rate based on all English translations of primary source documents. The result was three primary definitional categories, with 'the expected yield on newly created capital' as Wicksell's most frequently mentioned definition. The second review compares Wicksell's original definition to its presentation in academic literature and assesses if modern literature has fragmented or misinterpreted his theory. It looks at definitional fragmentation, presentation fragmentation, and citation fragmentation across 167 peer-reviewed academic works. The result was a high percentage of fragmentation in each category. The definitional category with the highest frequency was 'no definition.' The third review analyzes a subset of these academic works. Works that are the most cited and propose new definitional renditions of Wicksell's natural interest rate. This analysis focuses on the 'stable prices' definitional component and the related idea of money neutrality. The result was that these highly cited works substantially revised the essence of Wicksell's definition and overlooked Wicksell's theory on aggregate price movements

outside the natural rate framework. The underlying premise of this study is that academic literature presents a fragmented misrepresentation of Wicksell's definition of natural rate of interest and theory. The evidence supports this. This imprecision has contributed to revising Wicksell's ideas in the history of economic thought. Further, theorists who build models on this revision of Wicksell create potentially less-than-optimal policy compasses, as they miss the rigors and essence of Wicksell's definitional theory. This study's primary limitation is that it analyzes only Wicksell's published and translated English language works. With evidence from the systematic literature reviews and statistical analysis, it is asserted that modern understandings of Wicksell's natural rate are fragmented, misunderstood, and need policy revision.

Keywords: Natural rate of interest, Knut Wicksell, Monetary Policy, Inflation, Deflation

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I dedicate this paper to my family, Kasia, Łucja, and Octavia, who support me daily with faith, hope, and love and teach me the essential life lesson: love never fails and raises us to more than we could ever be.

Ad majorem Dei gloriam

List of publications

1. Brycz, M., Biernat, M., Timiras, L. C., Nichifor, B., & Zait, L. (2024). Expected inheritance and pension attitudes among young people in EU post-communist vs. Anglosphere countries. *Journal of International Studies*, 17(3), 244-257.
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2. Brycz, M., & Biernat, M. (2024, May). Pension distributive justice attitude among young people and pension investment type in the family. Paper presented at the *11th International Scientific Conference "New Frontiers in Economics and Tourism" 2024*.

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Introduction

Research Background and Knowledge Gap

The natural rate of interest is essential today because monetary aggregates "plays virtually no role in the conduct of monetary policy"(Meyer, 2001, p. 1; Woodford, 2008). Instead, the shift has been to set interest rate targets primarily based on r-star, an empirically derived proxy for the natural rate of interest to achieve a specific policy stance. The long-term modern policy consensus is a money-neutral posture, understood today as output equals potential and a defined stable rate of inflation.

However, the conceptual framework for this monetary policy comes from an older tradition. The idea of harmonizing the market rate of interest with the natural rate of interest to bring about monetary equilibrium is historically connected to Knut Wicksell in *Interest and Prices*, 1898. It was reformalized as a theoretical concept and a practical policy tool, most notably by Michael Woodford in *Interest and Prices*, 2003, and Laubach and Williams in *Measuring the Natural Rate of Interest*, 2003, used in conjunction with the Talyor rule.

The issue is that the natural rate of interest is definitionally fragmented and misinterpreted in the modern academic literature that lays claims to Wicksell's theoretical foundation. Understanding the connection between fragmentation and definitional precision is essential for subsequent researchers. Wicksell wrote over eight hundred works, with an estimated forty percent concerning monetary theory (Jonung, 1988; Sandelin, 2002). Nevertheless, economists who claim to base their monetary theories and models on the Wicksellian foundation have cited only a small fraction of these works and even a smaller fragment of ideas contained

therein. The reliance frequently falls on recently published secondary sources rather than Wicksell's primary documents, or at least those of early Wicksellians.

Similarly, and most notably, the authors often cite only a minor fragment of Wicksell's definitional explanations of the natural rate of interest, detached from the context of the entire theory. Furthermore, the academic discourse is fragmented in its composition and presentation of the natural rate of interest. Specifically, Wicksell's natural rate is often described non-contiguously or without a clearly delineated and upfront definition of the term, as evidenced by works analyzed in this study. This citation, definition, and presentation fragmentation is a curious undoing of the development of rich tradition within the history of economic thought. This fragmentation has led to interpretations markedly different from the essence of Wicksell's theory, as evidenced in chapter 3 and chapter 4 of this study with an in-depth analysis of *Interest and Prices* (Woodford, 2003) and *Measuring the Natural Rate of Interest*. (Laubach & Williams, 2003).

For economic science to continue to develop a valuable and academic understanding of economic thought and the evolution of monetary theory coupled with policy, it is essential to clarify Wicksell's ideas based on a scientific methodology and propose a new direction grounded in empirical data and primary sources. This systematic review with meta-analysis with an empirical-based statistical examination of Wicksell's definitional theory is distinctive, as it methodically and statistically assesses all of Wicksell's works available in English, thereby sheds new light and insight into Wicksell's theoretical concepts.

Much of the advancement and development of Wicksell's theories came from Stockholm and Austrian schools in the early 20th century(Boianovsky & Trautwein, 2003a; Davidson, 1909, 1925; Hayek et al., 2008; Leijonhufvud, 1979; E. Lindahl, n.d.; E. R. Lindahl, 1929; Lundahl & Lundahl, 2015; Myrdal, 1931, 1939; Ohlin, 1937; Thomas, 1976; Uhr, 1960; Von Mises, 2013). The Stockholm school included names such as David Davidson, Karl Gustav Cassel, Bertil Ohlin, Gunnar Myrdal, Erik Lindahl, Dag Hammarskjold, Carl Uhr, and Axel Leijonhufvud(Boianovsky & Trautwein, 2006; Leijonhufvud, 1979; Schumpeter, 2006; Thomas, 1976; Uhr, 1960). The Austrian school included, most notably, Eugen von Böhm-Bawerk, Ludwig von Mises, Frank Fetter, Fredrick Hayek (Fetter, 1927; Hayek et al., 2008; *The Pure Theory of Capital* | F. A. Hayek, Lawrence H. White | Taylor &, n.d.; Uhr, 1960; Von Mises, 2013, 2016). The lively debates amongst these figures, which Wicksell was often a part of, contributed to the evolution of his ideas. For example, the Davidson-Wicksell Polemic continued to yield new insights and perspectives until Wicksell's passing in 1926(Boianovsky, 1998; Davidson, 1925; Jonung, 1988; Thomas, 1976; Uhr, 1960; Wicksell, 1936). However, curiously, the evolution of ideas found in the latter writings of Wicksell and the great minds around him are mainly absent in academic literature today. This lost Wicksellian connection is a significant oversight.

The post-war experiences of the 1920s and the global restructuring of international central banking, coming off the classic gold standard to the fiat floating exchange system, something Wicksell envisioned, created a dynamic environment for Wicksell's ideas to be tested(Boianovsky, 1998; Davidson, 1932; Fregert & Jonung, 2008; Jonung, 1979b, 2022; Myrdal, 1931; Trautwein, 2016; Wicksell, 1916a, 1918, 1936). In that context, essential ideas

such as money neutrality, the role of capital, expectations, time preference, a productivity index, non-monetary explanations for aggregate price movements, and applying the natural rate of interest theory to central bank management of the aggregate price level were examined.

Research Problem

The research problem is if academic peer-reviewed works about Wicksell's natural rate of interest or highly cited consensus theoretician's works that contain models that claim to use Wicksell's natural rate of interest as their conceptual base, fragment and misunderstand the essence of Wicksell's definitional ideas, then the assumptions and rigor on which their theory rest is in question and cannot lay claims to the Wicksellian theoretical lineage. Specifically, academic writers who use semantically similar language to Wicksell, calling the rate in discussion 'Wicksell's natural rate of interest,' but the essence is incompatible with what primary source documents suggest, then they should jettison claims to the Wicksell connection. Further, if academic writing about Wicksell's natural rate of interest is found to be significantly different or fragmented from what Wicksell actually understood it to be, in that case, subsequent writers using secondary source writing about Wicksell could perpetuate this confusion and fragmentation. The history of economic thought would not be presented factually and objectively. As a consequence, the development of economic thought, science, and policy might perpetuate this misinterpretation.

To lay claims to Wicksell's definition as the base, the starting point needs to be Wicksell's original definition derived from a complete reading of primary source documents. Then systematically analyzed or at least vetted through theoretical discourse, grounded in an

in-depth analysis of primary source documents as the Stockholm and Austrian schools did. This would give a clearer understanding of the definition of the term. Hence, authors can subsequently build a conceptual framework with claims to Wicksellian theory. However, if an alternative definition is used while simultaneously laying claims to the Wicksellian theoretical lineage, it would be reasonable and objective to systematically compare it to Wicksell's complete set of freely accessible primary source documents. This is why a broad reexamination of the definitional understanding of Wicksell's natural rate of interest is essential. This Wicksell connection needs to be rediscovered and brought to light anew. Not with a restatement based on secondary sources or a fragment of Wicksell's works but with a thorough examination under the lens of a systematic scientific process of all of Wicksell's English works. After this objective, systematic process economists can better stake a claim to a Wicksellian foundation for theories based on the natural interest rate.

There is a gap in economic science regarding the depth and precision with which Wicksell's natural interest rate has been analyzed. Remarkably, after over one hundred and twenty-five years, no one has systematically and statically analyzed Wicksell's definition. It is this statistical component that gives it tangible precision. Many academic works have analyzed Wicksell's natural rate of interest in the context of the theoretical discussion on the history of economic thought(Boianovsky & Trautwein, 2006; Garrison, 2006; Jonung, 1988; Keynes, 1930; Lachmann, 2010; Laubach & Williams, 2003; Leijonhufvud, 1979; Lundahl & Lundahl, 2015; Schumpeter, 2006; Sraffa, 1932a; Uhr, 1960; Woodford, 2003).

Additionally, numerous studies have focused on using new renditions of the Wicksellian natural rate of interest as a guide, blending ideas from Keynes' *General Theory*, consciously or through an unconscious transmission of secondary source reading(Boianovsky, 2006; Boianovsky & Trautwein, 2010; Flaschel, 2000; Fontana & Ononugbo, 2014; Laubach & Williams, 2003; Salerno, 2010, 2016; Stein, 1969; Tamborini et al., 2014; Woodford, 2003). This is seen most notably, for example, in (Laubach & Williams, 2003; Woodford, 2003), as examined in detail in this study.

However, to my knowledge, no systematic and statistical research on Wicksell, examines the congruence between academic literature's definitions of Wicksell's natural rate of interest and the definitions presented in Wicksell's primary source documents. Furthermore, no studies have quantitatively assessed the coherence and citation quality of how Wicksell's concept of the natural rate of interest is portrayed in scholarly works.

What new research needs to be studied

- A discovery and statistical categorization of all of Wicksell's definitions, reviewing every text in its entirety published and translated into English.
- A systematic review of how academic literature defines, references, and presents Wicksell's natural rate of interest in a statistically categorized comparison to how Wicksell defined it.

- An investigation of the most influential new renditions of the natural rate of interest compared to Wicksell, including an understanding of money neutrality, which is connected to the ‘steady prices’ aspect, one component of Wicksell’s definition.

What needs to be clarified

- How Wicksell defined and presented the natural rate of interest based on primary source documents.
- How academic literature after Wicksell defines the natural rate of interest.
- How academic literature after Wicksell references Wicksell’s works.
- How academic literature after Wicksell presents the natural rate of interest.
- How new renditions of the natural rate of interest differ from Wicksell’s definition.
- How new renditions understand money neutrality compared to Wicksell’s understanding and the implications for the ‘stable prices’ component of Wicksell’s definition.
- The implications of Wicksell's new ideas coming from the Wicksell-Davidson Polemic.

How have researchers addressed the issues so far

In economic literature, there exist definitional discussions on the natural interest rate in non-systematic literature reviews. Researchers have discussed the ideas on the natural rate of interest in a general theoretical, non-systematic way (Barsky et al., n.d.; Boianovsky & Trautwein, 2010; Garrison, 2006; Giammarioli & Valla, 2004; Glasner & Zimmerman, 2014;

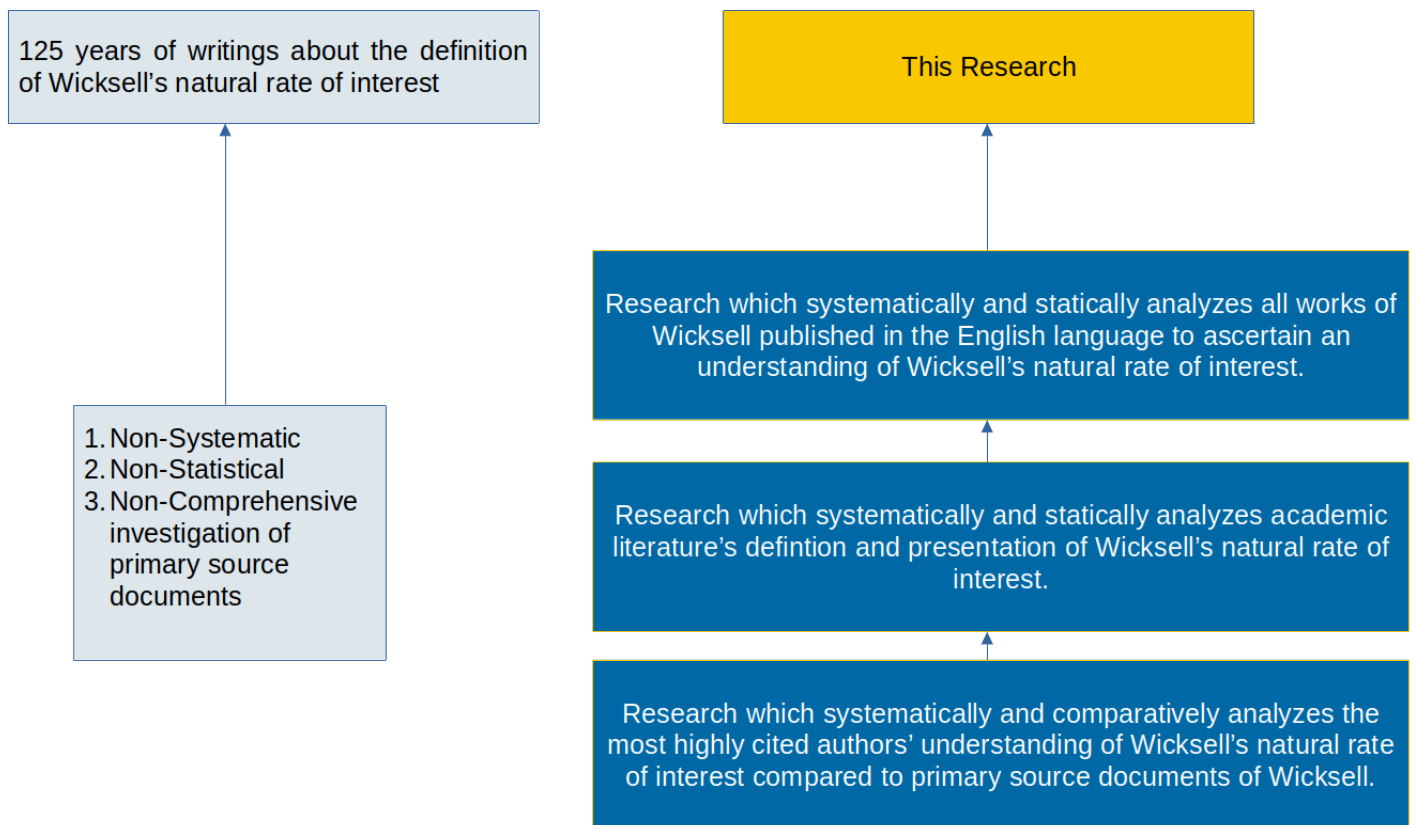
Harcourt, 1986; Hayek et al., 2008; Jonung, 1979; Leijonhufvud, 1989, 1997; Murphy, 2010; Nadal De Simone, 2023; Neisser, 1941; Palley, 2019; Schumpeter, 2006; Sraffa, 1932; Stiglitz, 1997; Uhr, 2013; Von Mises, 2013).

Knowledge Gap

After over one hundred and twenty-five years, there has been no research on Wicksell's definition of the natural rate that is both systematic and examined with empirical statistical data. That is, there has been no comprehensive systematic review of primary source documents that yields an objective statistical analysis of how Wicksell defined the natural rate of interest. Further, there have been no systematic statistical studies of how others understand Wicksell's natural rate of interest. Academic papers have discussed new renditions of Wicksell's natural rate of interest focused on econometric modeling and policy, citing secondary sources and a small fragment of Wicksell, but not definitional discussions and its implications based on comprehensive, methodical, objective full-text analysis of the complete works of Wicksell translated to English with empirical data to support this analysis.

Figure 1

Illustration of how the knowledge gap is researched in this dissertation.



Source: Own elaboration

As depicted in Figure 1, the discourse over one hundred and twenty-five years in the history of economic thought regarding the definition and understanding of Knut Wicksell's natural rate of interest was non-comprehensive, non-systematic, and non-statistical. It is hoped that the objectivity, transparency, and replicability intrinsic to systematic and statistical research in this field will assist others in exploring and testing assumptions about historical figures such as Wicksell, whose influence continues to be felt today.

Study Goals, Research Questions, and Hypotheses

This research aims to increase our understanding of the definition and application of Knut Wicksell's natural interest rate. From the definitional perspective, the goal is to clarify how Wicksell defined the natural interest rate based on primary source documents written by Wicksell, a systematic review with meta-analysis in the form of a statistical analysis of categorical occurrences. Next, examine how academic literature has defined Wicksell's natural rate of interest compared to Wicksell's original definition based on a statistical review of the occurrences of Wicksell's original definition and Wicksell's works cited by academics. This analysis will include how completely academic literature cites Wicksell's works.

Further, how cohesive academic literature's presentation of the definition when writing about Wicksell. In addition, this study aims to investigate how the most highly cited and influential interpretations of the natural rate of interest redefine Wicksell's ideas and concepts related to interest and money neutrality and integrate this understanding into theory and policy. Using the definitional insights from this study, coupled with Wicksell's understanding of money-neutral equilibrium and Wicksell's later writing about aggregate price movements and

stability, this study suggests thought experiments and further research on the study and application of Wicksell's ideas.

In summary, there has been no meta-analysis of literature with statistical analysis of data on the definition of the natural rate of interest to date, either from analyzing Wicksell's definition from primary source documents or how academic literature has defined it. Some academic writers generally understand the fragmentation and the impact of fragmentation on Wicksell's definition, but there is no empirical evidence to that extent. This study provides quantitative evidence to support the claim that Wicksell's definitions are fragmented in academic literature.

Thesis

Wicksell's natural rate of interest is definitionally fragmented in academic literature, and new renditions miss the essence of his theory.

The Null and Alternative Hypothesis

Null Hypothesis (H₀):

Wicksell's natural rate of interest is not definitionally fragmented in academic literature, and new renditions do not miss the essence of his theory.

Alternative Hypothesis (H₁):

Wicksell's natural rate of interest is definitionally fragmented in academic literature, and new renditions do miss the essence of his theory.

Research Questions

RQ1: How did Wicksell define the natural rate, based on all published texts of Wicksell translated into English?

H₁: Wicksell's primary definition of the natural interest rate is the “expected yield on newly created capital,” which was the micro foundation for the rate of interest that abstractly equates investment to savings and maintains a money-neutral price level.

RQ2: How completely does academic literature define the natural rate of interest, how well cited is this definition, and how fragmented is the definition in the presentation?

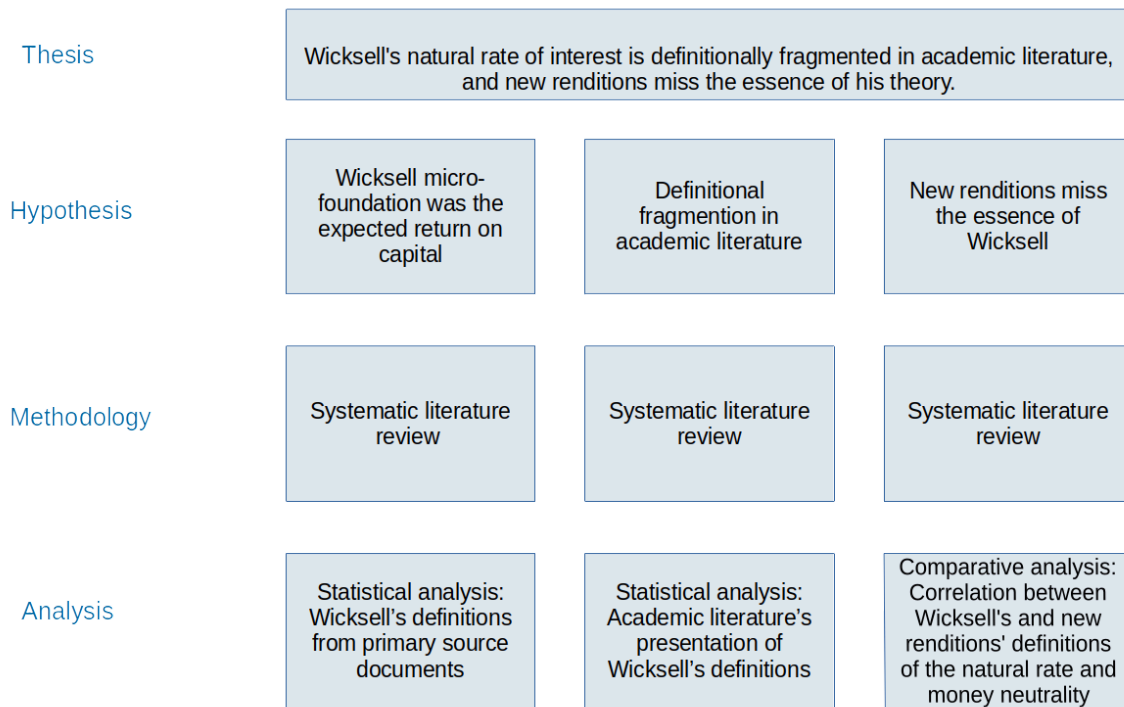
H₂: Academic literature predominantly gives only a fragment of Wicksell's definition; the presentation is fragmented, and the literature cites only a fragment of Wicksell's extensive works.

RQ3: How do new definitions of the natural rate of interest developed by highly cited modern authors compare with the essence of Wicksell's original definition and understanding of money neutrality?

H₃: Highly cited authors who develop new renditions of Wicksell's natural interest rate miss the essence of Wicksell's natural interest rate and money neutrality.

Figure 2

Methodology and analysis



Source: Own elaboration

As shown in Figure 2, the methodology selected for this research was a systematic review supported by statistical and comparative analyses. This methodology was used for objectivity, transparency, and replicability for subsequent scientific researchers.

Adhering to these principles is important to the research, particularly because the findings suggest a reasonable departure from the conceptual framework commonly held by the consensus within the field.

Structure of the Dissertation

Chapter 1 is a non-systematic literature review founded on primary source research. It is a historical survey of the natural rate of interest. Its purpose is to provide a contextual overview for subsequent chapters that are focused and specific. This chapter includes examining ideas that preceded Wicksell, Wicksell's development, and the theoretical lines after Wicksell to the present. Its relevance for this study is to trace how the natural rate of interest developed and changed through economic thought to current use today in theory and policy.

Chapter 2 is a systematic review of the literature. The literature is the works of Knut Wicksell. It discerns how Knut Wicksell defined the natural rate of interest based on a complete analysis of his published works available in English. It discusses the search method of Wicksell's text for the definitions of natural rate of interest. The results are summarized in a statistical table of outcomes. The categorizations in this chapter provide a conceptual framework for subsequent chapters of this thesis to ascribe facts and data to these categories for further analysis.

Chapter 3 is a systematic review of the literature. It surveys academic literature to determine how Wicksell's natural rate of interest is defined by academics, which analyze or develop theories about Wicksell's natural rate of interest. This chapter analyzes the data through statistical analysis to determine the types and extent of fragmentation of Wicksell's natural interest rate. It organizes the results into the conceptual categories laid out in Chapter 2. These results are presented in statistical tables. The tables focus on how Wicksell's definition of the natural interest rate is fragmented in academic literature. The three types of fragmentation investigated are definitional, presentation, and citation fragmentation.

Chapter 4 is a systematic review of literature. It extends the systematic literature review in Chapter 3 by examining a subset of works from this review. Specifically, the works that suggest a new rendition of the natural interest rate in a theoretical model are the most cited. The significance is that these works are used as a basis for a guide in monetary policy that references the natural interest rate. Since these works are influential for policy, this chapter analyzes these works compared to Wicksell's ideas. The ideas include defining the natural rate of interest, estimating the natural rate of interest, and money neutrality.

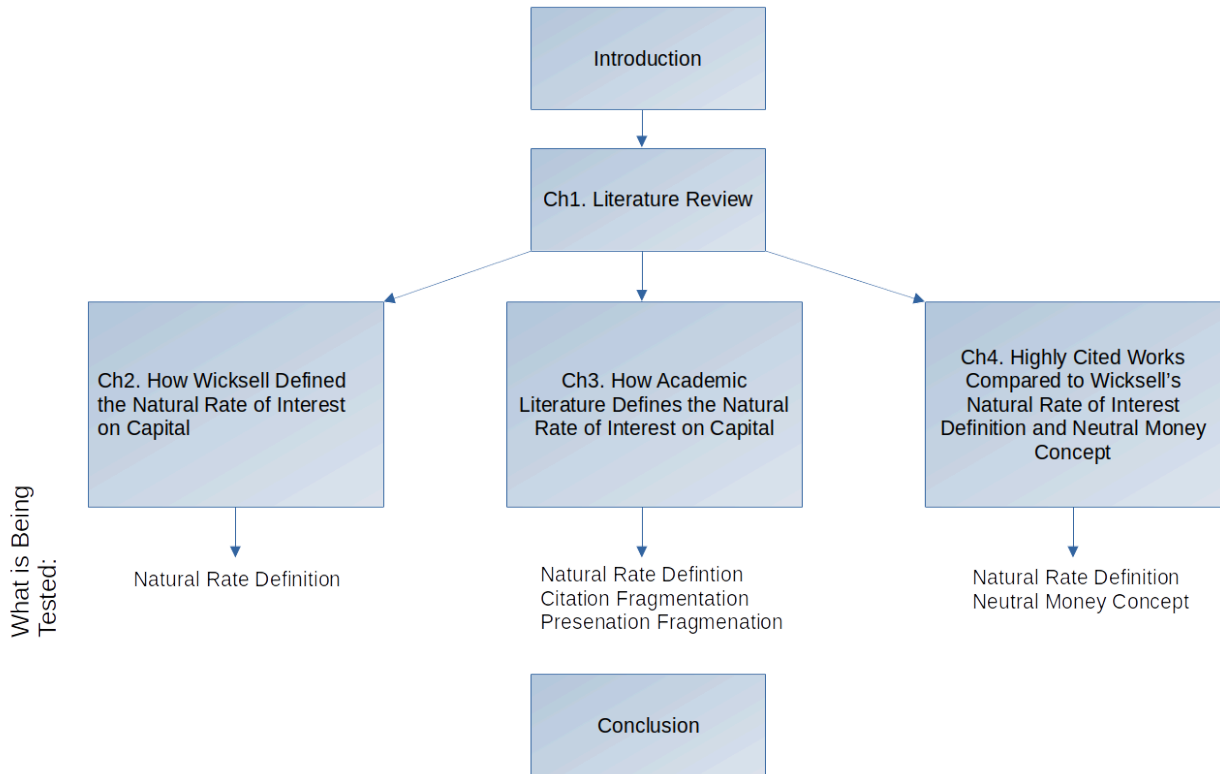
Chapter 5 concludes this study by summarizing the insights derived from the statistical analysis of the definition of the natural interest rate in Wicksell's works and academic literature and its presentation and application in a modern context. It also addresses the limitations of the study and provides suggestions for future research.

Most importantly this research, it encapsulates the essences of Wicksell and his contribution to the history of economic thought, modern academics, and monetary policymakers.

The following Figure No. 3 presents a condensed structure of this work.

Figure 3

Structure of the Dissertation



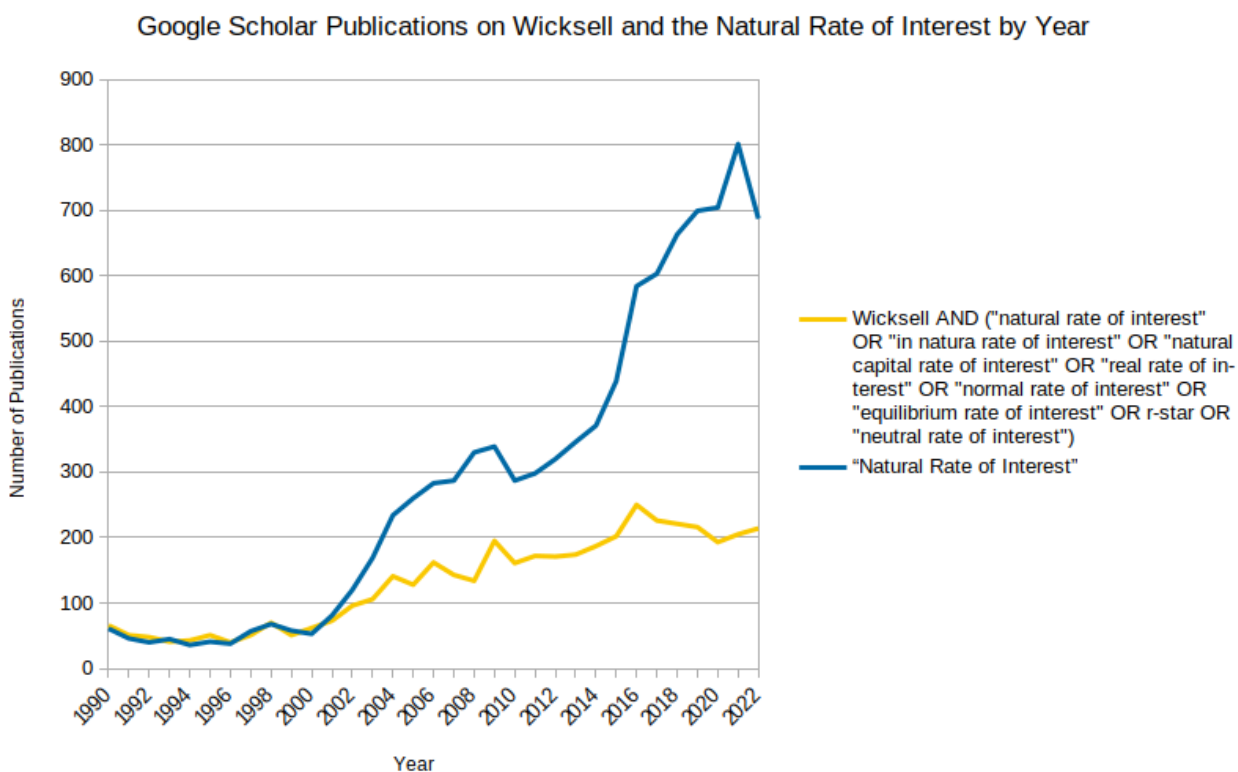
Source: Own elaboration

As illustrated in Figure 3, each chapter of the research addresses a specific question and hypothesis. However, the questions and hypotheses from preceding chapters build upon each other, where the evidence derived leads to the questions posed in subsequent chapters. For example, the evidence concerning Wicksell's definition in Chapter 2 forms the basis for the determinate criteria in Chapter 3, and Chapter 4 further extends the research from Chapter 3.

This sequential approach provides a view of how influential authors have embodied many of the issues in academic literature. These issues can potentially be transmitted to the next generation of researchers. Therefore, this underscores the importance of the current study for course correction, both in terms of the ideas themselves and the methodological manner in which researchers investigate historical ideas in the field of economic science.

The importance of this research is paramount as interest and research into Wicksell and the natural rate of interest have increased over the last decades. This is seen in the figure 4 below.

Figure 4



Publications pertaining to Wicksell and the natural rate of interest since 1990

Source: Own elaboration based on results from Google Scholar

If the definitional representation in the academic literature of Wicksell's natural rate of interest does not align with Wicksell, then this misinterpretation can perpetuate itself as authors rely on authoritative secondary sources that themselves might misinterpret Wicksell and fragments of Wicksell. Therefore, this research is essential at this juncture.

Chapter 1

Literature Review

1.1 Background

The literature review aims to establish a historical context to address this study's research questions better. This review surveys the history of economic thought with the intent to investigate whether modern scholars accurately capture Wicksell's understanding of the natural rate of interest definition and assess whether these contemporary interpretations are definitionally fragmented.

Specifically, the objective of this review is to demonstrate that the foundational literature subsequent to Wicksell captured the essence of his conceptual contribution; however, shows that contemporary scholarship has fractured the understanding of the natural rate of interest, omitting key aspects of Wicksell's original theory, particularly his definitional insights into the natural rate of interest and his later observations concerning the component of price stability. This literature review encompasses historical and modern scholarly works and asks the question: What essential elements of Wicksell's theory are absent in contemporary academic literature, resulting in a fragmented misinterpretation of his natural rate of interest?

The methodology in this chapter is a non-systematic literature review based on primary source research, concentrating on Knut Wicksell's theory of the natural rate of interest. Unlike subsequent chapters, which employ formalized methodological procedures and yield statistical results, this chapter adopts a non-systematic approach. The objective is to survey and analyze the relevant literature as a foundation that will be elaborated upon in the following

chapters. Despite the non-systematic nature of the methodology, this chapter adheres to a logical framework and employs a strategy for the inclusion of texts. The procedure is as follows.

Primary source research was the method and basis for the selection criteria of this non-systematic review. Specifically, the review focused on the primary source documents of historical economists who had engaged in intellectual exchanges with Wicksell or had formulated theories related to the natural interest rate, either as precursors or in parallel. That is, if Wicksell specifically mentioned or interacted with a historical economist and it fit into the conceptual framework of this review, that economist's primary source documents were studied and written about. Alternatively, if an economist was a relevant congruent precursor (e.g., Thornton), Wicksell was aware of after forming this natural rate framework. The method being that there was a direct or conceptual connection to Wicksell, the texts examined in this non-systematic review were the original texts. The chosen texts consisted of historical writings authored by these economists themselves, including Thornton, Turgot, Walras, Ricardo, Wicksell, Böhm-Bawerk, Mises, Hayek, Keynes, Davidson, Lindahl, and others. The selection method was first grounded in original, primary-source historical documents. That is, only the original economists were initially referenced in formulating the ideas in this review. However, secondary writers were cited for collaborating on this review's original text reading, but only as support.

A traditional, modern database search was inappropriate since this is a historical, non-systematic review. Historical primary source documents from the 1700s, 1800s, and early 1900s might not have the same algorithmic citation velocity as trending contemporary authors.

Therefore, it was necessary to ascertain the ideas of Wicksell and meaningful Wicksell connections through comprehensive research of historical material translated into English and develop a review based on the primary source research method to derive original interpretations.

This review is limited to the definitional issues, research questions, and logically connected concepts, such as the definition of stable prices, the definition of a money-neutral equilibrium, and how productivity integrates with monetary equilibrium relating to aggregate price stability. It does not contain every aspect of Wicksell's theories on every subject.

The chapter starts with a survey of Wicksell's definitional theories and proceeds with a chronological assessment of pertinent literature organized by historical schools of economic thought. The chronological framework was adopted because the study aims to analyze the history of economic thought within a contemporary context.

The sequence for this review is as follows:

Overview of Wicksell's theory

Pre-Wicksell

Stockholm School

Austrian School

Keynes

New Consensus

This review chronologizes literature pertaining to how Wicksell's ideas evolved from his early writings. It subsequently surveys Pre-Wicksellian writings, the concurrently developing Stockholm School and Austrian School of Economics, and the subsequent development of his natural rate theory from these schools. These schools have a reasonably coherent definitional understanding of Wicksell's natural rate of interest and Wicksell's later writings. That is, the Stockholm School and Austrian School of Economics had a more complete, less fragmented understanding of Wicksell's natural rate of interest than modern consensus writers, based on how Wicksell defined the natural rate of interest based on an examination of primary source documents. These schools of thought defined the natural rate in three different ways. They discussed money neutrality and incorporated Wicksell's later writings on the relationship between monetary equilibrium and the inverse relationship of productivity and price level.

Next, this review will look at the General Theory and the literature after the publication of Keynes' *General Theory* (Keynes, 1936). How, in the wake of the Keynesian revolution, the connection between Wicksell's ideas and the natural rate became convoluted and fragmented(Boianovsky & Trautwein, 2006, 2010; Hayek et al., 2008; Jonung, 2006; Leijonhufvud, 1979, 1989, 1997; Macovei, 2021; Salerno, 2010, 2016, 2020; Trautwein, 2016). Post-Keynesian revolution academic literature generally contains only fragments of the definition of the natural rate of interest, and other critical elements of Wicksell's theory are not present in the literature. As a result, economists began to change and misrepresent Wicksell's ideas in ways that were not congruent with his original thinking.

Specifically, this review will examine how highly cited new consensus writers misinterpreted the essence and totality of Wicksell's natural rate theory. Based on the evidence presented in this study, any claims to a Wicksellian theoretical lineage are objectively in question. Therefore, in contrast to the academic writers in the first part of the 20th century, specifically from the Stockholm school, highly cited modern consensus writers have only cited a small fragment of Wicksell's definition. This fragmentation perpetuates confusion in the academic literature and misrepresentation of Wicksell, a pivotal figure in the history of economic thought.

Highly cited modern consensus writers have misinterpreted Wicksell's natural rate as being based on 'stable aggregate prices' (Holston et al., 2017; Woodford, 2003). The stable aggregate prices axiom is a fragment of Wicksell's definition and is out of the context of his total theory. This singular definitional component contradicts the evidence that Wicksell's initial and primary understanding of the natural rate came from a microeconomic foundation.

Further, there is evidence that Wicksell revised his thinking in 1925, concluding that the aggregate price level could vary in monetary equilibrium (Davidson, D. 1925; Wicksell, 1936: Uhr, 1960) and (Boianovsky, 1998).

Therefore, the knowledge gap of this study is in the lost definitional connection modern literature has to the essence of Wicksell's theory. This gap exists as the knowledge or connection to that knowledge is forgotten, fragmented, and misinterpreted. The most notable gap is, specifically, the lost connection to Wicksell's original understanding of the definition of the natural rate of interest based on primary source documents of Wicksell's early and later works

and early academic writers that could read Wicksell's primary source documents in the original Swedish or German languages. This complete primary source understanding of the natural rate of interest is not found in the literature of Consensus writer's revision of the natural rate of interest for a modern audience.

1.2 Overview of Wicksell's Theory

Chronologically, Henry Thornton's conceptualization of "a comparison of the rate of interest taken at the bank with the current rate of mercantile profit" (Thornton, 1802, p.136), as well as Turgot's intertemporal capital theory of interest (Turgot, A, 1770), predates Wicksell's natural rate of interest on capital. "Turgot was the first who tried to give a scientific explanation of Natural Interest on capital" (Böhm-Bawerk, 1890, p.57). However, it was Wicksell whom modern economics rediscovered. Wicksell extended Böhm-Bawerk's term and concept of the 'natural rate' (Böhm-Bawerk, 1890) and placed it as a centerpiece in monetary theory.

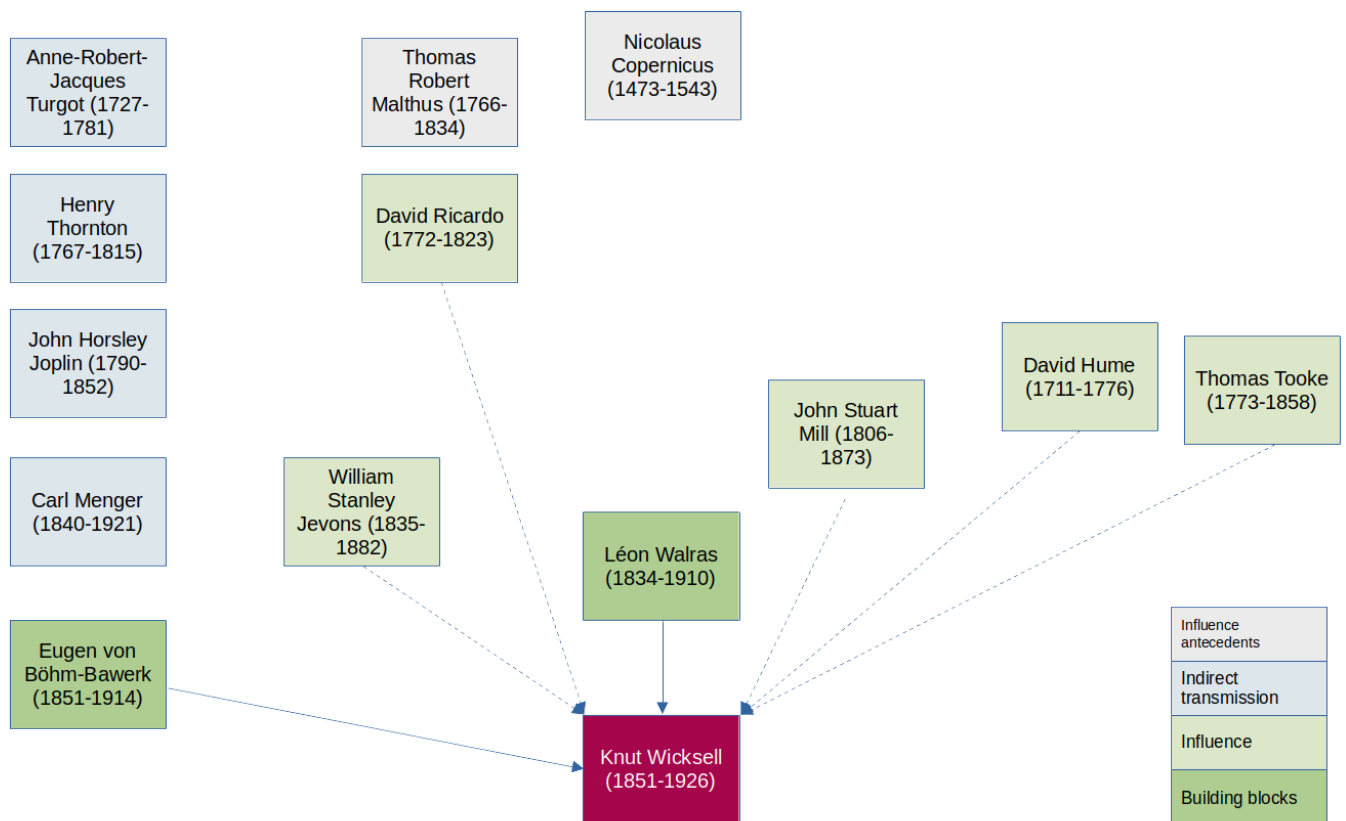
Before Wicksell, there was a dichotomy between the world of real economics (non-monetary) and monetary economics.

Wicksell fused the ideas of the marginal revolution, in this case, Böhm-Bawerk (from Menger (C. Menger, n.d.,1871, 1909; K. Menger, 1892; Stigler, 1937; von Hayek, 1934; Wicksell, 1921)), with the quantity theory of money and Walrasian equilibrium theory (Léon, 1969). The natural rate of interest is a price that unifies microeconomics with macroeconomics and the natural and monetary worlds. With a microeconomic foundation, Wicksell created an endogenous theory of money and credit.

Wicksell's natural rate of interest theory developed in the twentieth century through several lines of economic thought (e.g., Stockholm School, Austrian School, Keynes in the *Treatise* but not in the *General Theory*, the New Consensus) and in modern literature, it has assumed the connection with an essential econometric variable and policy tool r -star (Amato, 2005; Andrade et al., 2018; Barsky et al., n.d.; Bullard, 2018; Laubach & Williams, 2003; Meyer, 2001; Ohanian, 2018; Wieland, n.d.; Williams, 2016, 2018; Woodford, 2008). However, r -star is not Wicksell's natural rate of interest. Therefore, reexamining these theoretical lines in the history of economic thought is essential to determine how Wicksell's natural interest rate has been transformed and if it is conceptually rigorous today.

Figure 1.1

Economists that influenced Wicksell



Source: Own elaboration based on the works of (E. V. Böhm-Bawerk, 2012; E. von Böhm-Bawerk, 1895, 1906; Copernicus, 2016; Jevons, 1871; C. Menger, 1909; K. Menger,

1892; Mill, 2022; Ricardo, 1821; H. Thornton, 2017; Tooke, 1848; Turgot, A, 1770; Turgot, 1793; Walras, 1896; Wicksell, 1936, 2013)

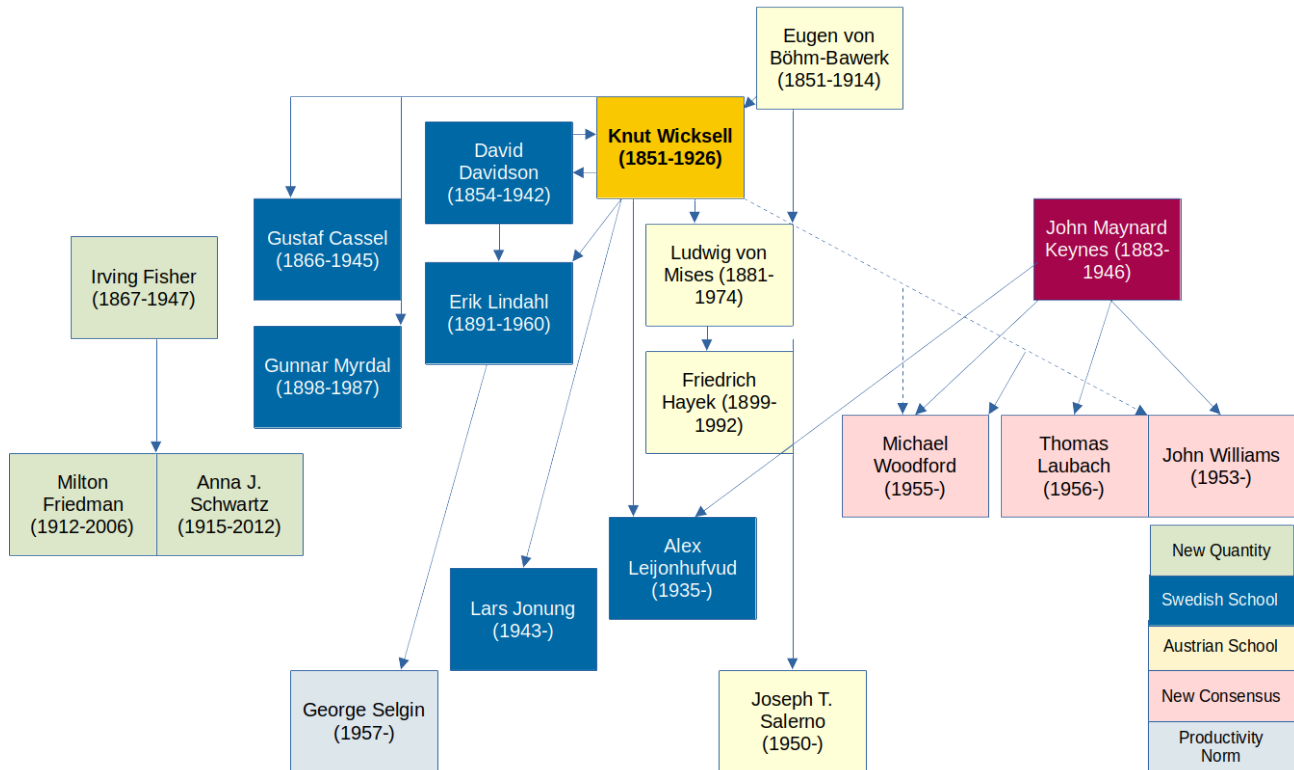
As seen in Figure 1.1, the path to Wicksellian natural rate theory flowed from Böhm-Bawerk, who first used the term 'natural rate' and understood interest embodying intertemporal preferences and entrepreneurial capital allocation decisions through time at a micro level.

The mechanism of Wicksell's *monetary* explanation for aggregate commodity price movements relates to the interaction of the natural and bank rates of interest(Wicksell, 1936, 2013). When the natural rate is above the bank rate, there is an incentive for entrepreneurs to take out loans and expand operations. A producer, a profit maximizer, will continue taking loans. That is, if an entrepreneur's expected profit rate on new capital is 10% and the bank interest rate on new loans is 5%, then commodity prices increase. In this disequilibrium scarce resources are bid up, resulting in an aggregate price rise. The converse is also the case. If the entrepreneur expects the profit rate on new capital to be 5% and the bank interest rate on new loans is 10%, then commodity prices decrease. If both the producers' expected profit rate on capital and the bank rate are at 7.5%, then there is an equilibrium. Wicksell called this price movement in either direction a cumulative process and, in theory, could go on *ad Infinitum*. In a world of pure elastic credit, prices would continue to rise or fall indefinitely until the market rate followed the natural rate back to equality(Wicksell, 1936, 2013). The crucial and significant element in this theoretical construct is the definition of the natural rate of interest. That is, Wicksell's

explanation of price movements is contingent on the definition of the natural rate of interest as it is the impetus for entrepreneurial action, the prime mover in Wicksell's thought experiment that "set(s) the price-cylinder in motion"(Wicksell, 1936, p. 101).

Figure 1.2

Economic theory today and Wicksell's influence



Source: Own elaboration based on the works of (Cassel, 1928; Davidson, 1913; Fisher, 1930; Fisher & Barber, 1907; Friedman & Schwartz, 2008; Hayek et al., 2008; Jonung, 1979a; Keynes, 1930, 1936; Laubach & Williams, 2003; Leijonhufvud, 1979; E. R. Lindahl, 1929; Myrdal, 1939; Salerno, 2010; Schumpeter, 2006; Selgin, 2018; Von Mises, 2013; Woodford, 2003)

As seen in figure 1.2, Wicksellian interest rate theory contiguous development flowed through the Stockholm School and the Austrian school in its essence from Wicksell, including Wicksell's 1925 developments at the end of the Dadvison-Wicksell polemic. However, consensus writers laying claims to the Wicksellian theoretical foundation are their ideas not in essence from Wicksell but from the *General Theory* while using the linguistic semantics of Wicksell.

Wicksell defined the natural rate of interest with different approaches and word usage over time. However, the essence remained consistent.

The natural rate of interest on capital Wicksell wrote concisely, "The expected yield on newly created capital" (Wicksell, 2013, p. 193) expressed in its analogous forms, the expected real rate of return on newly created mobile natural capital, equal to the marginal productivity of capital, or the expected profit rate(Wicksell, 1936, 2013).

The underlying premise is that microeconomic agents, entrepreneurs seeking profit, gauged the marginal benefit of investing in new capital against the marginal cost of borrowing. A complete survey of Wicksell's writings shows no evidence that he departed from this marginal microeconomic foundation.

There were two other renditions found in Wicksell, both aggregate renditions of the first, that is, a consequence of the actions of microeconomic agents' marginal intertemporal decisions regarding expected profit on capital or the marginal productivity of waiting (Wicksell, 2013). The second rendition was the interest rate equating aggregate savings and aggregate investment (Wicksell, 1936, 2013). That is the intersection of the marginal cost of borrowing with the

marginal benefit of borrowing, however, expressed in aggregate macroeconomic terms. The last and perhaps the most well-known is a rate that brings about a money-neutral price level or prices that do not tend to rise or fall for monetary reasons(Wicksell, 1936, 2013). Again, this is an aggregated result of the microeconomic agent’s marginal analysis and decisions. A derivative of this definition is what modern writers call “price stability” or ”Non-Accelerating Inflation Rate” (Woodford, 2003) and (Holston et al., 2017). These last two definitions of Wicksell are the aggregate effects or summations of the first. That is, profit-maximizing entrepreneurs make intertemporal calculations regarding investment in new capital, which drives the demand for credit and, ultimately, the aggregate investment and savings equality and the aggregate price level. It is the microeconomic calculation, decision, and action of the entrepreneur regarding capital that the natural rate of interest on capital crystallized from.

Wicksell writes:

There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them. This is necessarily the same as the rate of interest which would be determined by supply and demand if no use were made of money and all lending were affected in the form of real capital goods. It comes to much the same thing to describe it as the current value of the *natural rate of interest on capital* (Wicksell, 1936, p. 102).

Later, Wicksell restates:

“The rate of interest at which the demand for loan capital and the supply of savings exactly agree, and which more or less corresponds to the expected yield on the newly created capital, will then be the normal or natural real rate”(Wicksell, 2013, p. 193).

In Wicksell's initial articulation, his natural rate is in a world without money; that gives it its 'natural' component in the name. Natural capital, or real capital, operates in a world expressed in barter exchange ratios.

Therefore, from the start, there seems to be some ambiguity or at least open questions about the natural rate of interest's precise definition, as there are several renditions that define the natural rate of interest, That is, the rate which is neutral with respect to commodity prices, the rate where the demand and supply of *natural* capital exactly agree, the rate of interest in a barter economy, the expected yield on newly created natural capital, that is an intertemporal time preference rate. It seems Wicksell suggests different words and ideas. However, an objective study of Wicksell's works reveals an essential core understanding: "the expected yield on newly created capital"(Wicksell, 2013, p. 193), as this research demonstrates. Other articles are aggregations or consequences of this.

Therefore, we see three main approaches to defining the natural rate of interest on capital in Wicksell. The first is the microeconomic foundation; the other two are macroeconomic aggregations from microeconomic agent action. Because there are three renditions, the definitions are not analyzed in the context of the whole theory, rather than in a fragment; there could be ambiguity or at least open questions about the precise definition of the natural rate of interest. This is because several renditions define the natural rate of interest in Wicksell's writings. Even if Wicksell equated the three as the same, they are from such different approaches that they are open to interpretation outside a unified understanding of the theory. However, a careful reading of Wicksell's text shows that despite using different approaches by Wicksell, the

idea rests on the microeconomic foundation of the ‘expected yield on newly created capital.’ This is what was built from Bohm-Bawerk’s natural rate. Reading Wicksell in the context of Bohm-Bawerk (Wicksell, 1954), it was from this microeconomic foundation that equated investment and savings and influenced the aggregate price level.

The definitional foundations of the natural rate of interest, as Wicksell writes, “have been placed on secure foundations by the epoch-making work of Bohm Bawerk. The natural rate of interest, the real yield of capital in production.” (Wicksell, 2013, p. 205)

Without microeconomic agents acting on intertemporal decisions about resource allocation through time via the production process, weighted against consumption, aggregation would not make logical sense, as there would be no underpinnings. It is this micro foundation based on the expected yield on capital and its analogous definitions that Wicksell, the Stockholm, and Austrian Schools analyzed in their research, as well as some modern scholars (Boianovsky, 1998, 2006; Garrison, 2006; Hayek et al., 2008; E. Lindahl, n.d.; Macovei, 2021; R. Murphy, 2010; Myrdal, 1931; Salerno, 2011; Uhr, 1960; Von Mises, 2013). This study by Biernat shows that this first rendition, the ‘expected yield on capital,’ and its analogous definitions are the definitions Wicksell mentioned and discussed the most in his writings by a disproportionately large count.

In summary, in its three primary renditions, the theoretical definitional framework of Wicksell’s natural interest rate is the expected real return on newly created mobile capital, investment equal savings, and a money-neutral stable price level. The multiplicity of theoretical approaches Wicksell articulated when defining and describing the natural rate of interest reveals

a broader theory than a singular formulation; however, exploring the genesis, frequency, and logical conceptual progression of the ‘expected yield on capital is the foundation. Within these three conceptual categories, Wicksell used different vocabulary and terms for the definitions. Even within the context of the plurality of renditions suggested by (Marget, 1938), the three primary definitions are primary after a deeper contextual analysis rather than the literal phrase. Wicksell thought these three definitions more or less equated to the same; however, from different perspectives, with the foundation being the ‘expected yield on newly created capital.’ The money-neutral stable prices rendition was revisited to consider changes in productivity in his latter writings(Uhr, 1960; Wicksell, 1936).

What is essential is how economists interpreted these statements and which rendition they emphasized in the development of the natural rate of interest. However, in the simplest, most evident, and precise understanding, a microeconomic agent would only take a loan if they could see its profit. The entrepreneur is not making decisions based on abstract aggregate investment savings levels or aggregate price levels. Instead, entrepreneurs care about margins, not nominal prices. So, the expected rate of return on newly created mobile capital is the central idea and the idea that Wicksell mentioned most frequently. Wicksell's use of the expected rate of return in comparison to investment and savings equality and aggregate price level movements will be further examined later in the study.

1.2.1 Stable prices definition in light of Wicksell’s later writings

Wicksell’s ideas evolved. Few thinkers kept the same ideas over a lifetime, and Wicksell was no exception. Wicksell gained new insight based on observed data and correspondences with

other economists. Specifically and most importantly, the stable price component definition of the natural rate of interest is precisely what Wicksell revised in his thinking in 1925, and evidence in his writings supports this. Wicksell did not formally create a whole new theory; instead, it was in the form of a concession articulated by Wicksell (Boianovsky, 1998; Davidson, 1925; E. Lindahl, n.d.; Thomas, 1976; Uhr, 1960; Wicksell, 1925a, 1936). He passed in 1926 and did not have time to formally create a new major work. However, it has been noted that Wicksell updated his research before passing (Uhr, 1960). Nevertheless, the evidence in his 1925 writings was enough for his colleagues to continue this idea (E. Lindahl, n.d.; Uhr, 1960, 1960; Wicksell, 1936). Specifically, the aggregate price level might not be stable under the condition of monetary equilibrium. Monetary equilibrium, to Wicksell, was an equilibrium where money had no influence and prices moved naturally based on supply and demand, that is, in the absence of money or at least monetary influence. This barter exchange ratio economy, as explained in Wicksell's early works, later continued as money neutrality in an elastic credit economy. Davidson made this point to Wicksell in the early 1900s in his (Davidson, 1909). The key revision is that in his later works, Wicksell examined and concluded that non-monetary factors could shift the *aggregate price level* even when the natural rate is equal to the bank rate. In this case, productivity and the price level of this theme in the literature were revisited either directly from Wicksell or through indirect transmission, as argued by Biernat in this study, and 'David Davidson, Evan Durbin, Francis Edgeworth, Ludwig Von Mises, Robert Giffen, Gottfried Haberler, Ralph Hawtrey, Friedrich Hayek, Eric Lindahl, Alfred Marshall, Gunnar Myrdal, Dennis Robertson, Bertil Ohlin, Arthur Pigou, Carl Uhr, Mauro Boianovsky' (Boianovsky, 1998; Davidson, 1909; Edgeworth, 1925; Hawtrey, 1923; Hayek et al., 2008, 2008; E. Lindahl,

n.d.; Myrdal, 1931, 1939, 1939; Pigou, 2014; Selgin, 1999, 2002, 2018, p. 218; Thomas, 1976; Uhr, 1960; Von Mises, 2013), detailed in the context of the history of economic thought in a theoretical context by George Selgin, (Selgin, 1999) and again (Selgin, 2002) and by Mauro Boianovsky in the context of the Deflation of the 1920s (Boianovsky, 1998) specifically pp. 250-51 and 263-64 which addresses Wicksell's conciliatory remarks and Uhr. Evidence of Wicksell's concession could be interpreted as an informal annulment of his infamous 'stable price definition' of the natural rate of interest, as suggested by Davidson, Lindhal, Uhr, Hayek, Mauro Boianovsky, et al.

Remarkably, Wicksell's revision is not referenced or examined when modern consensus writers such as (Holston et al., 2017; Woodford, 2003) develop empirical proxies like r-star for Wicksell's natural rate of interest. There is no evidence that consensus writers reference this. There is no indication that consensus writers discussed Wicksell's latter works. What is even more remarkable is that it is in plain sight. It is not in a Swedish untranslated text or unpublished work of Wicksell's or an obscure journal. This revision is found in Wicksell's 1925 Swedish writings in *Ekonomisk Tidskrift*; however, they are included in the English appendix of the *Interest and Prices*, Wicksell's most famous work (Wicksell, 1936), for almost one hundred years. It is also noted that this is published for free online and freely accessible to all, not behind a paywall. Therefore, there is no reason for academics not to be able to access and study this part of Wicksell's life works. If this idea is in the appendix of all known English language publications of *Interest and Prices*, it is freely accessible, and any careful reading of Wicksell would manifest this critical insight. However, it is absent from highly cited consensus academic

literature focusing on Wicksell's natural interest rate. It is not even considered, analyzed, debated, or researched.

This idea that Wicksell revised his thinking regarding price stability is supported by Swedish economist and Wicksellian scholar (Uhr, 1960), in *The Economic Doctrines of Knut Wicksell*, where he reiterates in further detail how Wicksell in *Ekonomisk Tidskrift* in 1925, Wicksell conceded to David Davidson in the long-running Davidson-Wicksell Polemic that the price level could move inversely with productivity, even if a natural rate monetary equilibrium existed. Yet again, it is absent from consensus renditions of the natural rate of interest.

Uhr restated Wicksell's premise that something as simple as scarcity or abundance of goods could cause aggregate price level movements unrelated to monetary issues. Aggregate prices could move outside the influence of central bank activity, as other causes besides monetary factors would cause shifts in the price level. Uhr points out that Erik Lindahl in *Penningpolitikens Mal*(E. R. Lindahl, 1929) brought to light Wicksell revised his ideas about a stable price level norm. (Uhr, 298). Uhr writes, “ But if productivity changes... the price level of consumer goods should vary in a manner inversely proportional to changes in productivity(Uhr, 1960, p. 298).

This is a re-emphasis found in the appendix of Wicksell's *Interest and Prices* titled “The Monetary Problems of the Scandinavian Countries”(Wicksell, 1936). It has been translated into English and is in all known published versions of *Interest and Prices*. The evidence is as follows.

Wicksell writes:

“It is clear that this premise, namely, the shortage of goods, regarded as the primary cause of the rise in prices, leads us to an entirely different presentation of the problem from the one on which monetary theory has hitherto been based (Wicksell, 1936, p. 203).”

Furthermore,

“It seems futile to try to find a purely monetary explanation of the whole, or of the major part, of this deflation, as being due to "deflationist policy" of the Federal Reserve Board and other Central Banks(Wicksell, 1936, p. 211).”

These primary source passages from Wicksell’s latter writings and others are what writers such as David Davison, Erik Lindahl, Carl Uhr, Ludwig Von Mises, F.A. Hayek, and in a modern context, Mauro Boianovsky, and Hans-Michael Trautwein as well as Salerno and Macovei, researched and analyzed, as well as (Boianovsky, 1998, 2006; Hayek et al., 2008; Lindahl, n.d.; Macovei, 2021; Myrdal, 1931; Salerno, 2011; Uhr, 1960; Von Mises, 2013). They specifically read and referred to Wicksell’s early and later works in their totality. They analyzed Wicksell’s theory as a whole and not just a fragment or a fragment of a fragment. To paraphrase Hegel, ‘Truth is found neither in the beginning nor the end, but always the truth is the whole.’(Hegel & Baillie, 2003, p. 11)’

Therefore, a clear implication is if Wicksell’s latter writings indicated that the aggregate price level movements were caused not only by monetary reasons. This vital connection has been lost. When creating theory and estimates of the natural rate of interest, stabilizing the aggregate price level as an indication of the relative position of the natural rate in relation to the bank rate would not be logically consistent. This logical inconsistency is because of Wicksell’s insights

into aggregate price movements caused by non-monetary factors. Stabilizing the price level based on non-monetary exogenous events or shocks potentially leads to the inefficiencies associated with non-price rationing or less-than-optimal or efficient utilization of resources. That is a stable price level; a long-term stable price level could be a counter-productive monetary equilibrium. The early Wicksellians understood this as they read Wicksell's concession in the Davidson-Wicksell polemic. As his contemporaries considered, a productivity index might be coupled with a natural rate of interest framework. Therefore, because of the reasons mentioned above supported by the writings from Wicksell and the early Wicksellians discussed above, the logical conclusion is that a stable price level is not a dependable determinate criterion for the natural rate of interest equilibrium. From a definitional standpoint, the natural rate should return to its microeconomic default definition of expected return on newly created mobile capital. Stable prices contradict Wicksell's evolution of monetary theory. Wicksell's understanding of a money-neutral price level differs from a stable aggregate price level. This critical reading of Wicksell's latter ideas also negates the premise that aggregate price movements should be the crucial determinant variable to uncover the 'unobservable' natural rate of interest.

The Davidson-Wicksell Polemic implies that if productivity and prices move inversely, deflation rather than stable prices is money neutral in a growing healthy economy with productivity gains (Davidson, 1909, 1925; Wicksell, 1936). Writers such as George Selgin (Selgin, 2018) developed this similar idea in his writing *Less than Zero* regarding productivity and prices moving in opposite directions in monetary equilibrium.

However, in the New Consensus literature, such as Michael Woodford, Lanbauch, and Williams, this insight, writing, and understanding are overlooked and not incorporated into their theory on the natural rate of interest. Only fragments of Wicksell's early writings are considered based on the evidence of what is referenced and articulated. Only a small fragment of the definition of Wicksell's natural rate of interest is represented and out of the context of the whole of Wicksell's theory and the essence of his meaning.

1.2.2 Money neutrality

The concept of money neutrality is essential as it parallels Wicksell's understanding of stable prices. However, Wicksellian money neutrality is not synonymous with stable aggregate prices. If money is neutral, does that mean aggregate prices are necessarily stable? This section addresses that question in the context of Wicksell's early and later writings.

Wicksell writes:

Now, if money is loaned at the same rate of interest, it serves as nothing more than a clock to cover the procedure, which, from the purely formal point of view, could have been carried on equally well without it (Wicksell, 1898, p.191).

Wicksell asked why an economy only sometimes displays equilibrium as Walras envisioned. Wicksell's answer was that money was not always neutral, as portrayed in the Walrasian system (Léon, 1969). By neutral, Walras's economy made adjustments 'naturally' with only a numéraire and not with money or monetary influence. The idea of money neutrality is essential for any policy derived from the natural rate of interest. Money neutrality and stable

prices might seem synonymous in Wickell's most referenced writings, in the English language, *Interest and Prices*(Wicksell, 1936), *Lectures 2*(Wicksell, 2013) or *The Influence of Interest Rates on Commodity Prices* (Wicksell, 1907b). Wicksell conveyed that money would be a veil when the aggregate price level was stable. Wicksell felt relative prices would adjust to supply and demand and not be influenced, at least in a significant way, by monetary disruptions. However, in Wicksell's later writing, there is evidence that his ideas evolved. That is, price stability and monetary neutrality were different. Wicksell's 1925 writings in *Ekonomisk Tidskrift*(Wicksell, 1936) give evidence that a money-neutral monetary equilibrium is not synonymous with stable prices.

That is, with the expected return on newly created capital equal to the bank rate and their existing 'zero economic profit' on a micro level, there is no for "a ball or *cylinder* on a horizontal plane" ((Wicksell, 1936, p. 100)) unless the "horizontal plane" were to tilt through another mechanism, despite money neutrality(Fontana & Ononugbo, 2014). Rule-based monetary policy, which claims to follow the Wicksellian natural rate of interest on capital paradigm, would have to incorporate this idea of neutral money.

1.2.3 *in natura*

In *Interest and Prices* 1898, Wicksell describes the natural rate of interest as the *in natura* rate, the return on newly created mobile capital in a barter economy. That is in an economy that uses barter exchange ratios instead of money "if no use were made of money" (Wicksell, 1936, p. 102). In a barter non-monetary economy, a world without money prices, relative prices operated on supply and demand, and the aggregate price level would be neutral to money because it did

not exist. It was a component or assumption of the definition. A rate on natural capital uninfluenced by money. It is because Wicksell's idea was to first distinguish between the natural and monetary worlds, then build an interest rate, a price, and a relationship that unified the two worlds. Wicksell did not repeat this *in natura* aspect in his *Lectures*. However, without explicitly expressing the concept of *in natura*, the natural rate was still a capital rate of return in the real sector, without money's influence; that is why it is termed 'natural.' This *in natura* rate is what Mises referred to and developed (Von Mises, 2013), and Mises suggests it is necessary to distinguish from the *Geldzins* or the interest on loans as it is banks that issue fiduciary media unconnected to real *in natura* supply and demand conditions that bring an economy out of equilibrium (Von Mises, 2013) as did Hayek (Hayek et al., 2008). The point is that although Wicksell did not further develop the *in natura* concept in his *Lectures* (Wicksell, 2013), it was a foundational idea for his natural rate of interest. It continued and was debated by the Austrian School.

However, the consensus literature does not discuss or consider this important idea, extending Wicksell's natural rate of interest.

The significance of Wicksell's *in natura* component of Wicksell's definition is theoretical support for Wicksell's understanding of money neutrality. It ultimately opens the possibility to aggregate price movements in a natural rate equilibrium when shortages (or, conversely, surplus) bring about non-monetary aggregate price movements.

1.2.4 Capital

The 'natural rate of interest' is the natural rate of interest on 'capital.' This was the complete name of the natural rate of interest of Wicksell. It was literally a capital rate. This point is essential. Wicksell's work was about how the natural and bank rate relationship incentivized economic agents to borrow or lend capital. It was a theory of capital, production, and prices. Remarkably, consensus writers like Woodford (Woodford, 2003) would remove capital from the centerpiece of the natural rate of interest theory. Woodford believes capital is no longer needed as the center and is replaced by an analysis of the nature of intertemporal equilibrium, without the 'production and accumulation of capital goods central' as the basis for the natural rate of interest. In essence, the natural rate of interest on capital or the *natürliche Kapitalzins* is changed from a capital rate or a *Kapitalzins* to simply an interest rate based on "pure exchange economies." However, "pure exchange economies" is a simplified model of an economy that does not represent all the complexities, a model in which there is no production, only exchange. In other words, there is no capital. Capital is a factor of production; however, there is no production in a pure exchange economy, hence no capital at the center of the interest rate theory (Woodford, 2003). This is different from Wicksell's envisioned natural rate of interest on capital.

Wicksell asserts that to define this concept, one must first clearly understand the term real capital. (Wicksell, 1935, p.). Capital to Wicksell was newly created mobile physical capital, which is non-monetary. It was not a fixed or depreciating asset or expressed in monetary terms.

An example that illustrates this point is that of a potato grower. When one grows potatoes, the seed is a physical potato. That is the non-monetary, mobile capital. It is not the

plant, equipment, or labor that exists or money in retained earnings. There is a decision on how many potatoes are for future capital investment or current consumption. The grower could also borrow potatoes from another producer in a barter agreement. That is, buy seed potatoes from another producer with a contract of repayment in potatoes in the future at a stated interest rate. That is an illustration of Wicksell's natural rate of interest on capital. It also illustrates how the present versus future intertemporal price is the real rate of return on mobile non-monetary capital *in natura*. This Böhm-Bawerkian understanding of capital and interest is the natural rate of interest (Hayek et al., 2008; Wicksell, 2013). Attempts to abstract away from this microeconomic foundation lose the rigor of Wicksell's theory.

1.3 Pre-Wicksell Precursors to the Natural Rate of Interest

A study of the pre-Wicksellian natural rate of interest literature is essential because the similarity and logical consistency of ideas found in these pre-Wicksellian writers provide implicit support for Wicksell's underlying premise. A classic example of independent development supporting logical consistency in economics is the concept of marginal utility developed by economists in different countries: Carl Menger, William Stanley Jevons, and Léon Walras.

In the case of the natural rate of interest, Thomas Tooke (Tooke, 1848), Henry Thornton (H. Thornton, 2017), and Anne-Robert-Jacques Turgot (Turgot, 2011) all had remarkably analogous ideas to Wicksell. However, no evidence exists that Wicksell read the authors as mentioned above directly. Other precursory theories include John Law (1705), James Stuart

(1767), Adam Smith (1776), and Adam Müller (1816), who at least indirectly wrote about endogenous money creation in the context of ‘credit creation theory’ (Werner, 2014).

Thomas Tooke’s (Tooke, 1848) *A History of Prices and Circulation*, from the banking school, argued that money that affected prices was not just physical money but needed to include the ideas of bank deposits and credit, which is endogenous money from trade (entrepreneurial decisions). The research done on Tooke in the early 2000s helped bring to light the idea of endogenous money (Laidler, 2004; Skaggs, 2003; Smith, 2002).

However, in recent years, there have not been highly cited works that continue this research.

Henry Thornton's mercantile Profit rate

Thornton (H. Thornton, 2017) developed a theory like the natural interest rate, based on the ‘mercantile profit rate’ in his 1802 book, *An Enquiry into the Effects of Paper Credit*. He did not use the term natural rate of interest, but in essence, it was a parallel idea expressed in the concepts and terminology of the time. He argued that the (natural) rate of interest was determined by the "long-term average rate of profit" on capital and that any deviation from this rate would lead to "overtrading" and price level movements. This two-rate system was highlighted most notably by (Humphrey, 1975; Mésonnier, 2002 Sachs, 1995); however, in recent years, no literature that directly addresses Henry Thornton has come to notoriety based on the evidence of citation count.

"In order to ascertain how far the desire of obtaining loans at the bank may be expected... considering two points: the amount, first of interest to be paid on the sum borrowed; and, secondly, of the mercantile or another gain to be obtained by the employment of the borrowed capital. The gain which can be acquired by means of commerce is commonly the highest which can be had, and it also regulates, in a great measure, the rate in all other cases. Therefore, we may consider this question as turning principally on comparing the rate of interest taken at the bank with the current rate of mercantile profit" (Thornton, 1802, p. 253-254). This is remarkably similar to the Wicksellian idea that the entrepreneur seeking a return on capital makes an economic calculation based on the cost of borrowing.

Henry Thornton (1760-1815), in his book, "An Enquiry into the Nature and Effects of the Paper Credit of Great Britain" (1802), unknown to Wicksell until the 1920s, was a monetary theory similar to Wicksell's. Henry Thornton's mercantile profit rate might be slightly different semantically from Wicksell's natural interest rate; however, it is conceptually similar enough to classify it as an analogous idea. It is based on the idea that the mercantile profit rate, or the rate of profit that merchants can earn on the capital invested in trade, determines the aggregate price level. Thornton argued that entrepreneurs would bid up prices if the mercantile profit rate exceeded the bank rate. This is because entrepreneurs will borrow money from banks at the bank rate to invest in trade. They will use the profits from these investments to repay the loans, and their decisions are based on this microeconomic calculation.

This mercantile profit rate theory was the rate of profit that merchants could earn on the capital invested in trade net of accounting for the costs of production, transportation, and other

expenses. Thornton argued that this profit rate was an essential determinant variable of the aggregate price level compared to the bank rate. Like Wicksell, a high-profit rate compared to the bank rate would put upward pressure on prices.

The fact that there is a parallel theory developed independently is significant in the context of a definitional study of Wicksell's rate of interest because it also started with the microfoundation of individual action. The fact that it was the profit rate, in one explicit rendition, is precursory support for the idea that Wicksell's real rate of return on capital, or expected profit rate, was similarly the starting point and foundation of Wicksell's theory. The fact that Thornton independently developed a similar theory to Wicksell's is significant because it could be interpreted as support for Wicksell's theory because it is logically consistent and aligned with a microeconomic foundation. That is, if two independently developed theories use a similar conceptual framework and reach similar conclusions, it is like two tests or studies in science that help give support to an idea.

Anne Robert Jacques Turgot's Intertemporal Capital Rate

Anne-Robert-Jacques Turgot (1727-1781) developed an intertemporal capital theory of interest. Turgot's theory, articulated in his book *Reflections on the Formation and Distribution of Wealth* (1766), is based on the idea that the interaction between the demand for capital and the supply of capital determines the interest rate. Similar to Wicksell, the demand for capital comes from entrepreneurs or businesses that need to borrow money to invest in new projects. The supply of capital comes from savers or intermediaries that lend money. Turgot's (Turgot, A, 1770) 'intertemporal rate' and "profit on capital invested in productive assets" were incorporated

into an idea of economic stability. Research on this connection and understanding has come from the Austrian tradition, almost exclusively by Joseph T. Salerno, economist and historian of economic thought (McCaffrey & Salerno, 2014; Salerno, 2010, 2011, 2016), as well as Rothbard and Gordon (Turgot, 2011) in compendium commentaries of Turgot's works. Turgot discussed the idea of interest in relation to intertemporal entrepreneurial decisions similar to those before Böhm-Bawerk and decisions based on entrepreneurial and resource allocation and profit. This was almost a century before the same ideas took form in the Austrian theory of capital and interest (Turgot, 2011). This was coupled with Turgot's ideas of a loanable funds theory determining the bank rate of interest.

Turgot writes, "The price of the loan is.. determined by the chaffering of seller and buyer; by the balance between the offer and the demand. (Turgot, 2011)" and "The price of interest depends directly on the relation between the demand of the borrowers and the offer of the lenders(Turgot, 2011, p. 211)" Turgot pointed out the entrepreneur gages the return on capital investment, their expected profit in relation to the loan rate (Turgot, 2011, p. xxi). This, in essence, is Wicksell.

Wicksell was aware of the work of Tooke, Thornton, and Turgot, but he did not read their work directly. He was familiar with their ideas through the work of his teacher, Eugen von Böhm-Bawerk. Böhm-Bawerk's 1890 book, *Capital and Interest*, included a chapter on Turgot's 'natural interest rate.'

There have been economists before Turgot, such as Richard Cantillon and James Steuart, who wrote about the interest rate level determined by savings and investment but not with the

same rigor. Turgot developed Quesnay's physiocrat theory of land ownership wealth into a theory of interest. "Quesnay, the school's founder, so little comprehends the nature of natural interest that he sees in its replacement cost" (Böhm-Bawerk, 1890, p.62).

Furthermore, these precursors did not have the intertemporal component in their expositions nor a robust treatment of a natural rate. It was Turgot who described the trade-offs between current consumption and future consumption. Turgot discussed the interest rate, via the opportunity cost of postponing consumption in savings, that parallels Wicksell's development of Böhm-Bawerk's time preference theory of interest, that is, the marginal productivity of capital embodies the intertemporal decisions of microeconomic agents."

Böhm-Bawerk Time preference theory of interest

"there is in natural interest, as well as in loan interest" (Böhm-Bawerk, 1890, p.14)

"Profit of capital, or, as we shall call it, Natural interest" (Böhm-Bawerk, 1890, p.8)

“While, however, the conception of Loan interest is exceedingly simple, that of Natural interest requires a more close definition.” (Böhm-Bawerk, 1890, p.8) Böhm-Bawerk's (1851 – 1914)

These three quotes provide evidence that Böhm-Bawerk initiated the discussion of the natural rate of interest in terms of terminology and understanding.

Böhm-Bawerk is essential in understanding Wicksell because Böhm-Bawerk's theory was the basis of Wicksell's foundation for the natural interest rate. Entrepreneurs use the profit

on capital to gauge intertemporal decisions about investment in capital. This is the essence of Wicksell's natural rate of interest. Böhm-Bawerk's time preference theory of interest was a rebuttal of the naive productivity theory of interest based on the value and productivity of the classical school. Böhm-Bawerk argued that interest arises from people's preference for present goods over future goods, even when the future goods are more valuable. He identified three main reasons for this preference: Impatience: People prefer to have things now rather than later. This is known as impatience or the cost of delaying gratification. Uncertainty: People are uncertain about the future and may be willing to pay a premium to have something now rather than risk not having it. Roundabout production: Many goods and services require a long period of time to produce. For example, growing crops, raising livestock, and building houses take time. People are willing to pay a premium for these goods and services because they are more productive than goods and services that can be produced quickly.

The third point of productivity seems like a lapse back to the classical notion of interest and value, that is, interest is an interaction of time preference and classical productivity theory of value, but it is not; instead, it is another subtle aspect of time preference because the price of the capital already reflects the productivity (Fetter, 1976). The naive productivity theories of capital, with their origins in Jean-Baptiste Say (Böhm-Bawerk, 1890), were critiqued by Böhm-Bawerk's work.

By incorporating these notions into the natural interest rate for capital, Wicksell captured the intertemporal trade-offs between entrepreneurs' current and future consumption decisions when calculating expected profits related to their capital investments. Wicksell's natural interest

rate embodies the capital-related entrepreneurial calculation of expected profit. This, again, is the microeconomic foundation for Wicksell's theory.

The connection relating to time and capital is "there is in natural interest, as well as in loan interest, the strange element of acquisition of wealth without labor" (Böhm-Bawerk, 1980, p.14). It is this time preference that makes sense to quote. "According to Bohm-Bawerk, the characteristic of capitalist production lies not of current consumption, but of consumption in the more or less distant future" (Wicksell, 1890, p. 123). That wealth is based on a profit calculation through time. Referring to Adam Smith, Böhm-Bawerk reiterates the micro foundation Wicksell will base his theory on, "There must be a profit from capital because otherwise, the capitalist would have no interest in spending his capital in the productive employment of laborers" (Böhm-Bawerk, 1980, p.71).

Bohm-Bawerk also articulated the roundaboutness of production, that is, the critical element of time in production and stages of production. Bohm-Bawerk's observation, often misunderstood but certainly quite valid, is that in almost every enterprise, it is possible to increase the efficiency of the factors of production by appropriately lengthening the period of production. (Wicksell, 1890, p.133). Therefore, time, interest, and natural interest are linked in the production processes.

The German word *Kapitalzins* used by Böhm-Bawerk and Wicksell was capital interest or interest on capital. "It is generally called Interest when the capital consists of perishable or fungible goods." (Böhm-Bawerk, 1980, p.8). Wicksell also distinguished between rent land lasting and durable and mobile capital.

Wicksell discusses and credits Böhm-Bawerk for his natural rate of interest theory as a starting foundation, as it is specifically a Böhm-Bawerkian capital rate. "It is to the brilliant work of Jevons and Bohm-Bawerk that we mainly owe the enormous advance which has recently taken place in our knowledge of the nature of interest and the part played in production by capital." (Wicksell, 1898, p. 122).

The point is that the genesis of the confusion and misinterpretation in consensus academic literature starts with misreading this critical Böhm-Bawerk-Wicksell link. Modern writers of Wicksell's natural rate of interest on capital make capital "irrelevant"(Woodford, 2003). The above statement is evidenced by the fact that the most cited natural rate consensus authors (subsequently examined in detail in this study) do not have capital as the centerpiece the natural rate of interest on capital. Instead, the concept is displaced by ideas from exchange economics; Woodford writes: "natural" level of interest rates, in a way that makes the capital stock that actually exists and the effects of this upon the economy's productive capacity irrelevant(Woodford, 2003, p. 372). To not read and understand Böhm-Bawerk and place Wicksell's rate in the context of Böhm-Bawerk's natural rate theory from which it came will miss the essence of Wicksell's natural rate of interest—explicitly misinterpreting Wicksell's natural interest rate by simply emphasizing a fragment of his understanding.

Wicksell, in the context of Böhm-Bawerk and the spirit of Thorton, stressed the micro foundation of the economic agent making an intertemporal decision about taking a loan or not. This is the foundation of Wicksell's theory. An entrepreneurial choice about a loan is a microeconomic decision and foundation. Therefore, money neutrality could exist in a

deflationary environment, as Davidson, Lindhal, Mises, Hayek, and modern authors like Selgin pointed out (Boianovsky, 1998, 2006; Garrison, 2006; Hayek et al., 2008; E. Lindahl, n.d.; Macovei, 2021; R. Murphy, 2010; Myrdal, 1931; Salerno, 2011; Selgin, 2018; Uhr, 1960; Von Mises, 2013). The idea that money neutrality could exist in a deflationary environment if there is an inverse relation to productivity or scarcity is a radical departure from the accepted paradigm as a stable price index or stable inflation target to infer the natural interest rate. This logical sequence starts with the Böhm-Bawerkian microfoundation.

1.4 Stockholm School

The Stockholm School's developments of Wicksell's natural rate of interest sparked lively debates, including discussions on the potential existence of negative natural interest rates, multiple interest rates, the interplay between interest rates, relative price movements, business cycle theory, and most notably for this study, the potential for monetary equilibrium without stable aggregate prices.

The genesis of the Stockholm School can be seen as a clarification of Wicksell's theory of the natural rate of interest and clarified key theoretical aspects. However, despite their wealth of theory and ideas, their contributions are not reflected in highly cited consensus literature to a significant degree. Specifically, key figures such as David Davidson, Erik Lindahl, and Gunnar Myrdal (Davidson, 1905, 1909, 1913, 1925; E. Lindahl, n.d.; E. R. Lindahl, 1929; Myrdal, 1931, 1939; Thomas, 1976; Uhr, 1960) were instrumental in clarifying and refining Wicksell's definition of the natural rate of interest while fully citing and using Wicksell's whole definition. Other notable members, including Gustav Cassel, Bertil Ohlin, Erik Lundberg, Eli

Heckscher, and Dag Hammarskjöld (Boianovsky & Trautwein, 2003a; Carlson & Jonung, 2006), also contributed ideas connected to practical application and policy. Although the Stockholm School researched government policy, taxation, public expenditure, welfare economics, and social issues, they also conducted research and critical analysis on the natural rate of interest, including trade cycle theory (E. Lindahl, n.d.) (Lundberg, 1964; Lindahl, 1930), forced saving, monetary equilibrium (Myrdal, 1931) (Myrdal, 1939), and intertemporal equilibrium (Lindahl, 1930) (Trautwein, 2016).

Two noted contemporary authors (Boianovsky, 1998; Boianovsky & Trautwein, 2003a, 2003b, 2006, 2010; Trautwein, 2016) have extensively researched the Swedish school connected to Wicksell. Boianovsky and Trautwein have detailed the early Stockholm School mentioned above, as well as contemporary writers with a connection to Sweden (Uhr, 1960) and (Leijonhufvud, 1989, 1997) and more recently (Carlson & Jonung, 2006; Findlay et al., 2002; Jonung, 1979b, 2022). Notably, these writers were aware of the importance of a definition analysis of the natural rate of interest rate. Each addresses this in their works and suggests an understanding (Boianovsky & Trautwein, 2006) beyond consensus interpretations of the ‘price stabilizing rate.’

Wicksell-Davidson Polemic: The most significant idea relevant to this study is that the Wicksell-Davidson polemic was a significant evolution in Wicksellian thinking that is virtually ignored today by theorists and policymakers. Of the highly cited authors in the systematic literature review in the previous chapters, there is no mention of the Wicksell-Davidson polemic. It is significant because, contained in the latter developments, Wicksell’s thinking relates to

conditions of changing productivity and the idea that ‘stable prices’ alone can be the cornerstone to build an empirical proxy for the natural rate of interest. If there is evidence that Wicksell revised his thinking in the Wicksell-Davidson polemic, it does not change the core idea of Wicksell’s previous theory of the interrelationship of the natural rate of interest and the bank rate of interest. However, it does change the interpretation significantly.

Moreover, to ignore this would be to take a fragment of Wicksell’s thinking. This is particularly true relating to an appropriate guide to monetary policy. For example, it could replace the ‘stable price’ adage with a ‘productivity norm.’ It could replace a monetary equilibrium equated with ‘stable prices’ and a money-neutral monetary equilibrium with deflation in a technologically advancing society. Alternatively, even as others (Booth, 2020) have suggested, a society with efficiency gains from high levels of specialization or comparative advantage from international trade, which is an indirect effect facilitated by technological advances, will have the same effect. That is a ‘healthy deflation’ not caused by a lack of liquidity but rather by the growth in productivity, which occurs in normal healthy economies. These insights and understanding by Davidson and later Wicksell were a significant contribution of economics that is primarily not addressed by consensus writers but rather only some contemporary writers who specifically study the Stockholm school.

The Stockholm school’s founding, in particular, Lindahl and subsequently Myrdal, Lundberg, Ohlin, as well as modern authors like Leijonhufvud and Jonung, could be interpreted as a developmental consequence of the insights of this Wicksell-Davidson polemic (Uhr, 1960). Therefore, if the Stockholm school itself and the writings of Lindahl derived insights and

developed a substantial theory from the latter monetary doctrines, Wicksell, it cannot be deemed insignificant. It is just that this has been ignored by modern writers in the English language, as evident from the absence of referencing in the systematic review above. This is significant for the history of economic thought as academics and policymakers lay claims to the Wicksellian theoretical lineage yet do not cite and cover the totality of Wicksell's theory.

The evidence of a potential revision of Wicksell's thinking is found in Wicksell's writing in 1925 in the Swedish scientific journal *Ekonomisk Tidskrift* (Wicksell, 1936). Although the gold exclusion policy and a free-exchange stabilization norm played a role in the evolution of Wicksell's thinking, it was Davidson's examination of the data of wartime inflation and Lindahl's writings on the price level changes inverse to productivity or scarcity' (Uhr, 1960) that was central to Wicksell's concession.

Davidson bifurcated the causes of Sweden's inflation in terms of monetary and scarcity causes, and by Davidson's analysis, up to one-half of the inflation was caused by scarcity and, from this data, described the term "inflation" as unscientific or at least imprecise. (Uhr, 1960).

Lindahl's work, which Wicksell read in 1924, was clear, "The price level of consumer goods should vary in a manner inversely proportional to the change in productivity...it protects entrepreneurs against losses to a desirable extent when productivity declines, and it also prevents them from realizing extraordinary gains at the expense of creditors when productivity increases. Such gains would be economically undesirable(Uhr,1960, p.298)" Lindahl, 1924. Lindahl demonstrated the idea of a productivity index for maintaining the 'real value of contracts' to Davidson and Wicksell in 1924 (Uhr, 1960).

Therefore, (Davidson, 1905), as pointed out by researchers into productivity and prices - (Selgin, 2002; Thomas, 1976; Uhr, 1960), disagreed with Wicksell's natural rate of interest definitional criteria relating to a 'stable price level' as productivity affects price level in a natural rate monetary equilibrium and eventually Wicksell conceded himself when presented with evidence and data from the early part of the 20th century. Wicksell further understood price stabilization and money neutrality as two different conceptual ideas that are interrelated but not necessarily interdependent. Davidson based his idea on evidence that productivity growth drives economic growth. He argued that the quantity of goods and services produced for a given amount of resources increases as productivity grows. The result is that the price of goods and services should fall to keep the value of money constant. George Selgin (Selgin, 2002, 2018) has done notable work on interpreting the difference between a price-stable norm and a productivity norm with its modern-day genesis in the Davidson-Wicksell Polemnic for the modern audience.

Erik Lindahl: Erik Lindahl's significance in the context of this study was his ideas paralleling Davidson's idea regarding money macro equilibrium of prices and aggregate price stability. Lindahl's rule-based monetary policy proposed that the price level should move inversely to productivity, which differed from Wicksell's stable price-level policy rule (E. Lindahl, 1958, 2016; E. R. Lindahl, 1929). Lindahl's approach, as Fregert (1993) explained, was influenced by his understanding of Davidson's and Wicksell's latter works and how productivity influences prices. Lindahl's norm for monetary policy highlighted how modern writers of Wicksell have misconstrued Wicksell's stable price criteria (Fregert, 1993, p. 129). *Swedish Economic Thought—Explorations and Advances*, 125-142. (129))Lindahl's methodological and

mathematical approach advocated a rule-based policy for monetary policy, and he believed that expectations affected the price level and money supply (Boianovsky & Trautwein, 2006).

Lindahl also challenged Wicksell's premise that the bank rate followed the natural rate, believing that the natural rate of interest, the normal rate, is not equated with a stable price level because of expectations (Uhr, 1960) and Davidson's productivity critique (Boianovsky & Trautwein, 2006).

Erik Lindahl's contributions to economic thought extended to the role of expectations in the context of *ex-ante* and *ex-post* analysis of the natural rate of interest. Gunnar Myrdal clarified that *ex-post* savings are always equal to the investment. Still, the critical analysis lies in *ex-ante* decisions by economic agents based on expectations that determine the monetary equilibrium trajectory. Lindahl's emphasis on rule-based policies and the role of expectations in determining the natural rate of interest's trajectory has influenced modern monetary policy debates. (Woodford, 2003).

Gunnar Myrdal - Gunnar Myrdal's significance in the context of this study was a development of Wicksell's definition and extending this theory to include expectations and a productivity index. He did not revise Wicksell's definition of the natural rate of interest but rather extended his theory. Myrdal emphasized the role of expectations and the central bank's management of expectations in determining the speed of price movements in a cumulative process (Myrdal, 1931, 1939). This was in line with the ideas by Davidson and Lindahl that the natural rate of interest cannot be ascertained by observing a stable price level alone but instead requires reference to a productivity index (Davidson, 1909, 1925, 1932; E. Lindahl, 2016; E. R. Lindahl, 1929). Myrdal also questioned the definition of stable price level and noted that it

differed from the real rate of return on capital and investment and savings equality, which were interconnected (Myrdal, 1939). The Stockholm School understood Wicksell's definition of the natural rate of interest in the context of the expected return on capital and the ex-ante investment and savings equality. Still, they were cautious about attributing monetary equilibrium to a simple "stable prices" axiom. This critique was noted by Hayek (Myrdal, 1939) (Uhr, 1960). The Stockholm School's continuity in academic research is evident in the works of scholars such as (Ohlin, 1937) and continued in modern times with (Lundberg, 1974) Carl Uhr, Axel Leijonhufvud, Klas Fregert, who continued to build on the ideas of the old-school Wicksellians. (Fregert & Jonung, 2008; Leijonhufvud, 1997; Uhr, 1960) (Uhr, 1960; Myrdal, 1939; Fregert, 1993) as well as (Carlson & Jonung, 2006).

1.5 Austrian School

The significance of the Austrian school of economics in this study is their understanding of the definitions of the natural rate of interest and how it agrees with Wicksell's definition based on microfoundations. As claimed by the original Austrians (E. V. Böhm-Bawerk, 2012; E. von Böhm-Bawerk, 1895, 1906; Fetter, 1914, 1920, 1927; Von Mises, 2013, 2016) and supported by modern Austrians (Garrison, 2006; Hayek et al., 2008; R. Murphy, 2010; R. P. Murphy, 2022; Rothbard, 1972, 1990; Salerno, 2010), the natural rate is an intertemporal rate that entrepreneurs calculate when weighing an investment in capital based on the expected rate of newly created capital in production. Although the above Austrian writers might vary in their articulation of this, the micro foundation and intertemporal element connected to entrepreneurial choices regarding capital and human action are significant. This time dimension, the fusion of the idea of capital

over time in the production process, was the basis of Austrian capital theory and articulated by (Von Mises, 2013) but also in its precursory form by Jevons in 1871 and Böhm-Bawerk in 1889 (E. V. Böhm-Bawerk, 2012; Jevons & Black, 1970; McCaffrey & Salerno, 2014).

In other words, the definition of the natural rate for the Austrians is an intertemporal rate, a calculation the entrepreneur makes when weighing an investment in capital through time in the context of Wicksell's first rendition of the expected yield on newly created capital and the second of equality in the demand and supply of loan capital when barter ratios are used. The Austrians emphasized the monetary influence on relative price effects of non-neutral money and the possibility of a naturally declining price level. The Austrians transformed Wicksell's theory of the natural rate of interest as a basis for a theory of capital lengthening, which they applied to explain monetary explanations of trade cycles. The theory extends Wicksell's natural rate of interest theory into a business cycle theory based on the time preference of individuals, specifically savers and investors, and roundabout production methods.

Mises

In *The Theory of Money and Credit*, Mises defined the natural rate of interest as “the rate that would be determined by supply and demand if actual capital goods were lent without the mediation of money”(Ludwig Von Mises, 2012, p.355). In *The Theory of Money and Credit*, Mises refers to this as the "natürliche Kapitalzins" based on the term used by Böhm-Bawerk and Wicksell. That is, if you look at the German term "natürliche Kapitalzins," it is clear that it refers to 1) capital and 2) capital that is 'natural.' Neither idea is found in the consensus renditions such as those (Laubach & Williams, 2003; Woodford, 2003). In English, the translation is

“natural rate,” which has a different and ambiguous understanding to a native English speaker than the term “natürliche Kapitalzins,” which might better be translated as ‘the rate which is applied to capital that is defined as natural using barter exchange ratios.’ Simply calling it the ‘natural rate’ might be a literal translation but does not do justice to a proper translation in the context. Literal translations in language are often misleading (Chakrabarty et al., 2022; Fried, 2009). In the Misesian rendition, it is significant that the natural rate is as "if real goods were loaned in natura [directly, as in barter] without the intermediary of money" (Festré, 2006, p. 333). He emphasized the in natura aspect of Wicksell's theory and extended its use. For Mises, this understanding comes from the history and evolution of money, derived from the insights of (K. Menger, 1892). Money is based on something real, which is based on a social understanding that has been agreed on in the collective unconsciousness of a capitalistic economy over time. This real linkage anchors money and credit in a free market. It is a tangible real natural asset such as gold that acted like a tether that would link the bank to the natural rates of interest and ensure there would not be an extended divergence. Mises emphasizes this definitional aspect of Wicksell because he felt "fiduciary media" causes systemic distortions in the real sector if not linked to something natural like gold (Von Mises, 2013, 2016). For Mises, as for Menger, gold was the link between the natural and financial worlds (C. Menger, 1909).

During Wicksell's time, much of his theory was written in the context of the classical gold standard. The classic gold standard was different from the gold standards that followed. He believed that lowering interest rates causes a credit expansion, which misleads entrepreneurs into thinking that more capital goods are available than exist. Mises writes, "This lowering of interest causes a credit expansion. This misleads businessmen into thinking there is a greater amount of

capital goods available than actually exist" (Mises, 2010, p.66). Thus, definitionally, emphasizing the *in natura* aspect, Mises did not alter the definition of the natural rate of Wicksell, and he extended its use in the context of money neutrality.

The natural rate of interest's need for a requisite feedback mechanism Mises's analysis of Wicksell's theory of the interplay between the natural rate of interest and the market rate of interest led to the development of the Austrian business cycle theory (ABCT) (Ludwig Von Mises, 2012). In the canonical form, the ABCT postulates that when the market rate (a price) is below the natural rate, this 'wrong' price gives signals to entrepreneurs to undertake capital-lengthening ventures that are not sustainable. It would result in malinvestment from these wrong signals (Hayek et al., 2008) and noted here (*The Pure Theory of Capital* | F. A. Hayek, Lawrence H. White | Taylor &, n.d.). For Wicksell, it was a cumulative process of price level changes. For Hayek, it was a trade cycle theory. Wicksell believed that the disequilibrium would self-correct if banks had reserve ratios; however, in a perfectly elastic credit system, disequilibrium could go on indefinitely (Böhm-Bawerk commented 'Wicksell must have been dreaming when he wrote that') (Festré, 2002; Swedberg, 1997, p. 117)

As (Salerno, 2010) suggests, the world of Böhm-Bawerk, Wicksell, and Mises was anchored in a commodity standard. For Wicksell, the bank rate would follow the natural rate of interest as banks eventually became aware through market signals and reserves For Mises, a commodity standard tethered the natural and loan rates together and was essential to the theory, as it was the link between the natural world and the monetary world Gold, a commodity, evolved organically as a medium of exchange The Austrian school position is gold is a form of natural

money as it developed as an endogenous medium of exchange by societal agreement rather than government ordination (Ludwig Von Mises, 2012) In the absence of the bridge of natural or sound money, the unbridled system would not work to create long-term stability A fiat system would impede the entrepreneurial discovery that equalizes the natural rate of interest and the market rate In contrast, a commodity standard provides the requisite feedback mechanism for approaching the market rate consistent with the natural rate Therefore, without this link, a purely empirical estimate of the natural rate is questionable or at least a different theory Cachanosky, more recently, points out this feedback issue when using the natural rate of interest in a fiat system (Cachanosky & Lewin, 2016; *The Mises-Hayek Business Cycle Theory, Fiat Currencies and Open Economies* | SpringerLink, n.d.)(Cachanosky, 2014).

Friedrich August von Hayek

Hayek built upon Mises' theory of the trade cycle by incorporating Wicksell's natural rate of interest, but two key issues arose in the process related to the definition. Firstly, he suggested that monetary equilibrium could exist even if the natural and bank rates of interest were at the same level, but aggregate prices were decreasing (Hayek et al., 2008). This aligned with Davidson's underlying premise in the Davidson-Wicksell Polemic that productivity and the price level move inversely. Secondly, as pointed out by (Straffa, 1932a, 1932c), Hayek defended Straffa's criticism of the concept of multiple natural rates of interest; that is, there could be a different natural rate of interest for every commodity. The Straffa-Hayek debate continued without a definitive resolution. Recently, the Austrians offered two solutions (Lachmann, 2010)

and (R. Murphy, 2010). Wicksell thought in terms of averages and, as echoed by Hayek, the natural rate of a long-term average rate of profit.

Wicksell writes: "The so-called natural or real rate of interest on capital, by which, in theory, the money or loan rate of interest is regulated, is, of course, fundamentally merely an abstract concept, an average of the real yield of capital in all existing commercial enterprises, of which some, in fact, yield returns many times in excess of this average, others less, while still others, not so few in number, even make a loss" (Wicksell & Sandelin, 1999, p. 5)

Hayek's definitional critique of Wicksell's Stable price definition

Hayek also takes this position, "money rate of interest ("Geldzins") may differ from the equilibrium or natural rate because the demand for and the supply of capital do not meet in their natural form but in the form of money." (Hawtrey & von Hayek, 1932) This is not just a loanable funds model in a fiat economy; Wicksell's insight was unique. However. Subsequently, we find a particular where Hayek acknowledges indeterminateness in the definition: "Unfortunately Wicksell's change in terminology is also linked up with a certain ambiguity in his definition of the 'natural rate'" (Hawtrey & von Hayek, 1932).

J.G. Koopman, a contemporary of Hayek and Mises, was adamant that the natural rate of interest should not be equated in any way to a stable price level (Selgin, 2002) . This was because of productivity increases associated with a developing economy and its effect on supply. Koopman pointed out that deflation, not a stable price level, was evidence for neutral money. Prices fall in response to efficiency gains, such as technological improvements, business and logistical organization, and comparative advantage of international trade. Hence relative and

absolute price changes are a natural occurrence in a dynamic market system striving towards an optimal growth path. In fact, this idea is not without evidence; 19th-century deflation was empirically linked to higher growth (Bordo, Lane, & Redish, 2004) Deflation may be observed during downturns, but it is not empirically linked to causing downturns, Therefore, to prevent a drop in prices could distort the natural market (Atkeson & Kehoe, 2004) Hayek argued a stable price level as evidence for the natural rate in agreement with the market rate was not a criterion for equilibrium and in his own words "incomprehensible."

Hayek wrote:

“The rate of interest at which, in an expanding economy, the amount of new money entering circulation is just sufficient to keep the price level stable, is always lower than the rate that would keep the amount of available loan capital equal to the amount simultaneously saved by the public: and thus, despite the stability of the price level, it makes possible a development leading away from the equilibrium position But Wicksell does not recognize here a monetary influence tending, independently of changes in the price level, to break down the equilibrium system of barter economics: so long as the stability of the price level is undisturbed, everything appears to him to be in order”(Hayek et al., 2008, p. 58).

This criticism of the practical use of a stable price level as a guide for estimating the natural rate cannot be incorporated into using r -star as the natural rate of interest proxy. In contrast, stable inflation is a modern consensus primary condition for equilibrium. However, the mere existence of money as a tool to stabilize aggregate prices might distort this natural process

and the way transactors interact, as money always exerts an influence, even in a perceived equilibrium. Therefore, the stable inflation criterion is questioned.

To reiterate, Wicksell's natural rate of interest was "neutral with respect to commodity prices" (Wicksell, 1898). However, this asserted that money itself had a neutral influence and did not tend to create a rise or fall in commodity prices. This is not the same as stable prices or a stable inflation rate. Neutral means monetary influences were not the cause of price disturbances. However, it does not preclude relative price changes or changes in the price level from real factors, as Wicksell's natural rate of interest, by definition, including the statement "determined by supply and demand if no use were made of money" (Wicksell, 1898) Therefore, real factors, changes in supply and demand, could move the price level in money macro equilibrium This critical point is not addressed in the r-star policy line.

Hayek also takes this position, "money rate of interest ("Geldzins") may differ from the equilibrium or natural rate because the demand for and the supply of capital do not meet in their natural form but in the form of money." (Hawtrey & von Hayek, 1932) This is not just a loanable funds model in a fiat economy; Wicksell's insight was unique. However, subsequently, we find a particular where Hayek acknowledges indeterminateness in the definition: "Unfortunately Wicksell's change in terminology is also linked up with a certain ambiguity in his definition of the 'natural rate'" (Hawtrey & von Hayek, 1932).

Unresolved Issue of Multiple Natural Rates of Interest

Hayek felt that banks should set the market rate to the natural rate of interest under specific conditions. However, Piero Sraffa pointed out that there are multiple natural rates of interest. Each commodity could have its own natural rate of interest.

Sraffa writes:

If money did not exist, and loans were made in terms of all sorts of commodities, there would be a single rate which satisfies the conditions of equilibrium, but there might be at any one moment as many "natural" rates of interest as there are commodities, though they would not be "equilibrium" rates (Sraffa, 1932).

After an exchange and Sraffa's rejoinder in *The Economic Journal*, Hayak never answered this critique. It has been subsequently written about without a clear resolution. (Glasner & Zimmerman, 2013). Ludwig Lachmann (Lachmann, 2010), Murry Rothbard (Hutchison, Lachmann, O'Driscoll, Rothbard, & Jewkes, 1978), and Robert P. Murphy (Murphy, 2004) have addressed this issue. Murphy has a suggested resolution that includes replacing the Misesian idea of an evenly rotating economy equilibrium with a dynamic equilibrium construct. However, this applies to the Wicksellian Austrian *in natura* theoretical line, and not explicitly addressing the empirically derived r^* . The multiple natural rates of interest debate has never been fully reopened, and it is just accepted that r^* is or should be a singular rate at least as a policy tool.

1.6 Keynes

Keynes is the pivotal figure who has exacerbated the confusion about the definition of the natural rate of interest. Keynes did this by initially accepting the natural rate of interest in his

Treatise (Keynes, 1930), what Alex Leijonhufvud calls 'Keynes' finest hour' (Leijonhufvud, 1979). However, Keynes rejected the natural rate of interest in his *General Theory* (Keynes, 1936).

What is significant and remarkable here is that Keynes essentially renames the natural rate of interest in his *General Theory* and calls it his marginal efficiency of capital, defined as the "prospective yield of the investment" (Keynes, 1936, p. 69).

At the same time, Keynes developed a neutral rate of interest, semantically similar in name to the natural rate of interest, connected to full employment. Keynes writes that the optimal rate is "the rate of interest which prevails in equilibrium when output and employment are such that the elasticity of employment as a whole is zero" (Keynes, 2017). In other words, in modern New Consensus terminology, this is the rate at GDP 'output equals potential' (Laubach & Williams, 2003).

This is renaming the 'expected yield of on capital, which was the Wicksellian natural rate of interest, to the *marginal efficiency of capital*, and simultaneously emphatically stating that he is "no longer of the opinion that the concept of a 'natural' rate of interest, which previously seemed to me a most promising idea, has anything very useful or significant to contribute to our analysis (Keynes, 1936, p. 121)" is an essential point of confusion. This is a clear, logical contradiction in Keynes concerning the definition of the natural rate of interest.

This insight is largely absent from academic literature except from economic historian Joseph Salerno. In his work (Salerno, 2016) notes that it is unclear how or why it came about that

Keynes himself confuses the definition of the interest rate. However, based on the evidence in Keynes' writing, it is confusing the definition of the natural rate of interest.

Therefore, what is significant and remarkable is that Keynes states that the natural rate is unimportant. Still, his marginal efficiency of capital, a central aspect of his work, which is the returns expected from the capital asset or the expected real return on investing in the capital, is the Wicksellian natural rate.

Salerno writes: "Unwilling or unable to comprehend this distinction, Keynes in the *General Theory*, (pp. 192–93) charged Mises along with Friedrich Hayek and Lionel Robbins with "confusing the marginal efficiency of capital with the rate of interest." Keynes's "marginal efficiency of capital" was his peculiar term for the expected rate of return on investment — which is nothing other than Wicksell's natural rate."

Therefore, we can see that Keynes discussed the Natural rate of interest in the *Treatise* and in the *General Theory* under different definitional and semantic approaches. However, Keynes conflates the issue of the interest rate, that is, the natural rate of interest.

This notable discourse on the interest rate is a turning point in the history of economic thought. In Keynes' *General Theory*, his confusion and assertions about the natural rate of interest are an often-overlooked aspect of Keynes' understanding of interest, highlighting the importance of clearly defining terminology. In this case, it is his rendition of the interest and his term, the marginal efficiency of capital, and his claim about the natural rate of interest. His interest rate analysis is why researchers need to reference and compare primary sources without fragmentation of key concepts in the spirit of objectivity and even humility.

Highly cited consensus writers such as Woodford (Woodford, 2003) did not find a natural rate of interest in the *General Theory*, yet used fragments of Keynes's ideas as the center of his work. This is an unintended consequence of the fragmentation or confusion of terms and definitions. The New Consensus natural rate can be interpreted as a fusion of the ideas of Keynes's writing in his *Tract on Money* in 1923 (Keynes, 1923), where he advocated aggregate price level stabilization and countering deflation, and his *General Theory* (Keynes, 1936) where he advocated full employment or full utilization of resources, both of which ignore the essence and microfoundations of Wicksellian theory of interest and defer theory and policy to an aggregate analysis. Both Keynes and the New Consensus think in terms of aggregation and lose the nuances embedded within Wicksell's original natural capital rate of interest concept.

Keynes defines the natural rate of interest as follows:

"Following Wicksell, it will be convenient to call the rate of interest which would cause the second term of our second Fundamental Equation to be zero the natural rate of interest, and the rate which prevails the market rate of interest. Thus, the natural rate of interest is the rate at which saving and the value of the investment are exactly balanced so that the price-level of output as a whole (II) exactly corresponds to the money rate of the efficiency earnings of the Factors of Production. Every departure of the market rate from the natural rate tends, on the other hand, to set up a disturbance of the price level by causing the second term of the second Fundamental Equation to depart from zero." (Keynes 1930a: 154–155).

In summary form:

"the rate at which savings and the value of Investment are in equilibrium."(Keynes 1930a: 196–199) and “the rate of investment”(Keynes, 1936, p. 121).

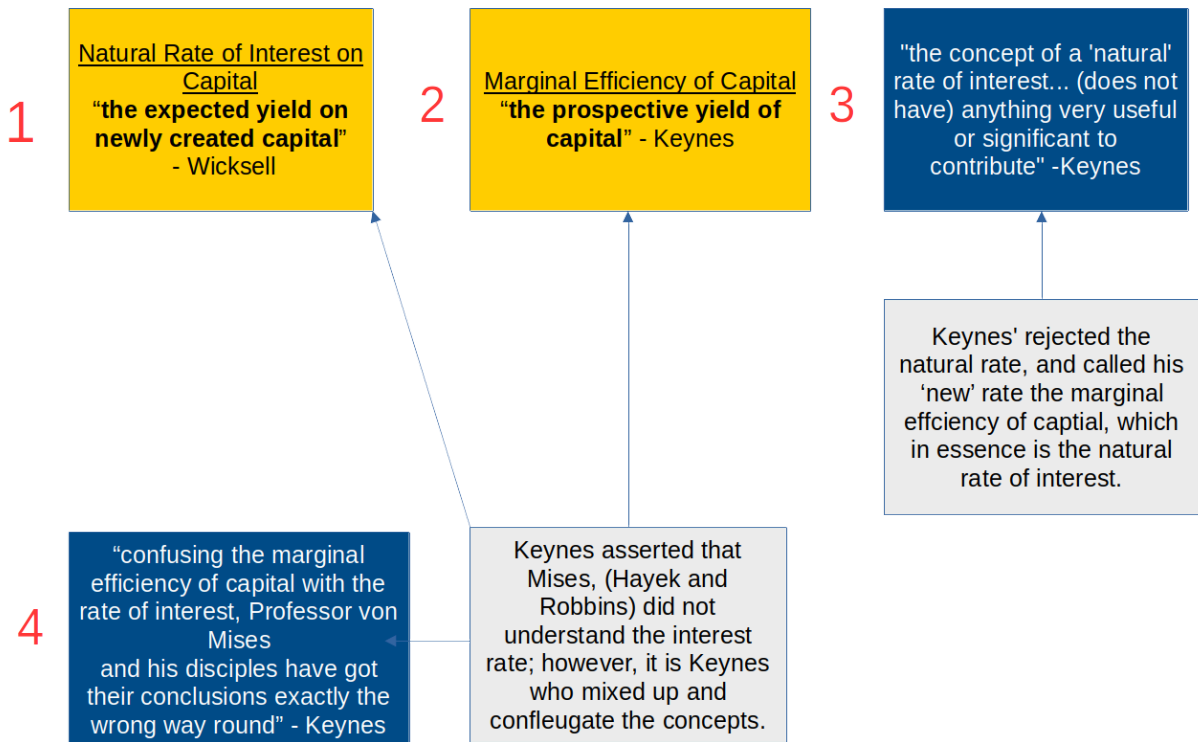
Essential elements are missing from Keynes’ theory of the natural rate, and this gives evidence that Keynes emphasized fragments but not the totality of Wicksell’s theory. The words are clear; Keynes is using the vocabulary, but it is unclear whether Keynes' understanding of the Wicksellian natural rate as Wicksell entirely presented it in the entirety of Wicksell’s works, including the essence of a time preference theory (Fetter, 1920; Von Mises, 2016) of entrepreneurial calculation profit(Rothbard, 1972), based on margins rather than aggregate signals.

Further, Keynes makes no reference to Wicksell’s *in natura* rate. The idea of barter exchange ratios of Wicksell (Wicksell, 1936) was the starting point for the exposition of the natural rate of interest. Nor does Keynes detail the nature of capital as Wicksell does, that is, the nature of capital as mobile capital, existing only at the moment.

Further, when reading Keynes, native speakers of the English language (Hazlitt, 1959; McKenna, 1960; Rothbard, 2007; Salerno, 2016) and this author have noted that the construction of these sentences is not straightforward, and this adds to the confusion as he interjects new word constructions for existing concepts. In the words of economic historian Murry Rothbard, Keynes’ writing is “a wilderness of unclear writing and pretentious jargon”(Rothbard, 2007, p. 2). However, this ‘jargon’ like his particular use of the “marginal efficiency of capital,” adds to the misinterpretation of the interest rate.

Figure 1.3

Genesis of the confusion on the natural rate of interest and the interest rate



Own elaboration, (Keynes, 1936; Wicksell, 1936)

As depicted in Figure 1.4, Keynes (1936) rejects the prevailing concept of the natural rate of interest on capital, proposing instead a novel concept known as the marginal efficiency of

capital. In the context of the interest rate and the marginal efficiency of capital, Keynes criticizes economists who understood or developed Wicksell's definition of the interest rate, arguing that they were confused about the concept of interest. Among those he specifically charged with not understanding what an interest rate is were Lionel Robbins, Ludwig von Mises, and F.A. Hayek, who are noted experts in interest rate theory, and Wicksell. Nonetheless, at the same time, Keynes identified the definitions of the two rates in a discourse that was reminiscent of aspects of Wicksell's definition, which he rejected. The existing literature needs to provide more evidence to elucidate why Keynes conflated the interest rate concept, and speculation on this matter lies beyond the purview of the current research.

One notable consequence of this conflation is the loss of what has been termed the 'Wicksell connection' from the *Treatise on Money* to the *General Theory* (Keynes, 1930; 1936). This confusion has permeated subsequent economic thought, contributing to ongoing uncertainty in the definition and understanding of the interest rate (Leijonhufvud, 1979)(Salerno, 2016).

Keynes replaces the interest of the natural rate framework, a loanable funds theory in the context based on an entrepreneurial intertemporal decision at a micro level regarding capital, and replaces it with a liquidity preference theory of money and the real money supply (M/P) that determine the market rate and this, in turn, determines the level of investment. This is the opposite of what Wicksell envisioned, as argued by (Garrison, 2006); that is, the natural rate was the core rate that intertemporal decisions were based on and acted as an attractor to the market rate. Therefore, for Keynes, with a focus on aggregate output potential and, ultimately, the interest rate primarily determined in the financial markets, interest rate theory becomes

fragmented. This is represented through the post-Keynesian IS-LM and FE framework and subsequently cascades into the New Consensus misunderstanding of the natural rate of interest.

1.7 The New Consensus

This section examines the definitional issues and criticisms surrounding the natural rate of interest rate concept used in the New Neoclassical Synthesis (New Neoclassical Synthesis) in the literature as it exists after the Keynesian revolution starting with precursory writers of the 1970s and the New Consensus writers of the 1990s to today. This analysis emphasizes the theoretical foundation of the New Neoclassical Synthesis literature, which does not examine the empirical model itself but what it is based on. It does not look at every issue but focuses on the definitional contrasts and comparisons to Wicksell's natural interest rate on capital and the New Neoclassical Synthesis conception of this and money neutrality.

Following the publication of the *General Theory* (Keynes, 1936), a fundamental divergence emerged regarding the definition and application of the natural interest rate. One line of thought adhered to the original Böhm-Bawerk-Wicksell approach; this line anchors the natural rate of interest in microeconomic principles and capital (Wicksell, 1936). The other line of thought, the New Neoclassical Synthesis, is based on a fragment of the definition of the natural rate: price stability. Because of claims to the unobservability of the natural rate, the New Neoclassical Synthesis advocates for an entirely empirical monetary natural rate of interest linked to output potential and based on macroeconomic aggregate price indexes, such as the CPI and the PCE.

There is little debate that New Neoclassical Synthesis is the most influential line of thought compared to heterodoxical lines such as the Austrian school of thought. The basis for this influence claim is the count of the total number of academic articles and citations and notoriety in central bank literature and research. This evidence is why the New Neoclassical Synthesis is the line considered the generally accepted understanding of the natural rate of interest. However, high levels of citations do not necessarily prove conceptual rigor or authentic claims to Wicksell.

In their research, numerous consensus researchers utilize the natural rate of interest concept as defined by the New Neoclassical Synthesis (New Neoclassical Synthesis). However, they often do not explicitly distinguish between the New Neoclassical Synthesis's definition and Wicksell's original conception of the natural rate of interest (Andrade et al., 2018; Lewis & Vazquez-Grande, 2017; Mesonnier & Renne, 2007). In other words, these authors often do not make it explicit that the New Neoclassical Synthesis's natural rate of interest is different from or at least clearly distinct from Wicksell's definition, even though this difference may be implied in their discussions. (Brzoza-Brzezina, 2003; Garrison, 2006) suggests that the New Consensus School's interpretation of the natural interest rate differs from Wicksell's understanding of the concept (Wicksell, 1898); however, it uses the empirical proxies aligned with New Neoclassical Synthesis's ideas in research. (Pivetti, 2012) research focused on the historical origins of the natural rate and the differences between the Wicksellian and New Neoclassical Synthesis conceptions.

However, like Sraffa, Pivetti questions the practical applicability of the natural rate concept. Pivetti sees the interest rate as a monetary phenomenon primarily determined by central bank policy and institutional factors. In contrast, several scholars, such as (Garrison, 2006) and (Murphy, 2010) as a continuation and developed this idea, and investigated the definitional discrepancies, specifically scrutinizing the element of time preferences in capital structure that is noticeably absent in the New Neoclassical Synthesis (New Neoclassical Synthesis) definition.

In addition, other academics, including (Evans; and Baxendale, 2008) and (Salerno, 2011), ground their examination of the New Neoclassical Synthesis's natural rate in the historical context of economic thought. In other words, they emphasized how Wicksell's definition significantly diverges from the New Neoclassical Synthesis. This variance raises complications when it comes to utilizing and estimating this rate. (Salerno, 2011) advocates for a natural rate of interest not anchored on price level stabilization but instead on the profit rate. A practical application is a revised U.S. Bureau of Economic Analysis (BEA), profit rate of non-financial corporations, underpinned by an understanding grounded in Wicksell's definition. This interpretation of the profit rate as the natural rate of interest was later refined and further improved by (Macovei, 2021). In Macovei's calculation as an extension of Rothbard (Rothbard, 1972, 2004) and Salerno's calculations the return on investment or the natural rate of interest on capital calculation is: "(i) the ratio of companies' net operating surplus to net stock of produced assets, i.e., fixed assets and inventory, or (ii) the ratio of companies' corporate profits to their net stock of produced assets. The numerator, i.e., the measure of corporate profitability, includes the pure rate of interest and entrepreneurial profit"(Macovei, 2021, p. 240). Further details of the calculation and treatment of capital are in (Macovei, 2021, p. 240,241,242).

In a parallel critique, (Murphy, 2007) points out the widespread confusion in monetary theory between the equilibrium rate of interest and the marginal product of capital. Similarly (Gertsen, 2019) emphasizes these definitional differences and draws on empirical evidence related to the interest rate and business cycles. Directly challenging the established paradigm, (Selgin, 2018) calls the price stability axiom into question, which forms the core component of the New Neoclassical Synthesis's definition of the natural interest rate. Specifically, Selgin's productivity norm is based on a fall in the general price level as productivity increases, in contrast with 'stable prices or stable inflation(Selgin, 2018), which is from the lineage of Davidson, Wicksell, and Lindahl(Davidson, 1909, 1925; E. Lindahl, 2016; E. R. Lindahl, 1929; Wicksell, 1936).

Numerous scholars, including(Amato, n.d.)to, (Boianovsky & Trautwein, 2006), (De Fiore and Tristani 2011), (Laidler, 2006), (Nadal De Simone, 2023), and (Rogers, 2006), have highlighted the conceptual distinctions between the New Neoclassical Synthesis and Wicksell's theory, each from their unique perspective. Most recently (Nadal De Simone, 2023) draws a sharp contrast between Wicksell's natural rate of interest and the New Neoclassical Synthesis claim on multiple levels. These researchers, among others, note that the degree of deviation between Wicksell's understanding, the New Neoclassical Synthesis, and central bank action is significant. The definitional and theoretical differences about the natural rate of interest or any reference to it objectively question the New Consensus's claim to Wicksell's theoretical lineage. Further, it questions the conceptual rigor if the foundations rest on convoluted ideas.

New Consensus researchers, such as (Holston et al., 2017), (Christensen & Rudebusch, 2017) in the US, (Benati & Vitale, 2007), (Garnier & Wilhelmson, 2005), (Mésonnier & Renne, 2007), (Amato & Laubach, 2011), (Huang & Liu, 2005), (Bernhardsen & Gerdrup, 2007), and (Marta & Marqués, 2004) in the Euro area, concentrate their efforts on developing empirical proxies. These are predicated on a synthesis of economic ideas and Keynesian models that have evolved since the times of Keynes and Friedman. This includes considerations of aggregate demand and the Phillips curve (Wieland, n.d.). However, throughout their work, they persistently emphasize the price stability component of Wicksell's natural rate of interest as a defining characteristic.

The New Consensus, or the New Neoclassical Synthesis (New Neoclassical Synthesis), signifies the integration of modern macroeconomic schools of thought — a blend of new classical macroeconomics with Keynesian economics and real business cycle theory. It represents New Keynesian monetary economics, which offers a consensus perspective on the economic fluctuations of key macroeconomic variables (Goodfriend, 2004). The New Consensus comprises four main components: Microeconomic agents participate in intertemporal optimization, analyzing and making decisions based on future price, income, and allocation expectations (Mankiw, 2010). In rational expectations, economic agents leverage all accessible information to form expectations (Sargent, 2015; Muth, 1961). Pertaining to competitive markets, these are imperfect, potentially leading to price stickiness or rigidity (Keynes, 1936; Mankiw, 2010; Woodford, 2003). For firms, adjusting prices is cost-intensive, which can also contribute to price rigidities or stickiness (Keynes, 1936; Woodford, 2003).

The New Neoclassical Synthesis (New Neoclassical Synthesis) conception of the natural rate of interest is summarized by Michael Woodford:

"The natural rate of interest is just the real rate of interest required to keep aggregate demand equal at all times to the natural rate of output." (Woodford, 2003).

This premise is grounded in the absence of price or wage stickiness, a fundamental assumption of Keynesian theory in its optimal state. This is what Keynes', in the introduction to his French edition of his *General Theory*, understands as the 'specific theory' (Keynes, 1936), an optimal state or natural state, while the rest of his *General Theory* primarily explores deviations of aggregate demand from the full potential of output (GDP) (Murphy, 2022).

The fundamental theoretical framework is a scenario where output and employment optimally utilize resources, and this top-down serves as the basis for determining the natural rate rather than Wicksell's microeconomic capital rate. Similarly, Thomas Laubach and John C. Williams suggest, "The natural rate of interest is the real interest rate compatible with output equaling its natural rate and stable inflation" (Holston et al., 2017).

Consequently, the consensus typically depicts the natural rate of interest as the rate at which real GDP matches potential output, with aggregate prices remaining steady - in other words, maintaining a low and stable inflation rate (Baily, 2004; Holston et al., 2017).

This interpretation of the rate of interest is grounded in the idea of optimizing real and potential GDP, and a careful reading of Keynes' one sees that this closely aligns with the ideas presented in Keynes's *General Theory* (Salerno, 2016). Essentially, this rate from the

New Neoclassical Synthesis aligns closely with the 'neutral rate' from Keynes's General Theory. This alignment becomes evident when contrasted with Keynes's notion of a neutral rate — "which prevails in equilibrium where output and employment are such that the elasticity of employment as a whole is zero" (Keynes, 1936).

This idea can arguably, in an intermediary state, be traced back to Milton Friedman's concept of the "natural rate of employment" (Friedman, 1968). Even though the transmission of Keynes's ideas could be considered indirect through Milton Friedman — who, despite being well-acquainted with Keynes's work, did not adhere to his theories — the resemblance remains. Friedman developed the notion of the "Natural rate of employment" (Friedman, 1968), a concept which shares substantial similarity with Keynes's neutral rate, thus demonstrating an analogous thread running through both.

This definition suggests that what the New Neoclassical Synthesis describes aligns more closely with Keynes's neutral rate concept than Wicksell's 'expected return on capital' (Hayek et al., 2008). The emphasis here is that it is a full employment rate. As pointed out by (Rallo, 2013) and (Bagus et al., 2014), a degree of inflation is accepted to keep aggregate demand stimulated and employment at or near its potential in Keynesian thought. As recognized by (Salerno, 2011) and (Garrison, 2006), The New Neoclassical Synthesis is thinking in terms of aggregate demand instead of individual economic agents making intertemporal allocation decisions regarding capital. This is, in essence, a contrast between Keynes versus Wicksell. This observation indicates consistency in language and ideas from Keynes to Woodford, Laubach, Williams, or virtually any New Neoclassical Synthesis writer.

Surprisingly, a notable omission in the New Neoclassical Synthesis (New Neoclassical Synthesis) literature when defining Wicksell's natural rate of interest is the idea of 'capital' integrated into the definition. For Wicksell, the definition of the natural rate of interest was intrinsically tied to capital (Wicksell, 1898). It is the natural rate of interest on capital. It is literally *natürliche Kapitalzins* from Böhm-Bawerk work on capital Böhm-Bawerk (Von Mises, 2013). Therefore, excluding capital makes the rate non-Wicksellian. However, like Keynes's approach, the New Neoclassical Synthesis de-emphasizes this aspect of capital, moving it away from the theory's centerpiece (Keynes, 1936). The New Neoclassical Synthesis, as constructed by scholars such as Woodford (2003) and Laubach & Williams (2003), revises the fundamental principles of the natural interest rate on capital. As discussed with Michael Woodford (personal communication, November 25, 2022), Woodford's book *Interest and Prices*, as a tribute to Wicksell, does not place capital as the center of Wicksell's natural rate. It is no longer the Wicksellian idea of microeconomic agents making intertemporal choices, specifically regarding the expected return on newly created mobile capital in production in a natural (in natura) non-monetary economy (Wicksell, 1936, 2001). Within the New Neoclassical Synthesis framework, the natural rate of interest is no longer defined in terms of the rate of interest on capital (Woodford, 2003). It takes a fragment of Wicksell's definition and deploys it in a Keynesian framework. The New Neoclassical Synthesis, Instead, replaces the need for capital and expected return on capital in the definition with a construct derived from exchange economics (Woodford, 2003) determined in the financial markets of a monetary economy. (Salerno, 2011, 2016) points out that this redefinition and determination in the market for money and financial assets, by way of the New Neoclassical Synthesis natural rate through the

intersection of the ISLM and full employment aligns more closely with Keynesian thought, diametrically opposed to the Wicksellian perspective.

Garrison (2006) raises an intriguing point regarding the necessity of basing intertemporal decisions on real capital by microeconomic agents for a theory to rightfully assert itself as a "natural" rate of interest theory. Similarly, Butos (personal communication, August 18, 2018) suggests that without microfoundations within a fiat system, this theory would simply transform into an understanding of observable money prices and output within a monetary economy, thereby reducing it to a variation of a monetary rate.

In the contemporary fiat economy, where only money prices are perceptible, a shift occurs from the circumstances of Wicksell's era. Consequently, we are left with an entirely monetary approximation of the natural rate of interest. The ubiquity of money, an inherent part of every transaction, that is, the second half of every transaction, creates a systemic influence of money that cannot be filtered out through econometric methods. This is particularly true in a pure fiat economy if the natural rate's definition aligns with that proposed by the New Neoclassical Synthesis.

Further complexity arises from the systemic effects of regular policy interventions. Therefore, it becomes critical to explore the plausibility of accurately estimating the natural rate of interest or even its utility for policy application in an economy where money lacks a natural capital reference point.

Wicksell (1898) addressed this issue in his chapter, "Practical Proposals for the Stabilization of the Value of Money." However, his discussion was framed within the context of bimetallism and a gold standard rather than an unlinked estimation.

This argument is echoed among Wicksellians, including Gunnar Myrdal (Myrdal, 1939) and Erik Lindahl (Lindahl, 2016), who also questioned the feasibility of estimating a practical policy rule's natural rate of interest based on stabilization, considering the permeating influence of money in every transaction.

Closely connected to the idea of a natural economy is a money-neutral economy. The concept of a money-neutral economy is closely associated with a natural economy. In his model, Wicksell (1936) explains that if the natural capital rate aligns with the money rate, money does not exert an influence. This specific Wicksellian viewpoint is that money is a neutral veil in money macro equilibrium in the context of the natural rate of interest.

This divergence in emphasis changes the course of the academic literature. The ideas that once defined the natural interest rate have been de-emphasized, largely favoring a Keynesian perspective conceptual understanding of interest. This departure from Wicksell's original concept of the natural rate of interest and money neutrality underscores a trajectory in the history of economic thought that is not true to a primary source understanding of Wicksell.

One idea that Wicksell is clear on is that his equilibrium was an economy where money has no influence when put in the context of the natural rate of interest framework (Wicksell, 1936). If the natural rate of interest and market rate of interest are in agreement, then money would be as a veil that is neutral.

However, a study by Boianovsky and Trautwein (2006) on Woodford's seminal work "Interest and Prices" shows a lack of discussion regarding monetary neutrality. In fact, Woodford's book *Interest and Prices* (named after Wicksell's book), which is 785 pages long and goes to great lengths to justify its connection to Wicksell, the term "neutral" is entirely absent, which begs the question why it is not discussed and addressed like Wicksell and the Stockholm and Austrian Schools which developed Wicksell's ideas. This absence is not exclusive to Woodford; other pivotal works by widely cited economists such as Thomas Laubach and John C. Williams also fail to address Wicksellian money neutrality. In the essence of Wicksell's understanding, this idea was swept aside in the wake of the Keynesian revolution.

Woodford's work is seminal, and credit must be given to its valuable reexamination of Wicksellian principles from a fresh perspective, which offers new insights and initiates new debates and examinations, including this work. Advocating for a rule-based monetary policy in line with the Taylor Rule, Woodford adopts an empirically-driven definition of the natural rate of interest, premised on the idea of fully flexible prices in capital stock and all prices, both past and future (Woodford, 2003).

While Woodford's natural rate of interest maintains some elements of Wicksellian theory, particularly in terms of its correlation to real factors such as productivity changes or consumer intertemporal preference (in contrast with Wicksell's entrepreneurial preferences regarding capital), its core differs considerably from Wicksell's concept of the natural rate of interest (Boianovsky & Trautwein, 2006).

Despite claiming to uphold neo-Wicksellian principles, Woodford constructs a dynamic monetary rule based on mathematical constructs in a cashless society devoid of a banking system, with a single representative household striving for lifetime optimization. His unique definition of the natural rate of interest is described as "the equilibrium real rate of return in the case of fully flexible price...a direct correspondence to the natural rate of output" and one "that yields period-by-period price stability" (Holston et al., 2017), essentially deviates from Wicksell's original conception.

Boianovsky and Trautwein (2006) argue that even though Woodford's work employs language reminiscent of Wicksell, in essence, his perspective is distinctly different. Furthermore, empirical constructs such as r^* (r^*), an empirical proxy of the natural rate of interest, which hinges on the DSGE/Woodford or new derivative FED/US models, rest on assumptions that depart from Wicksellian viewpoints. Which, in and of itself, is not incorrect, but it can not be claimed to be Wicksellian if the departure is clear. Further, Wicksell's assumptions were vetted over a quarter of a century of thought, so the rigor conceptually has a degree of trust. Mayer and Schnabl (2021) question the validity of these assumptions, given the apparent dichotomy in definitional understanding.

Woodford's model is divided into two major ideas: sticky prices and sticky wages. Both have faced academic critique, both historical and contemporary (Dunlop 1938 and Tarshis 1939; Christiano 1999 2001), a fact acknowledged by Woodford himself. He further notes empirical criticisms related to wage stickiness and the counter-cyclical nature of real wages.

Distinct from Wicksell's non-monetary natural rate of interest, which is tied to the return on mobile capital and subjective intertemporal preference, Woodford's and Keynes' rates focus on aggregate demand, output, employment, and nominal rigidities that could hinder the full utilization of resources. This approach uses interest rates to scrutinize output gaps and integrates ideas from the IS-LM model and liquidity preference into Woodford's theory (Weise, 2007).

However, Woodford is criticized for overlooking key Wicksellian insights, as highlighted by Boianovsky and Trautwein (Boianovsky & Trautwein, 2006), and for failing to address issues with the IS-LM and Liquidity Preference theory. Hans-Michael Trautwein (2003), a distinguished Wicksellian scholar, points out the New Neoclassical Synthesis's reference to the natural rate of interest as a policy benchmark in ways Wicksell would not have, and he emphasizes the importance of inherent uncertainty and complexity in real-world economies.

Boianovsky and Trautwein (2006) suggest that the New Neoclassical Synthesis's natural rate closely resembles Keynes's General Theory more than any of Wicksell's ideas or theory. Their argument here is that the New Neoclassical Synthesis combines Wicksell's term, the natural rate, with Keynes's idea of the marginal efficiency of capital, creating a hybrid concept that reflects the expected return on capital under conditions of full employment and price stability, which is different from Wicksell's.

Finally, Boianovsky and Trautwein (Boianovsky & Trautwein, 2006; Boianovsky, 2006) propose that Woodford's work, as presented in *Interest in Prices*, requires further development to incorporate key Wicksellian concepts effectively. This critique focuses on how he needs to develop ideas directly connected to credit economies, the cumulative process, the

(non-)neutrality of money, and a definition of the natural rate of interest that aligns more closely with Wicksell's original concept. Woodford's model oversimplifies economic microfoundations (simplifies to one general microeconomic agent). He disregards Wicksellian ideas such as credit creation, the quantity of credit, the money quantity (he has a cashless society), and microeconomic entrepreneurship relating to capital, that is he, no quantity of money, which Wicksell saw his theory as an extension of, no quantity of credit and no capital decisions with an entrepreneur gaging the capital rate against the money rate. His model aligns more closely with Keynesian theory, pre-Keynesian revolution, and post-*General Theory* ideas, which are embedded in the New Keynesian IS-AS-MP synthesis (Boianovsky & Trautwein, 2010). It is worth noting that Woodford's theory on consumption aligns more closely with liquidity preference theory than with capital theory

Woodford's approach notably emphasizes a short-run stabilization time horizon, implying that money is not neutral in the short run and that policy effectively steals the economy back to full Keynesian employment. This stance is supported by DSGE models, including those presented by Edge, Kiley, and Laforé (2008), Barsky, Justiniano, and Melosi (2014), and Curdia et al. (2015). An alternative approach to monetary policy uses a similar neo-Keynesian framework. It emphasizes long-term defined aggregate variable stabilization while targeting short-term interest rates through empirical analysis and modeling. Significant contributions in this area come from Laubach and Williams (2003), Kiley (2017), and Holston, Laubach, and Williams (2017).

Moreover, some researchers have explored the short-run stabilization horizon using long-term rates or policy tools, such as the approach proposed by John M. Roberts (2018). On the other end of the spectrum, the model by Del Negro et al. (2017) focuses on the long-term stabilization horizon with long-term rate and policy targeting.

Woodford's framework also integrates key elements from the IS-MP and IS-LM models. It aligns with the Phillips curve through the introduction of multiple rates and considerations of financial intermediation friction. As Woodford articulates, "This kind of model provides a straightforward account of the way in which a central bank's interest-rate policy affects the level of economic activity and also the inflation rate once one adjoins a Phillips curve to the model"(Woodford, 2010).

These various models and perspectives underscore the complexity and diversity of ideas within this realm of economic theory. When one considers Wicksellian ideas and the ideas of the Stockholm school in general and juxtaposes them against the ideas of Woodford, on a positive note, one sees how different perspectives bring new insights and keep the interest in Wicksell alive. The criticisms and viewpoints keep the academic discourse lively and allow for a constant rethinking and refinement of key monetary concepts. However, this work. However, this has to be based on primary sources, reading, and scholarly research during Wicksell's critique. This is why many of the critiques focus on the New Neoclassical Synthesis, particularly the abstract nature of the natural rate, the challenges of measuring it, and other ways it differs from Wicksell's original concept. Willams redefined the natural rate of interest as "the real fed funds rate consistent with real GDP equaling its potential level (potential GDP) in the absence of

transitory shocks to demand. Potential GDP, in turn, is defined to be the level of output consistent with stable price inflation, absent transitory shocks to supply. Thus, the natural rate of interest is the real fed funds rate consistent with stable inflation absent shocks to demand and supply (Williams, 2003)."

Further, Williams writes, "Unfortunately, the "natural" real rate of interest is not observable, so it must be estimated (Williams, 2003)". The issue with William's conception of the natural rate of interest, his definition radically departs from Wicksell's micro foundation and capital grounding and even the *in natura* understanding and falls back ultimately to modeling a hypothetical rate that stabilizes low inflation.

In his 1973 work, Axel Leijonhufvud critically evaluated the New interpretations of the natural rate of interest from both a historical and theoretical standpoint. Leijonhufvud argued that the new interpretations deviated from the traditional Wicksellian conception of the natural rate, prioritizing the "expected yield on newly created capital" (Wicksell, 1898).

Leijonhufvud refers to Keynes's *Treatise on Money*, where the natural rate is defined as a state of equilibrium between investment and savings. He contrasts this with the neutral rate concept in the *General Theory*, which he considers to have led economic thought astray. He argues that analysis needs to be grounded in the real economy (like Wicksell did), implying that an overemphasis on monetary theory could miss important details about how economies work.

Specifically, Leijonhufvud highlighted, well before Woodford's analyses in the 2000s, that there were problems with the constructs developed after the *General Theory*, such as the liquidity preference theory and IS-LM models. As a result, their inclusion in a natural rate of

interest framework is questionable. Leijonhufvud posits that extending the early Keynesian ideas that followed the *Treatise on Money* would be more effective; it was Keynes' best work.'

In his subsequent work (Leijonhufvud, 1979), he proposed Theory Z, which could serve as a basis for the future development of the natural rate of interest concept.

Joseph T. Salerno (2012) from the modern Austrian school of economics puts the New Neoclassical Synthesis's emphasis on price stability on an unsure theoretical footing. He argues that the new neoclassical synthesis is from Keynes rather than Wicksell. He claims that fundamental factors, such as capital productivity, must be adequately treated in determining the natural rate, as Wicksell did. As a scholar of the history of economics, Salerno argued against the New Neoclassical Synthesis's interpretation of the natural rate as an equilibrium concept. Instead, he sees it should be understood as the rate that maintains the intertemporal structure of production, much like Mises and Hayek argued. He contends that the New Neoclassical Synthesis's focus on equilibrium and stability, almost to an obsession, abstracts away from real economies' inherent dynamism and heterogeneity. Salerno maintains that such a view could lead to policy missteps as it fails to account for structural changes and market processes that could influence the natural rate. He contends that the natural rate of the New Neoclassical Synthesis is influenced more by the *General Theory* than Wicksell's *Interest and prices*. Salerno's conveys this theory is the opposite of the Wicksellian definition because the rate is derived in the financial markets rather than a natural rate of capital. It was Wicksell's point that there is a rate separate from a monetary rate. If it is derived from the financial markets rather than, as Wicksell's theory indicated, it is not the natural rate of interest. The essence of the original

Wicksellian natural rate is determined by the interplay between present and future consumption (as embodied in capital goods) within the real sector of the economy. Thus, Wicksell's conception of the natural rate is fundamentally anchored in the dynamics of the real economy rather than in the financial markets. It is argued that the market rate is a shadow of the natural rate and follows it. The New Neoclassical Synthesis Salerno argues that they need to clarify this critical point because they need to interpret the definition of the natural rate.

Salerno writes that in this regard, the natural rate has transmogrified into "an elusive, non-market policy goal." It points out that without a commodity standard, it can not be ascertained through empirical methods (Salerno, 2016).

Following a detailed examination of the history of economic thought, Salerno suggests (Hayek et al., 2008) that despite its variety of names, in terms of the monetary theory of the natural rate of interest, it remains fundamentally a Keynesian monetary theory originating from the General Theory.

(Macovei, 2021) similarly argues against the consensus view of the definition of the natural rate of interest. He argues against the claim made by economists (Summers, 2014) and discusses (Krugman, P., 2014) that the natural rate of interest has significantly declined. This is because they misdefine the natural rate of interest, not the profit rate, as Wicksell suggested (Macovei, 2021). The reason is that this theory that Summers uses is based on a model developed by economists Thomas Laubach and John C. Williams, who used the Kalman filter to derive the natural interest rate from the deviation of predicted GDP from actual GDP. However, Macovei highlights several limitations of this model and the methodology used to derive the natural interest rate. An alternative method for calculating the natural rate of interest uses the rates of

profit for US nonfinancial corporations, which is more closely aligned with Wicksell's expected profit rate, the rate of capital in production (Macovei, 2021; Salerno, 2011).

Geoff Harcourt (Cohen et al., 1997; Harcourt & Kriesler, 2013) critiqued the neoclassical theory of interest and the idea that capital goods are homogeneous similar to Sraffa's (Sraffa, 1932a) critique of Hayek. Joseph Stiglitz (Stiglitz, 1997) while not explicitly advocating for a Wicksellian definition, which is common among writers about the natural rate of interest, Stiglitz has analyzed the New Neoclassical Synthesis definition. The main idea is that the complexities of the world can not be represented in modeling. (Stiglitz, 1997) from the New Keynesian school is an advocate of using the Natural rate of interest as a policy guide but does not offer a definition congruent with Wicksell; instead, it falls back to the Phillips curve analysis of trade-offs between inflation and unemployment. This particular dynamic was not found in Wicksell, who related business cycles to real factors.

Thomas Palley, a Keynesian, is skeptical of the natural rate of interest, as he defines it in line with the Keynesian idea and writes, 'There may be no interest rate that can deliver sufficient AD for full employment. Consequently, there is no NRI.' (Palley, 2019). This is because it takes a Keynesian full employment perspective of the natural rate of interest. Similarly highly cited and noted writers such as Marc Lavoie (Seccareccia & Lavoie, 2016) and Paul Krugman (Krugman, 2014) have all argued that the natural rate of interest does not take into account the complexities of the real world, but this is because their critiques are based on a New Neoclassical Synthesis definition of the natural rate of interest.

Richard Anderson argues Wicksell never advocated for the Central Bank of Sweden to use his theory as a policy prescription. Anderson points out that households make decisions based on intermediate-run rates of 5 to 10 years to maturity, not short-term rates set by central banks. Shocks cause short and long rates to diverge from the longer-term rate of return on capital (Anderson, 2005). Therefore, as a policy tool, the current framework is far from Wicksellian.

Frank Shostak and Mark Thornton (M. Thornton, 2009) and Thorsten Polleit (Belke et al., 2009) express criticisms of the New Neoclassical Synthesis based on a lack of microfoundations, something that is central in the original Wicksellian ideas. The idea here is that the New Neoclassical Synthesis reduces individual time preferences, capital investment, and production processes to a single measurable and targetable variable. This is contrary to the nature of human action. They argue that this reductionist view could distort the capital structure, leading to an artificial boom and bust cycle, which is the cornerstone of the Austrian business cycle theory.

(Potužák, 2018) points out the issues with price stabilization at an aggregate level with the natural rate because relative prices are more important than an average. Further, deflation is a growing economy's natural aggregate price level effect.

Werner (Werner, 2014) provides empirical evidence of Wicksell's endogenous theory of money, which explains how banks can create purchasing power based on perceived market signals.

The measurement of r -star has also been a point of contention. The New Neoclassical Synthesis interpretation requires policymakers to estimate r -star empirically, with uncertainties

and the issues inherent in modeling aggregate variables. Koopmans (1947), in his critique of measurement in economics, points out the challenges of empirically estimating abstract theoretical constructs, a critique that is quite relevant in the context of r -star. Woodford (2003) and Laubach and Williams (2003) are aware and acknowledge these difficulties in the New Neoclassical Synthesis, asserting that the measurement of r -star is indeed challenging, prone to revisions and errors.

Laubach and Williams (2003) use a Kalman filter approach to account for the unobservable variable; however, imitations like assumptions, linearity, Gaussian noise, and model dependence. Unlike in physics, one estimates a distant star through inference, in economics applied to economics, the variables are not independent starts but have a complex interdependency level. Despite this, and what researchers know are limitations, their work continues to highly reference and shape empirical literature on the natural rate of interest, despite inherent weaknesses and reasonable literature criticism. For instance, Macovei (2015) argued that the use of the Kalman filter can lead to estimation biases and questioned the robustness of the Laubach-Williams estimates.

Wood (2008) questioned the accuracy of empirical estimates of the natural rate and is realistic about the limitations of these measures. If the estimates are in question, it follows that the monetary policy being guided by them is hypothetically suboptimal. His claim is that central banks need to be cautious about relying on such estimates, considering the potential for error and the implications for policy decisions.

1.8 Conclusion

Academic literature that studies and builds on the definitions of the natural rate of interest shows a definitive pattern. ProtoWicksellian natural rate precursors and early old-style Wicksellian literature before the *General Theory* understood the natural rate of interest rests on the micro foundation of entrepreneurial anticipation of yield on newly created capital. In Wicksellian terms, it was the weighing of intertemporal choices as an extension of Böhm-Bawerkian capital theory, which Wicksell discusses is abstractly connected to the supply and demand for real capital. Precisely and succinctly, the natural interest rate on capital is “the real interest of the actual business. A more accurate, though rather abstract, criterion is obtained by thinking of it as the rate which would be determined by supply and demand if real capital were lent in kind without the intervention of money.” (Wicksell 1936: xxiv–xxv).

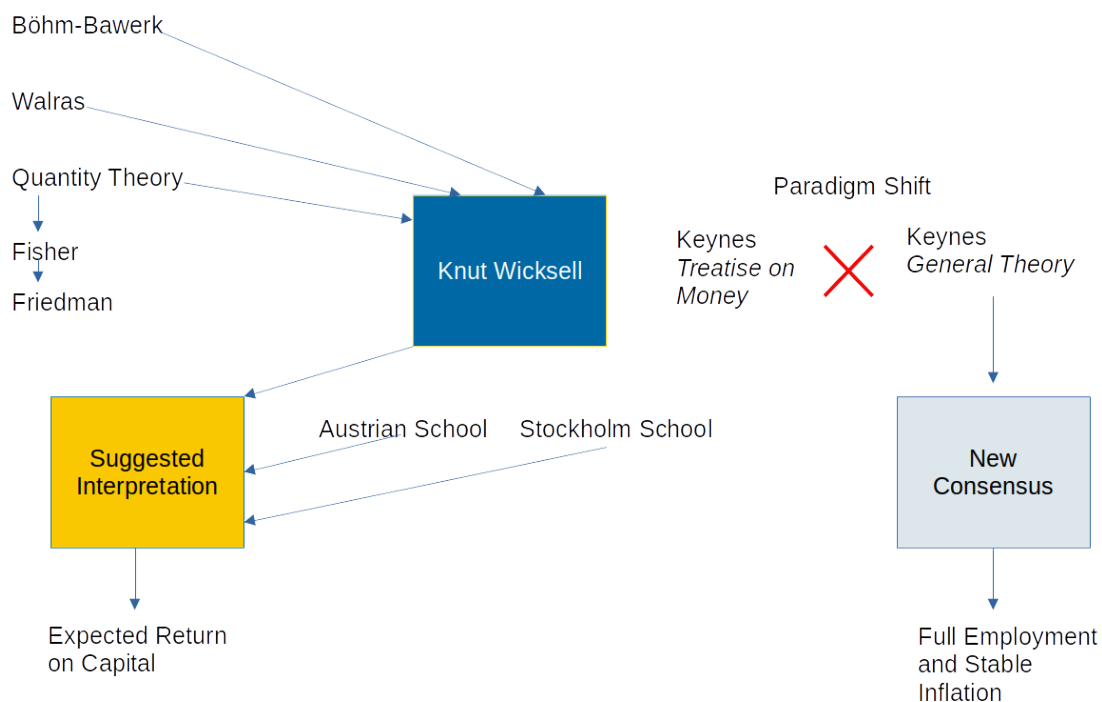
After the *General Theory*, the literature describes a fragment of Wicksell’s theory. It promotes the Wicksellian natural rate of interest as the inflation-stabilizing rate connected to aggregate demand at its full potential. This fragment is the most cited and influential for policy but objectively not Wicksellian. As shown in the evidence presented in this review, it also does not center the micro-foundations of what entrepreneurs expect to earn on newly created real or natural capital considering intertemporal calculations through the production process or central concepts representing the natural rate as the interest rate on capital, the profit rate. In simplest terms, the profit rate is gauged against the bank rate. That is literally, ‘the natural rate of interest on capital’ as interpreted by the New Consensus is not natural as understood by Wicksell, it is not specifically a capital rate, and without the intertemporal micro-foundations, it is not an interest rate, at least as understood by Wicksell. This parallels Voltaire’s commentary on how, at

face value, a term without context (Voltaire & Bruno, 1829) can be a misnomer and lead to subsequent historical misinterpretation.

Therefore, the evidence presented in this review is that the modern consensus understanding is definitionally imprecise based on the primary source documents of Wicksell and Wicksell's contemporaries' elaboration and reiteration of the definition. Modern and influential interpretations do not even consider Wicksell's later writings, including writings on the price level's inverse relationship to productivity. These latter Wicksellian writings break the link between monetary equilibrium and stable prices. Therefore, the New Neoclassical Synthesis representation and claim to the natural rate of interest based on a fragment of the definition and theory backed by this review of the literature and the subsequent empirical evidence in this study is a stark misinterpretation rather than a subtle difference or evolution from Wicksell.

Figure 1.4

Economists interpretation of Wicksell



Source: Own elaboration based on (E. V. Böhm-Bawerk, 2012; Fisher, 1930; Friedman & Schwartz, 2008; Hayek et al., 2008; Keynes, 1930, 1936; Laubach & Williams, 2003; E. R. Lindahl, 1929; Von Mises, 2013; Wicksell, 1936, 2013; Woodford, 2003)

As seen in Figure 1.4, The new consensus definition of what they, specifically by name, call Wicksell's natural rate of interest is more from the *General Theory* of Keynes, the rate "where output and employment are such that the elasticity of employment as a whole is zero" (Keynes, 1936, p. 303), that is "output equaling potential" (Laubach & Williams, 2003, p. 2) and

not based on the essence of Wicksell's interest rate theory, with the micro foundation of the entrepreneur's intertemporal decisions about natural capital, *Natürlicher Kapitalzins* (Wicksell, 1898). Semantically, the linguistics are the same, which further confuses the issue.

In conclusion, it is essential to refer back to primary source documents with systematic and statistical analysis at this time to give academic objectivity and transparency to the issue so economic science can better clarify what Wicksell's theory was conveying.

Moreover, the subsequent conceptual framework will allow theoreticians who lay claims to the Wicksellian foundation to model with conceptual rigor.

What is needed is a robust understanding of the Wicksellian definition in its original form before any empirical exercise. "It is quite wrong to try founding a theory on observable magnitudes alone. In reality, the very opposite happens. It is the theory which decides what we can observe." (Heisenberg, 1988) Despite the use of sophisticated econometric estimation techniques (such as the Kalman filter) in the literature of (Wynne & Zhang, 2018) in the context of general equilibrium models and literature of (DSGE/ FRB/US) (Blanchard & Galí, 2007) that can be used as a generally accepted benchmark for policy (IS + AS + Taylor rule), (Taylor, 1993) (Woodford, 2003), as suggested by (Salerno, 2011) and (Garrison, 2006) and (R. Murphy, 2010) a conceptually rigorous and valuable understanding of the natural rate of interest is ascertained through insights derived from the political economy rather than empirics. In conclusion, this chapter has given non-systematic evidence and support for the sub-hypotheses and supports the thesis: Wicksell's natural rate of interest is definitionally fragmented in academic literature, and new renditions miss the essence of his theory.

Therefore and in conclusion based on this examination in this non-systematic literature review and insights pertaining to the lost Wicksellian connection, there is a need for further, systematic examination with the lens of a statistical analysis in subsequent chapters.

Chapter 2

How Wicksell Defined the Natural Rate of Interest

This section analyzes Wicksell's definition of the natural rate of interest based on his original writings. This investigation further organizes these definitions into distinct conceptual categories.

The aim of this research section is to understand how Wicksell defined the natural rate of interest. The research question is: How did Wicksell define the natural rate, based on all published texts of Wicksell translated into English?

2.1 Methodology

The methodology is a systematic review of primary source research literature with statistical analysis. The descriptive statistics are subsequently analyzed to classify and quantify the methods and ways Wicksell defined the natural rate of interest.

The procedure is as follows. It examines all primary source documents of Wicksell's that were translated into the English language and published. Of the 143 published works of Wicksell in any language, 52 works are published in English if one breaks out and counts the individual works found in compendiums (e.g., *Selected Essays*, *Selected Papers*). 3 unpublished works in English are excluded, as they were not freely available. The compendiums were disaggregated in the count because each is a conceptually unique work written at different times.

The text of each of Wicksell's works was searched using keywords that are connected to a definition of the natural rate of interest. When a word or phrase related to the natural rate of interest was identified within Wicksell's writings, the surrounding text was analyzed. This examination determined whether the context indicated a mere usage of the term or whether it represented a definition or definition-like statement as articulated by Wicksell.

Terms used by Wicksell:

The method employed in this research was a heuristic search instead of a blind search. Specific terms were purposefully chosen with broadness to capture all underlying uses and related concepts. For instance, the particular phrase 'marginal productivity of waiting' was not searched; instead, the broader term 'marginal productivity' was used under the assumption that 'Marginal productivity of waiting' would be encompassed within this broader search. Conversely, the term 'interest' alone was not utilized for searching, as it did not yield additional definitions unless paired with qualifiers like 'natural' or 'normal.' The search process carefully reviewed the following terms, synonyms, and phrases, identifying whether a definition was contained within the paragraph where the search term was mentioned.

Natural rate

Normal rate

Equilibrium rate

Interest on capital

Interest rate

Rate of interest

Rate of return

Real rate

Profit rate

Profit on capital

Surplus profit

Entrepreneurial profit

Expected profit

Profit of entrepreneurs

Marginal productivity

Yield on capital

The rate at which

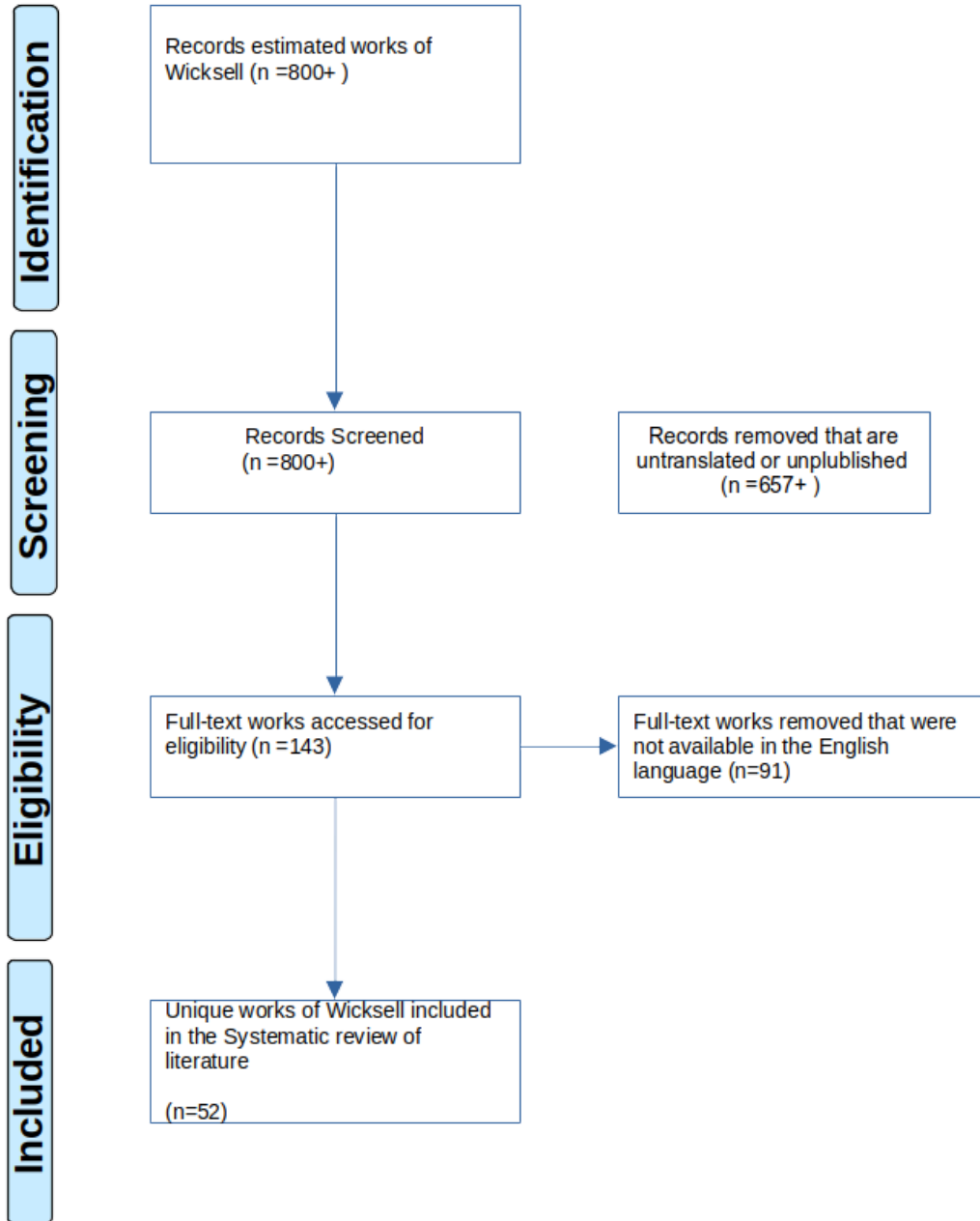
The works of Wicksell were in PDF format, and a search was done using the search functionality of a PDF reader. The greatest latitude was given regarding a definitional

articulation not to exclude anything relevant. That is, the English language translation and sentence structure were examined to determine if the term usage was a definition. Wicksell's definitions that were explicit using a direct nominative case clause were immediately counted and classified. The implicit definitions were similarly counted and classified after confirmation that the articulation was a definition, even, for example, using a roundabout passive grammatical construction without a direct nominative case clause.

When a definition was found and confirmed, it was classified into a corresponding category based on the type of definition. If the classification was one of the categories, then the next definition was analyzed. If the literal definition was not unambiguously classified, then the surrounding text was considered for more context. If the search yielded an ambiguous classification, it was considered if that definition was actually a subset of a broader meaning, as the definitions are conceptual rather than literal. The categories themselves were analyzed to determine if additional categories should be added based on the complete universe of discovered definitions. The classification process also considered if the definition could fit into multiple categories.

Figure 2.1

PRISMA systematic review flow diagram for analysis of Wicksell's natural rate of interest in Wicksell's writings.



Source: Own elaboration

As depicted in Figure 2.1, the initial identification of Wicksell's works was screened for publications available in any language, resulting in 143 works deemed eligible. All texts were full-length and freely accessible. Among these, 91 works were screened for not being in English. 52 works with full text freely available in English were included and forwarded for analysis.

It is essential to recognize that Wicksell expressed the ideas in his writings within the context of economic theory rather than providing textbook dictionary definitions. As a result, the definitions included in this study are situated on a spectrum representing various levels of explicitness in defining terms. Writing during the latter part of the 1800s and the early 1900s, Wicksell did not prepare specific sections for definitions, glossaries, or textbooks. Instead, the essence or meaning of a definition had to be ascertained by understanding his exposition within the broader context of his theoretical framework and the concepts he aimed to communicate. Wicksell's approach to defining terms often involved discussing the interest rate and qualifying it with a phrasal definition. These definitions ranged from explicit to implicit. For instance, Wicksell would articulate a definition and refer to it as the natural interest rate. At other times, he would employ the term within a broader context, such as explaining the interaction and

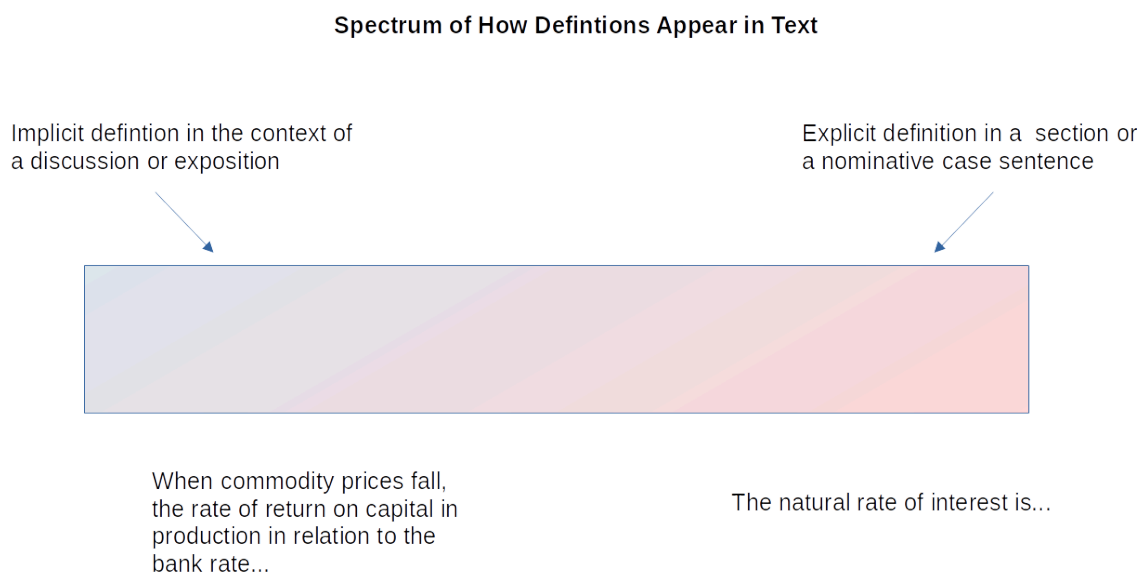
relationship between the money rate and the interest rate, with a qualification adjacent to the expected yield of capital in production, the profit rate, or the rate of return on capital. Within the comprehensive context of his theoretical discourse, it becomes evident that Wicksell often implicitly defined the interest rate to which he referred.

For example, in the context of discussion, the yield on capital in production was the natural rate of interest. This wider range of definitional inclusion is an essential methodological aspect because language interpreted only on a strict literal basis does not represent the essence of a theory.

This is illustrated in Figure 2.2.

Figure 2.2

Qualified forms of definitions in Wicksell



Source: Own elaboration

2.2 Results

Of 52 of Wicksell's works published in English, 21 contained a definition of the natural rate of interest. The result was a count of 60 definitions of the natural rate of interest identified. Of the 60 definitions identified, there were 3 conceptual categories. When Wicksell used one of the search terms like the 'natural rate' or 'normal rate' juxtapositioned in context to a discussion, the definition sense was ascertained and placed into the categories below. The definitional categories used in this study are defined as follows.

Table 2.1

Wicksell's definition of the natural rate of interest in three primary classifications.

Code	Definition
1	Expected yield on the newly created capital
2	Investment equals savings
3	Stable price level

Source: Own elaboration

As seen in Table 2.1 each definitional category gives a numeric identifier for simplicity when displaying the results tables. Category 1 is “the expected yield on the newly created capital”(Wicksell, 2013, p. 193). It includes ideas as “the expected profit rate” and “the real interest of actual business”(Geschäftsgewinne, business profit) (Wicksell, 1936, p. xxv), “the long run by the profit on capital,”(Wicksell, 2013, p. 186) and the “marginal productivity of real capital,”(Wicksell, 1907b, p. 217) as these conceptually refer to the expected yield on newly created mobile capital. Succinctly, the first category is the yield on capital category. Capital with a time dimension as the basis for entrepreneurial action. Regardless of the semantics, it is connected to the expected yield, that is, which entrepreneurs gauge intertemporal choices regarding capital in production on prospective yield.

Category 2 is connected to the ideas connected to Wicksell’s mention of investment and savings equality regarding the natural rate of interest. An example of this conceptual definitional category is the phrase "the rate at which the demand for new capital is exactly covered by simultaneous savings" (Wicksell, 2013, p. 193) or “determined by supply and demand if real capital were lent in kind” (Wicksell, 1936, p.xxv)

Category 3 is connected to the idea that the natural rate is the rate in equilibrium “which is neutral in respect to commodity prices, and tends neither to raise nor to lower them” (Wicksell, 1936, p. 102).

The definitions could be further categorized based on the literal wording or translation. However, such an effort falls within the realm of a semantic discussion. If one organizes each

definitional phrase found in Wicksell's works into a conceptual framework, it becomes evident that the definitions refer back to one of three primary definitions as defined by Wicksell. This section aims to identify the definitions of Wicksell's natural rate of interest in his published English works, as well as to document the frequency of occurrence of this definition within each category. Analyzing the frequency within primary source documents provides insights into how Wicksell utilized and conceptualized the definition of the natural rate of interest.

Time preference is not considered a major definitional category as it is related directly to the microeconomic decisions of entrepreneurial agents making intertemporal decisions regarding the expected yield on newly created capital. Therefore, it is rolled into category 1 as a subcategory. Here, Wicksell makes the connection between the marginal productivity of capital and the marginal productivity of waiting. Wicksell links it here: “We have hitherto considered production, distribution, and exchange as if they were affected without the assistance of money; in other words, as if laborers, landowners, and capitalists received an apportionment of the product in kind—...Interest was regarded as the direct expression of the marginal productivity of real capital itself, as the difference between the marginal productivity of saved and current (present) labor and land, or, more correctly, as the marginal productivity of “waiting”(Wicksell, 2013, p. 5). However, an additional analysis was done with time preference in any regard as it could be debated.

Table 2.2

Wicksell's definition of the natural rate of interest in four primary classifications with time preference bifurcated from the expected yield on newly created capital.

Code	Definition
1	Expected yield on the newly created capital
2	Investment equals savings
3	Stable price level
TP	Time preference

Source: Own elaboration

As depicted in Table 2.2, time preference is categorized separately from Category 1. The fourth category, symbolized by the abbreviation 'TP' for Time Preference, was designated not by a numerical identifier but rather by 'TP.' This differentiation delineates its debatable sub-classification, thereby setting it apart from other core classifications, a concept further discussed in the literature review within this study. For instance, Wicksell states, 'the expected

profit on capital had considerably increased, owing, for example, to technical improvements in production or increased demand for capital (i.e., a general increase in the marginal productivity of waiting)' (Wicksell, 2013, p. 193). The integration of time preference into entrepreneurial expectations and profitability assessments emanates from Wicksell's interpretation, influenced by Böhm-Bawerk's three reasons for positive interest (Garrison, 2006; Böhm-Bawerk, 2012; Wicksell, 1954).

The subsequent section presents the results, with time preference considered as a subcategory of the expected yield on the newly created capital. That is, in this case, the expected profit rate or yield on capital encompasses time preference.

Table 2.3

Wicksell's definition of the natural rate of interest in three primary classifications with the frequency of occurrence in percentage terms for each definitional category.

Definition Type	Percent of Definitions in Each Category
1+TP	78.95%
2	10.53%
3	10.53%

Source: Own elaboration based on the findings in this research

In Table 2.3, the majority of the results fall into the first definition category, termed 'the expected yield on the newly created capital' (Wicksell, 2013, p. 193), constituting a higher percentage compared to the other two categories. Specifically, in Wicksell's writings, the idea or category of 'the expected yield on the newly created capital' is the most frequently mentioned in describing the definition of the natural rate of interest. 78.95% is evidence that objectively shows a predominance of this definition category. Of the 57 definitions found, 45 corresponded to

Category 1. This number is 750% greater than either Category 2 or Category 3, which contained six definitions each. In discussions related to the natural rate of interest on capital, Category 1, which extends the Böhm-Bawerkian conception—as discussed in this study's literature review—exhibits a predominance across Wicksell's published works available in English.

Categories 2 and 3 were notably less prevalent, serving as abstractions from the microfoundation of Category 1. Specifically, Category 2 constituted 10.53%, or 6 definitional occurrences, and Category 3 mirrored this with an identical 10.53% or 6 definitional occurrences.

If time preference is broken out into a separate category, the following are the results.

Table 2.4

Wicksell's definition of the natural rate of interest in four primary classifications with the frequency of occurrence in percentage terms for each definitional category.

Definition Type	Percent of Definitions in Each Category
1	70%
TP	10%
2	10%
3	10%

Source: Own elaboration based on the findings in this research

As evidenced in Table 2.4, even when time preference is considered as an independent category, the most frequently occurring factor is, by a substantial margin, the expected yield on newly created capital. Segregating time preference into a separate category did not alter the ordinal ranking of frequency. Specifically, six of the definitions found in Table 2.3 were allocated to the time preference category, denoted as TP. This resulted in a coincidentally round percentage

data set. The frequency of occurrence for TP is commensurate with Categories 2 and 3 within Wicksell's work. With 42 definitions identified, Category 1 comprised 70% of the 60 definitions, making it the most prevalent. Time preference and Category 2 and Category 3 had 10% each. Each one represents a less important idea than Category 1 in terms of the frequency of definitional mentions.

A number of the definitions were coupled with other definitions; in the same sentence or paragraph, Wicksell described two or three conceptual definitional categories in one paragraph.

An example of this is the first paragraph of Wicksell's *Interest and Prices* Chapter 8: "THERE is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them. This is necessarily the same as the rate of interest which would be determined by supply and demand if no use were made of money and all lending were affected in the form of real capital goods. It comes to much the same thing to describe it as the current value of the natural rate of interest on capital." (Wicksell, 1936, p. 102). Other occurrences of the natural rate of interest in Wicksell's works were singular definitions in a paragraph. However, each occurrence was considered unique whether it occurred intermingled with other renditions or apart.

The results of the breakout are as follows.

Table 2.5

Wicksell's definition of the natural rate of interest in three primary classifications with the frequency of occurrence in percentage terms for each definitional category, with a category for multiple definitions in one paragraph.

Definition Type	Percent of Definitions in Each Category
1+TP alone	76.09%
2 alone	4.35%
3 alone	0%
Multiple in one paragraph	19.57%

Source: Own elaboration based on the findings in this research

As seen in table 2.5 the data shows a predominance in category 1. As a singular idea, Wicksell articulated the natural rate of interest in terms of the expected yield on capital. It

consistently shows a result that is substantially higher than the other categories. Category 3, which is the neutral price category, does not appear alone in any rendition, and category 3, the investment savings equality, had fewer results alone. As discussed in the review of literature, these were abstractions of Category 1 and were found together and separate from Category 1.

Similar results are observed if you break out time preference into a separate category.

Table 2.6

Wicksell's definition of the natural rate of interest in four primary classifications with the frequency of occurrence in percentage terms for each definitional category, with a category for multiple definitions in one paragraph.

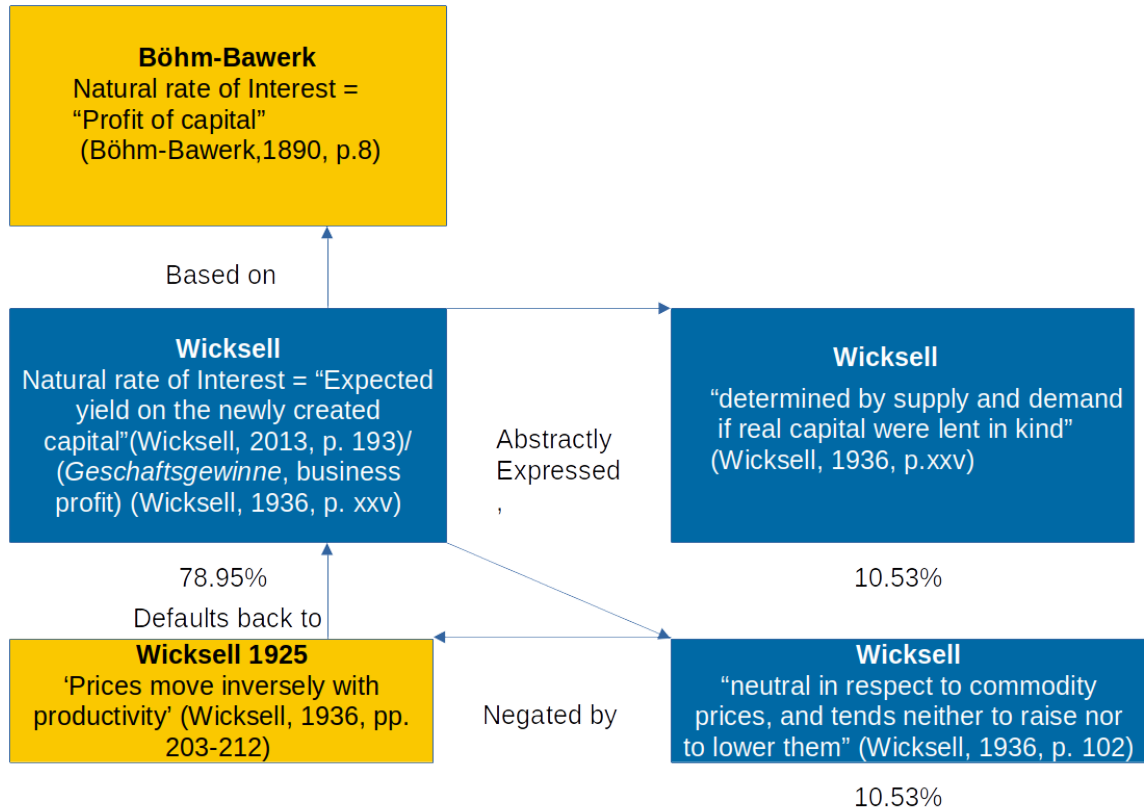
Definition Type	Percent of Definitions in Each Category
1 alone	65.96%
TP alone	4.26%
2 alone	4.26%
3 alone	0%
Multiple in one paragraph	25.33%

Source: Own elaboration based on the findings in this research

Table 2.6 aligns with other findings, demonstrating that Wicksell's conception of the natural rate of interest was predicated, by a considerable margin, on the expected yield of newly created capital. In both instances, 15.63% of the definitions occurred adjacent to another definition. In all iterations of data representation, category 1 was the most frequent occurrence.

The barter aspect within Wicksell's definitions was not identified as a separate definition but rather functioned as a supporting complement to the theory that the natural and monetary worlds are two distinct universes, with the natural rate serving as the unifier. This concept of barter exchange ratios, or the *in natura* component, appeared three times within the context of Wicksell's definitions. Wicksell elucidated the barter exchange ratio in relation to each category: specifically, once within the same paragraph as Categories 1 and 2, once alongside Category 1 and TP, and once in adjacency to Categories 2 and 3.

Figure 2.3



Source: Own elaboration based on the findings in this research

As depicted in Figure 2.3, the principal reference to the meaning of the natural rate of interest is associated with the micro foundation of expected return on capital. This had 45 of the 57 definitions, or 78.95 %, Wicksell proposed. This aligns with the broader context of the

cumulative process theory, where entrepreneurial decisions are measured against loan rates of interest. The other two interpretations presented are abstract representations of the microeconomic foundation, with 10.53% or 6 in each category of the 57 definitions Wicksell mentioned.

2.3 Discussion

The research problem is that no studies to date analyze all of Wicksell's English-published works for the frequency of definitional renditions of the natural rate of interest and, consequently, no quantitative primary source research regarding how Wicksell defined the natural rate of interest. This quantification of primary source documents is essential to bring objectivity and transparency to Wicksell's definition of the natural rate of interest. The research question is 'how Wicksell defined the natural rate, based on all published texts of Wicksell translated into English?' The goal is to use primary source documents of Wicksell to categorize and quantify Wicksell's definition of the natural rate of interest in his writing. This section identifies the definitions of Wicksell's natural interest rate in his published English works and the statistical frequency of occurrence of this definition in each category. The frequency found in primary source documents gives an indication of how Wicksell used and understood the definition of the natural rate of interest.

This section used a mixed methodology. It used qualitative and quantitative techniques—specifically, a systematic review of qualitative material analyzed based on descriptive statistics. The content analysis was undertaken to determine how Wicksell defined

the natural interest rate and what percentage of times Wicksell used a particular definitional rendition.

To summarize the main finding, Wicksell most frequently defined the natural rate of interest as "expected yield on the newly created capital" or a conceptually equivalent phrase.

The data parsing resulted in three conceptual categories, with Wicksell broadly defining the natural rate in three ways. Wicksell considered each rendition essentially the same.

1. The expected yield on the newly created capital.
2. The rate that brings equality between investments equals savings.
3. The rate that manifests a stable aggregate price level.

These conceptual categories correspond with the early Swedish Wicksellians such as Erik Lindahl and are supported with historical precedence. Lindahl writes, "According to Wicksell, the "normal" rate has three characteristics: (1) it corresponds to the natural or—as it was later called—the real rate of interest; (2) it establishes an equilibrium between the demand for and the supply of saving, and (3) it is neutral in relation to the price level—whereas a rate of interest above or below "normal" will influence the price level in a downward or upward direction" (E. Lindahl, 2016, p. 246).

Theoretically, the definition could be broken out into more refined categories based on the literal wording or translation, but that is semantical rather than conceptual. However, if one

organizes each definitional phrase found in Wicksell into a conceptual framework, the definitions refer back to one of the above three definitions of Wicksell.

Statistically, the data shows the majority of Wicksell's own reference to the natural rate of interest on capital 80% is from the category the 'expected yield on newly created capital,' which in its analogous or closely related form is expressed as the expected profit rate based on the marginal productivity of capital, which in longer form, is the expected real rate of return on natural mobile capital which embodies the intertemporal preferences of microeconomic agents. 80% based on a simple frequency calculation is statistically significant when compared to the other two renditions of 10% for the investment equals savings and 10% for the stable price level. The data gives strong support to the premise that Wicksell was writing about capital's expected yield from an entrepreneurial microeconomic basis, at least based on frequency in this writing.

This result is consistent with the definition of the early Swedish Economists from the Stockholm School and their understanding of the capital rate, "the hallmark of old-style Wicksellian theory... the "capital rate" (i.e., the expected rate of return to real investment)" (Boianovsky & Trautwein, 2006, p. 177). These early Swedes knew Wicksell and read Wicksell's words untranslated. Similarly, subsequent scholars who focus on the history of economic thought, such as Carl Uhr's understanding of Wicksell's rate as the "marginal productivity of real capital"(Uhr, 1960, p. 227) or Joseph Salerno's "the expected rate of return on investment... affected by entrepreneurial decisions about the allocation of resources among consumer goods and capital goods industries based on anticipations of these preferences (Salerno, 2016, p. 1)", as discussed in this study's review of the literature. That is, the statistical

result is consistent with the conclusions from the literature review. Even if ‘time preference’ is treated as a separate category, the relative frequency of the ‘expected yield on capital’ is 70.49%.

At times, Wicksell mentioned more than one categorical rendition in the same sentence paragraph or even sentence. The data shows that 18.37% of the time, two or three definitions were mentioned in the same paragraph. However, this did not change the predominance of the first category if the counting was taken from this perspective, as the result is 75.51%. Wicksell would theoretically connect the definitions. His definitional thinking was a whole theory; each rendition connected to the other rather than an exclusive fragment. However, based on the evidence presented, he did not weigh each rendition the same in his thinking process; one was a foundation.

When the 78.95% result from the ‘expected yield on capital’ is contrasted with the following two categories, the results of ‘savings equals investment 10.53 %’, and ‘stable prices ‘10.53 %’, this further highlights the statistical difference. That is, the differential spread is large and provides strong evidence that Wicksell was thinking in terms of this microeconomic foundation across the totality of his writings. That is, entrepreneurs measure their expected return on capital against a loan or bank rate when making decisions regarding capital. The other two renditions are logical consequences of the microeconomic action as they are aggregate concepts.

This is a clear and noteworthy difference from the single definition given by modern consensus authors of ‘stable prices’ or ‘stable inflation’ (Woodford, 2013) and (Holston et al., 2017). Objectively, the stable *price level* definition of Wicksell (which is subtly not the same as

stable *prices/stable inflation*) is only a fraction of Wicksell's own reference, which is 10.53%. When one compares 78.95% of the 'expected yield on capital' to 10.53% of the stable price level, it is a multiple of 7.5 or 750% more mentions of the "expected yield on capital' than the 'stable price level' rendition, according to Wicksell's primary source documents published in English. Even though, conceptually, Wicksell did not say 'stable inflation,' if the consensus 'stable inflation' is accepted as the same as 'stable price level,' this is a fragment of Wicksell's understanding as shown by this writing. This fragment is out of the context of the totality of Wicksell's theory and transformed into a simplistic axiomatic policy recommendation; however, it is not based on presented factual data relating to an in-depth study of Wicksell's primary source documents. The data provide reasonably convincing evidence that the definition as represented today (as shown in Chapter 3 of this study) or by highly cited consensus writers (as shown in Chapter 4 of this study) is not aligned with Wicksell. They use their own interpretation of a fragment of his definition from a fragment of his works.

The general picture emerging from the analysis is that Wicksell's definition of the natural rate of interest is misrepresented or misinterpreted today based on this section of the study's data. It is the first piece of evidence, which will be extended in subsequent chapters. It supports the validity of this paper's thesis, claiming that new renditions present a fragment of the definition of the natural rate of interest and miss the essence of Wicksell's theory. A central premise here is that this is not a measure of different points of view academics have, but rather, primary source research, the completeness of research of Wicksell's definitions. In order to develop a point of view and extend Wicksellian theory, the starting point needs to be an objective evaluation of what Wicksell wrote before one can critique or extend it. A diversity of points of view in

academia is a celebrated norm. However, this study is to examine factual data around the starting point. Factual data is supported by concrete evidence systematically and scientifically. Therefore, the reader is cautioned not to see the array of definitions as simply different vantage points but as instead as a gauge of the fractures of our view of the original definition and completeness of the retrospective data points of Wicksell's original theory transmitted to the current understanding. Without a complete set of data, primary source data, any scientific interpretation can be lacking. Wicksell's multiplicity of theoretical angles on the natural rate of interest conveys a theory that is broader and deeper than a simple a singular formulation.

The impact of this insight is that monetary theory and policy that lays claims to the Wicksellian theoretical foundation is in question if consensus writers are not aligned with Wicksell's primary source understanding of the definition of the natural rate of interest on capital. Reliance on a fragment or a simple axiomatic formula such as 'stable inflation' or 'stable prices' might not be optimal because Wicksell's theory is theoretically richer and deeper. With Wicksell's depth of theory and understanding, some scenarios come into play that are micro and macro dynamic, such as the impact of a new wave of technological innovation, and a fresh revision of the totality of Wicksell's natural theory is in order.

A limitation of this study is that Wicksell's untranslated and unpublished writings, which reside at Lund University in Sweden, remain unexplored.

To date, these documents have not been systematically examined. This current study is related only to the universe of published and English-language translation works.

Further, the English language translations are from the early part of the previous century, and some linguistic interpretations might be in question. Therefore, a revisitation of these untranslated works might be a worthy study. Another limitation of this study is the classification of definitions into categories. Although most of Wicksell's definitional pronouncements were clear since this is a qualitative analysis that was transformed into quantitative data, there hypothetically could be some subjectivity or even subconscious or unintentional author bias in the process of classification.

Further, frequency of occurrence is only one measure of weight when measuring the significance of an idea.

The classification of the definitions or what constitutes a definition can be further explored. The objective of the research is to take the essence rather than a literal definition. However, subsequent research might reclassify or exclude some of the data as inherent in language is subjectivity, especially when working with translated texts.

Based on the data, further research and investigation into the theory of Wicksell's definition is essential. The impact of a more transparent, more definitive understanding of Wicksell's natural rate of interest based on primary source documents, including unpublished and untranslated, is essential for the history of economic thought as well as current theory and policy. A more accurate representation of ideas can be obtained with a more in-depth investigation into these primary source documents. A particular emphasis on Wicksell's latter writings and thoughts and potentially any ideas to revise his theory relating to stable prices would be of particular importance. The impact would be if the current paradigm of understanding regarding

the Wicksellian natural rate of interest were to shift, new models and insights could be conceptualized that would be useful for macro policy and central bank action. This chapter answered the research question and the evidence supports the sub-hypothesis: Wicksell primarily defined the natural rate of interest as the expected yield on newly created capital, which was the micro foundation for the rate of interest that equates investment to savings and maintains a neutral price level.

Chapter 3

How Academic Literature Defines the Natural Rate of Interest

This chapter analyzes academic literature that discusses Wicksell's natural rate of interest. This investigation uses the conceptual definitional categories in Chapter 2 to further assess the degree of fragmentation in the academic literature's definition of the natural rate of interest.

The aim of this research section is to objectively determine if academic literature presents a fragmented definitional analysis of the natural rate of interest of Knut Wicksell. The research question is, do academic writers fragment their presentation of Wicksell's natural rate of interest, and if so, how? This question specifically includes the subcomponents of how completely does academic literature defines the natural rate of interest, how well cited is this definition with reference to Wicksell's primary source documents, and how fragmented is the definition in the presentation.

3.1 Methodology

The methodology in this study is a systematic review of literature with statistical analysis. That is, it is a mixed methodology, combining qualitative and quantitative tools in the investigation. The research design involves identifying the sample study and analyzing it quantitatively based on the degree of fragmentation.

The procedure is as follows: This study qualifies the types of fragmentation below. Then, it conducts a literature database search based on the criteria outlined below. Then, it analyzes the results based on the fragmentation types, measuring the results with descriptive statistics.

Defining Fragmentation in Research

The term fragmented in this study has three similar but distinct meanings.

1. **Definitional Fragmentation** -The authors only cite a fragment of Wicksell's definition on the natural rate of interest. That is, there are multiple renditions and quotes found in primary source documents of Wicksell that give evidence to his understanding of the definition of the natural rate of interest as a whole. A definitional fragment is a reference to one or more components of that definition, however, omitting other conceptual components. Therefore, only a fragment of Wicksell's definition is discussed in the literature.
2. **Reference Fragmentation** - The issue is that authors writing about Wicksell's natural rate of interest cite, in most cases, a fragment of Wicksell's works. This fragmented approach can result or lead to a lack of awareness and potential misinterpretation within academic writing regarding the true nature of the natural rate of interest. The focus on secondary sources rather than primary source data when studying historical economists is becoming increasingly prevalent due to the ease of using secondary sources in academic databases, the archaic and roundabout language of historical texts, the recognition and high citation score of secondary sources even compared to original authors, and the general accessibility of modern secondary sources compared to older original texts. In economics, modern economists tend to rely on secondary sources. This practice may neglect and misinterpret the original materials exponentially. Reliance on these secondary sources can lead to misunderstandings and misinterpretations that are subsequently built

on by others referring to the new work built on secondary sources, similar to the well-known phenomenon of the 'telephone game.' As definitions and understanding are removed with each nth degree from primary sources by iterations of secondary sources upon secondary sources, the potential for distortion grows. This is a cumulative process unto itself, which generates conclusions that may diverge significantly from the original context and meaning. That is why, to maintain scientific objectivity, it is important to critically evaluate the sources, that is, secondary or primary, and the completeness of the primary sources for looking at potential implications for academic scientific research. This study, and the above point, does not even consider Wicksell's non-English sources, which is both a limitation and a point for further research.

3. **Presentation Fragmentation** - The authors present the definition of the natural rate of interest in their works in a fragmented way. Primary presentation fragmentation is defined as authors presenting the definition not in the first 25% of the paper but somewhere after; for example, the first definition would be presented 50% into their work and not have a separate definitions section. This means that the author might present the definition 50% into the paper, but this would not be fragmented if it were contained in a separate definitions section. Therefore, if a paper is about the natural rate of interest but does not define it at the start of the discussion or a demarcated definition section, the readers can misunderstand the intended meaning or definition. Further, presentation fragmentation can come in the form of non-contiguous fragmentation. Another way a definition can be qualified as fragmented in presentation is that the writer will define it in one way in one section of the paper and define it in another way in another section of the

paper. An example of non-contiguous presentation fragmentation is in the paper's first section; they may refer to the natural interest rate as the expected profit rate. Then, without reference to this initial definition, further into the paper, they write about the natural rate as the rate that creates aggregate price stability. This presentation can lead to misinterpretations or confusion when reading the article, especially since scanning or skimming scholarly journals is common among researchers.

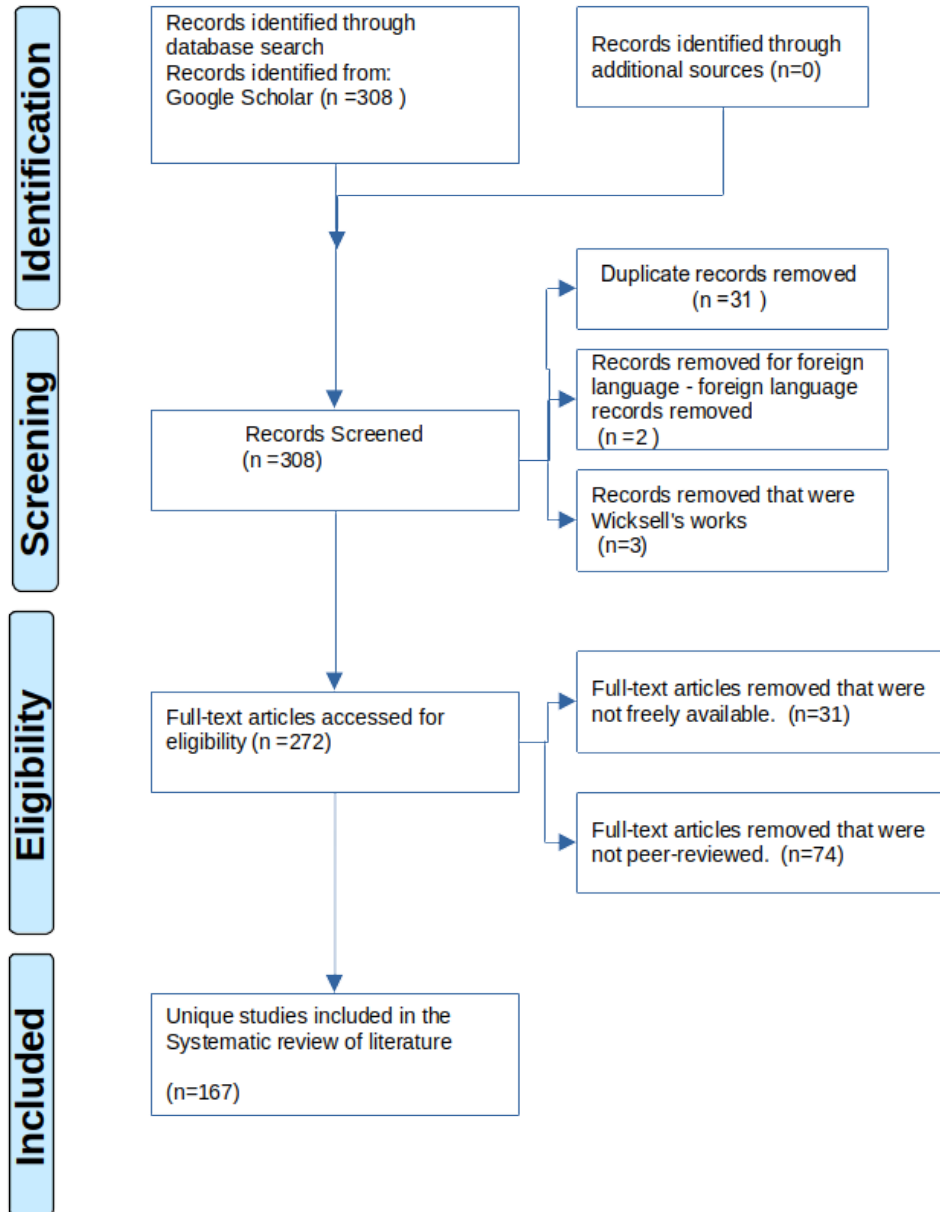
The Approach

The approach used in this paper is a systematic literature review. A general literature review can emphasize a particular theoretical line and risk being partial in an analysis. In contrast, a systematic literature review maintains objectivity based on the parameters and selection criteria. Therefore, a systematic review of the literature is more appropriate in this context. Additionally, this study is a qualitative comparison based on a history of economic thought; however, quantitative methods are employed, using statistical analysis of the results.

Specifically, this study uses a systematic review of literature for a definitional analysis of the natural rate of interest by comparing text from Wicksell's actual writing and relating it to subsequent interpretations in the academic literature. Results are displayed as percentages of correspondence in that comparison.

Figure 3.1

PRISMA systematic review flow diagram for analysis of Wicksell's natural rate of interest in academic literature



Source: Own elaboration

As illustrated in Figure 3.1, a PRISMA diagram of the systematic review process, 167 works were finalized for analysis. In the initial identification step, 308 records were carried forward. Owing to the interest in Wicksell, there were significantly more records that could have been analyzed in deeper pages of Google Scholar. However, at the time of the research, a cut-off point was determined where citations or influence diminished to zero, resulting in 308 records in the initial identification step. A screening was conducted to remove duplicates, foreign language works, and works by Wicksell. Duplicates were often published articles that were also released as working papers but appeared separately in the Google database. After these screenings, 272 records were passed to the next section.

Further screening was performed for peer review considerations, and those not freely available were excluded. Ultimately, 167 works were selected as the results to be analyzed in this study. This process is elaborated on below.

Search Tool

The academic search tool used in this study was Google Scholar. Google Scholar has the highest scholarly work count in its index of any index in the world at the current time. The Google Scholar search algorithm is refined based on similar methods from Google Search, such as page rank and other quality checks. This study also considered EconBiz, EconLit, Research Papers in Economics (RePEc), and Microsoft Academic (discontinued), with the applicable keyword string for the natural rate of interest. However, after comparing results to Google Scholar, other search tools and economic databases did not provide significant differences in the pool of scholarly articles about Wicksell's natural interest rate. There were few differences partially because of the high number of articles chosen to analyze. Therefore, this study used Google Scholar alone.

Search Terms

The search string used was:

Wicksell AND ("natural rate of interest" OR "natural capital rate of interest" OR "real rate of interest" OR "normal rate of interest" OR "equilibrium rate of interest" OR "in natura rate of interest" OR "neutral rate of interest" OR "r-star")

The search terms are the primary descriptors of the natural rate of literature. They come from two sources: Wicksell and subsequent literature.

Terms used by Wicksell:

"natural rate of interest" ()

"natural capital rate of interest" ()

"real rate of interest" ()

"normal rate of interest" ()

"equilibrium rate of interest" ()

Terms used after Wicksell:

"in natura rate of interest" ()

"neutral rate of interest" ()

"r-star" ()

The search used the term "Wicksell" coupled with the "natural rate of interest" or another search term for the natural rate of interest, as, without the inclusion of the term "Wicksell," the algorithm produced less relevant results with a duplecity of meanings of various terms that refers to the interest rate in economic literature. For example, the "real rate of interest" could refer to Irving Fisher's "real rate of interest".

Although the terms "natural rate" or "normal rate," without the phrase "of interest," are abbreviations for the natural rate of interest, the inclusion of the phrase "of interest" was necessary because the search algorithm resulted in non-relevant results if omitted. For example, the term "natural rate" alone would return results focused on the natural rate of unemployment.

This might be tangentially related to the natural rate of interest, but that was not the primary focus of this research.

"*in natura* rate of interest" - "*in natura*" is the Latin term for in nature or, in this context, without the influence of money. It is a term Ludwig Von Mises, and others used to refer to the natural rate of interest, a rate "if the real capital were lent *in natura* without the mediation of money" (Von Mises, 2013, pp. 306–307). The term conveys that Wicksell's natural rate of interest operates in a world of barter exchange ratios and, therefore, is a "natural" rate of interest. It captures the idea in one of Wicksell's initial renditions, "if no use were made of money and all lending were affected in the form of real capital goods (Wicksell, 1936, p. 102)

"neutral rate of interest" - This term can refer to the natural rate of interest of Wicksell or the neutral rate of interest of Keynes.

"r-star" - This term refers to the empirical proxy for the natural rate of interest.

The algorithm captures any existing ancillary terms, referring to the Wicksellian natural rate of interest as Google Scholar understands synonyms and the general idea.

The Inclusion Criteria

This study used the first 308 database results. After 308 results, the citation count and relevancy declined. Of the 308 results, only works that fulfill the following criteria were included.

1. Peer-reviewed

2. English language

3. Full access

This study identified 167 results after being screened for the above inclusion criteria. These 167 academic works fulfilled the inclusion criteria papers were taken forward into the analysis.

3.2 Results

This section presents the results that identify the degree academic literature presents a fragmented representation of Wicksell's natural interest rate supported with quantitative data. This review investigated three components of fragmentation. The section will address whether academic works are fragmented in the following ways.

1. **Definitional fragmentation:** if authors cite only a fragment of Wicksell's definition
2. **Reference fragmentation:** if authors only cite a fragment of Wicksell's works
3. **Presentation fragmentation:** if authors present the definition after 25% of the paper and not demarcated in a definition section or the author presents several definitions in a non-contiguous

3.2.1 Definitional Fragmentation

The baseline used to compare the completeness of Wicksell's definition of the natural rate of interest was the three definitions stated by Wicksell, additionally if the author mentioned Wicksell's barter aspect of the definition of the natural rate. According to Wicksell, each of the

three definitions of the natural rate of interest "is necessarily the same rate of interest" (Interest and Prices, p.188). However, when Wicksell wrote, *Interest and Prices*, the absence of the barter or *in natura* component of the natural rate of interest would not be the same rate. That is, the in-kind aspect of the natural rate was integral.

The importance of presenting each of the three definitions is that although the rate is the same, according to Wicksell, they mean different things theoretically and practically. The barter or *in natura* aspect also has significant theoretical and practical implications. The *in natura* line was developed by the Austrian School of Economics, contrasting the Keynesian and New Keynesian paradigms. Therefore, it was given as a breakout of its own.

Also examined is whether an academic work gave a new definition of the natural rate of interest, a new rendition, not specifically Wicksellian, laying claims to the Wicksellian theoretical lineage.

The short codes used in the analysis were as follows:

Table 3.1

Wicksell's definition of the natural rate of interest in three primary classifications and one additional category for authors that suggest a new definitional rendition.

Code	Definition
------	------------

0	No definition
1	Expected yield on the newly created capital
2	Investment equals savings
3	Stable price level
5	New definition

Source: Own elaboration

Code 5 was used instead of 4 to clearly demarcate that it was explicitly not a definition from Wicksell but a new definition that claimed to emulate a modern version of Wicksell's natural rate of interest.

To reiterate, the objective here is to help answer the question of 'Does academic literature cite only a fragment of Wicksell's original definition?' through an examination of the data. Therefore, it is essential to note that the results are given from an array of vantage points to determine better or illustrate the diffusion of the distribution found in academic literature.

The following data tables show the results of the systematic review of the literature.

The first table shows the breakdown of the definitions found in the 167 papers analyzed. The table shows all papers analyzed and how they contain multiple definitions. Further broken out was if the paper mentioned the barter or *in natura* aspect of Wicksell's definition.

Table 3.2

Wicksell's definition of the natural rate of interest across academic literature by percentages is based on the frequency of occurrence in each category, as defined above in Table 3.1, with a breakout for barter conception included or excluded.

Definition Type			
Found	Total	Barter	No barter
0	31.14%	0.60%	30.54%
1	8.38%	0.60%	7.78%
2	11.38%	2.99%	8.38%
3	2.40%	0.00%	2.40%
5	14.37%	0.00%	14.37%
1,2	8.38%	3.59%	4.79%
1,3	1.80%	0.00%	1.80%
1,2,3	13.17%	8.38%	4.79%

1,2,3,5	1.20%	0.00%	1.20%
2,3	3.59%	1.20%	2.40%
1,5	0.60%	0.00%	0.60%
2,5	1.20%	0.00%	1.20%
3,5	1.80%	0.00%	1.80%
1,2,5	0.00%	0.00%	0.00%
1,3,5	0.60%	0.00%	0.60%
Total	100.00%	17.37%	82.63%

Source: Own elaboration based on the findings in this research

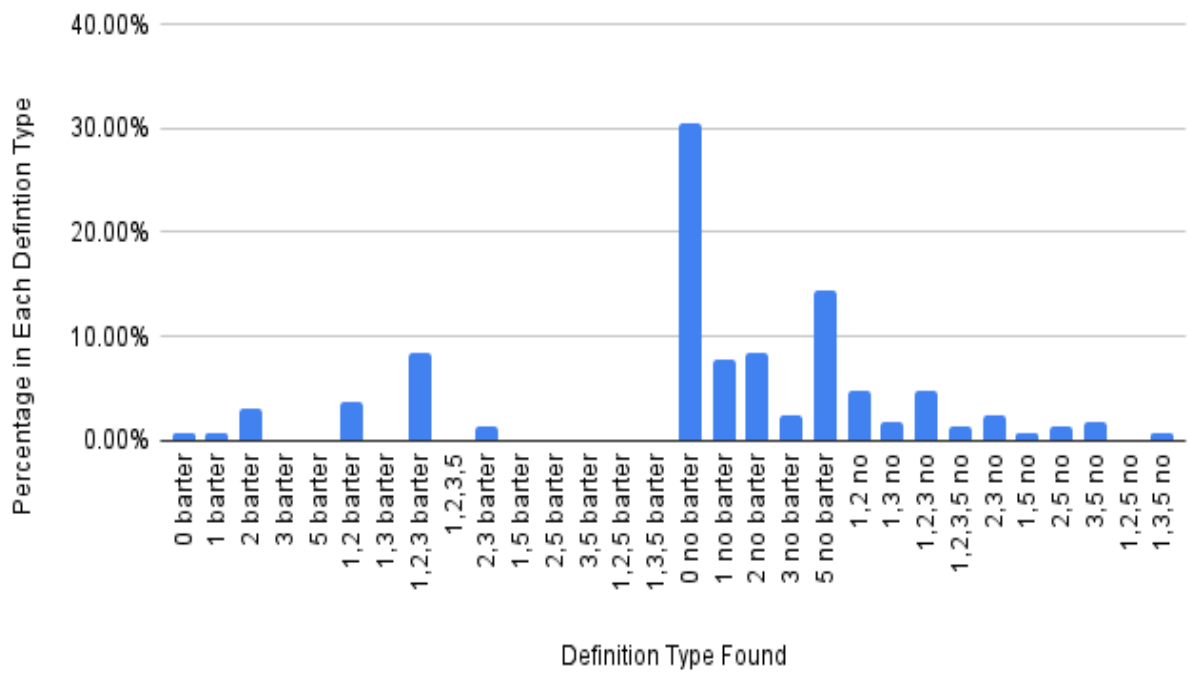
The above table, Table 3.2, shows that there is no predominant way in which academic literature defines the natural rate when referencing Wicksell or creating a new definition. The fragments of definitions academic writers chose are diverse. There are 30 unique interactions with the breakout between the barter and no barter component broken out. The largest category, or highest mode in the above table, is the authors who wrote about the natural rate of interest of Wicksell but did not present any definition.

The following is the graphical representation of the complete data.

Figure 3.2

How authors in academic literature defined the natural rate of interest - a visual representation.

How Authors Defined Wicksell's Natural Rate of Interest



Source: Own elaboration based on the findings in this research

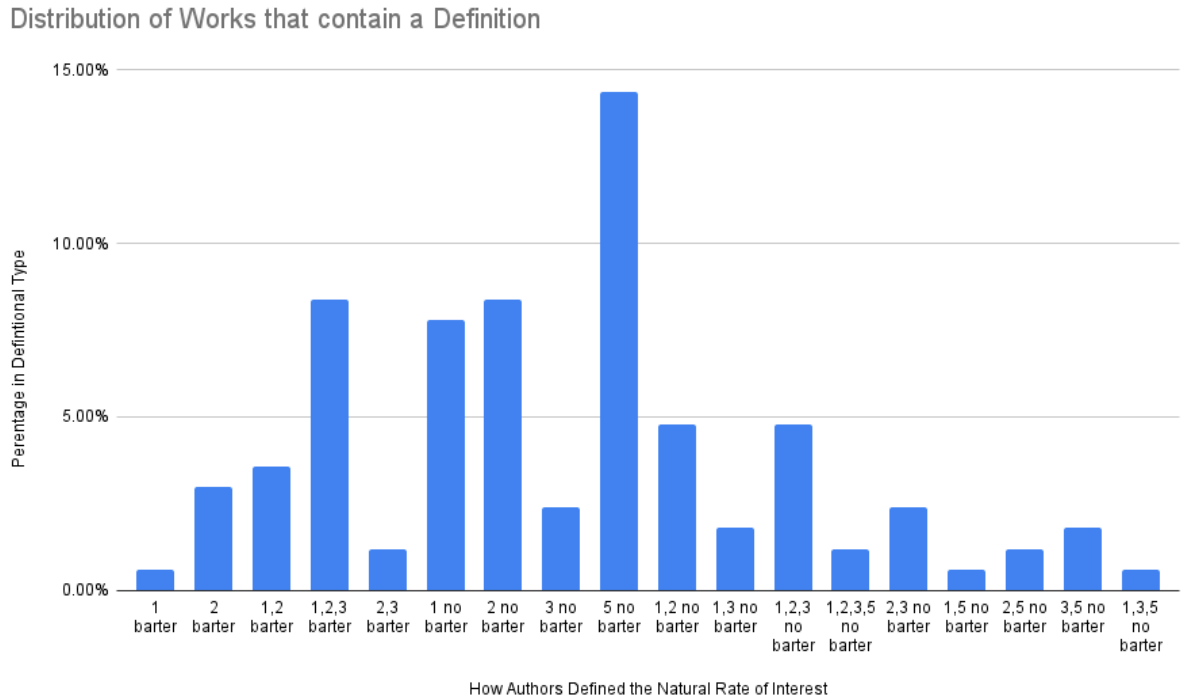
Figure 3.2 shows that the no definition and no barter was the highest categorical observation. The second highest category is no definition of Wicksell but a new definition of Wicksell's natural rate of interest, also with no mention of the barter idea in Wicksell. To clarify, in the codes mentioned above, 0 is no definition, 1 is a definition of the expected profit rate, 2 is I=S, 3 is a neutral price level, and 5 is a new definition that is not in Wicksell. Also, there is no mention of the barter economy of Wicksell and barter means it does contain this. The results show that 30% contained no definition at all, and most of the other works contained fragments of Wicksell as displayed by a combination of the codes.

The graphical representation of the 167 papers analyzed above shows that the only dominant definitional categories are “no definition” and “5 no barter”, which does not reference Wicksell's natural rate of interest.

All other occurrences of the definition are under 10%. Of the 18 iterations of the papers that tried to define the natural rate of interest with reference to Wicksell, the highest percentage was 8.38%.

Figure 3.3

Distribution of occurrence of definitions in the academic literature by classification categories that contain ‘some’ definitions.



Source: Own elaboration based on the findings in this research

That is, the above Figure 3.3 shows a distribution if you filter out the categories that did not contain any definition of the natural rate of interest. It includes works that redefined the natural rate and those that redefined and did not reference Wicksell’s original definition.

Objectively, it is not the complete picture of the no-definition category that is excluded, but the objective here is to examine fragmentation in the results.

The most significant part of this data is that 167 academic works analyzed the economists that proposed a new rendition of Wicksell’s natural rate of interest; 0.0% contained all three definitions of Wicksell and mentioned the barter aspect of Wicksell's theory. This is a measure of completeness and fragmentation. All academic literature studied that presented a new rendition of Wicksell was fragmented when referencing Wicksell’s natural rate of interest.

Table 3.3

Percentages of works in academic literature for those that contained all three categorical definitions of Wicksell with a comparison to those that suggested new renditions

Definition type Found	Total	Barter	No barter
1,2,3	13.17%	8.38%	4.79%
1,2,3,5	1.20%	0.00%	1.20%
Total	14.37%	8.38%	5.99%

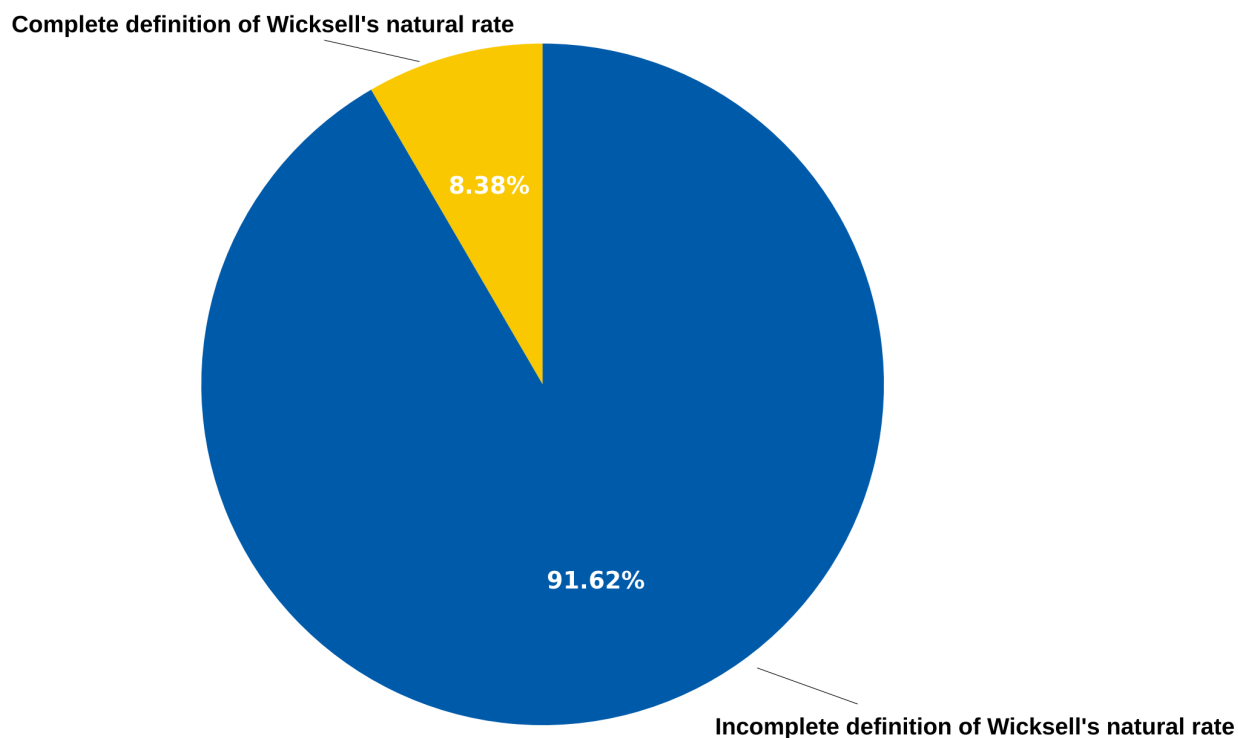
No definition=0, 1=Expected yield on the newly created capital, 2=Investment equals savings,3=Stable price level,5=New definition

Source: Own elaboration based on the findings in this research

As seen in Table 3.3 works that suggested new renditions of the natural rate of interest had a low percentage that showed a complete understanding or articulation of Wicksell's definitions. The academic works that contained all three of Wicksell's definitions of the natural rate of interest and included mentioned or discussed Wicksell's idea of a barter economy as part of the definitional discussion it was 8.38%. Therefore, 8.38% gave a full definition discussion of the Wicksellian natural rate of interest.

Figure 3.4

Paper that contains all categorical representations of the definitions



Source: Own elaboration based on the findings in this research

Figure 3.4 shows academic literature has an incomplete presentation of Wicksell's definition of the natural rate of interest. This is significant as coupled with other fragmentation, it has cumulative fragmentation.

14.37% mentioned all three definitions. However, without being coupled with a mention or discussion of the barter or *in natura* component of Wicksell's definition, it is absent of

complete theoretical discussion. Instead, it frequently appears as a list or a singular quote to encompass the three definitions, not a theoretical discussion.

The following result shows that 31.14% did not include any definition of Wicksell, with one source mentioning Wicksell's barter exchange ratio idea without defining the natural rate of interest.

Table 3.4

Academic works on Wicksell wrote about the natural rate of interest but contained no definitions.

Definition type Found	Total	Barter	No barter
0	31.14%	0.60%	30.54%

Source: Own elaboration based on the findings in this research

As seen in Table 3.4, 31.14% discussed Wicksell's natural rate of interest without defining it.

The data also shows that of the 167 academic works, only 17% mentioned Wicksell's idea of a barter economy connected to the natural rate of interest.

Table 3.5

Authors that mentioned the barter conception of Wicksell compared to those who did not.

Definition type Found	Total	Barter	No barter
Total	100.0%	17.37%	82.63%

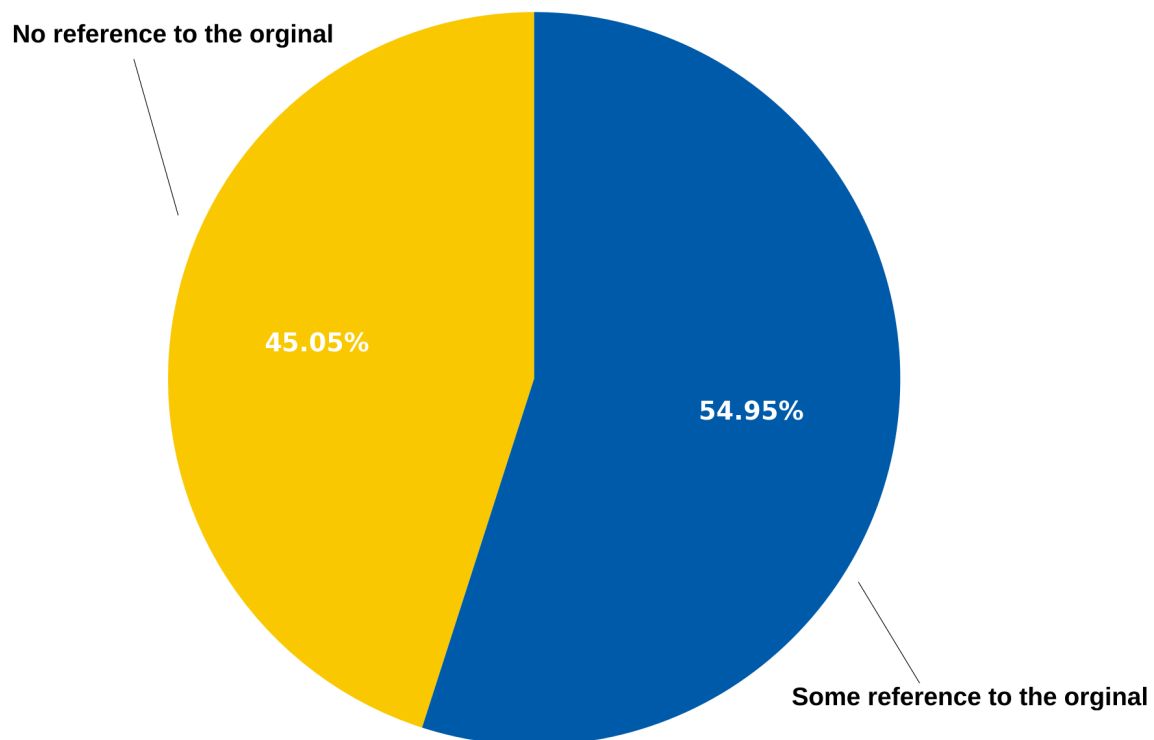
Source: Own elaboration based on the findings in this research

Table 3.5 shows most authors did not mention Wicksell's barter or natural interest conception articulated in his *Interest and Prices*.

Filtering out any category of no definition and the category that redefined the natural rate without reference to Wicksell's original definition, only 54.5% of the papers contained any reference to Wicksell's original definition. In this distribution, there is no predominant category.

Figure 3.5

Wicksell's definitions have no reference compared to some references to the original definition



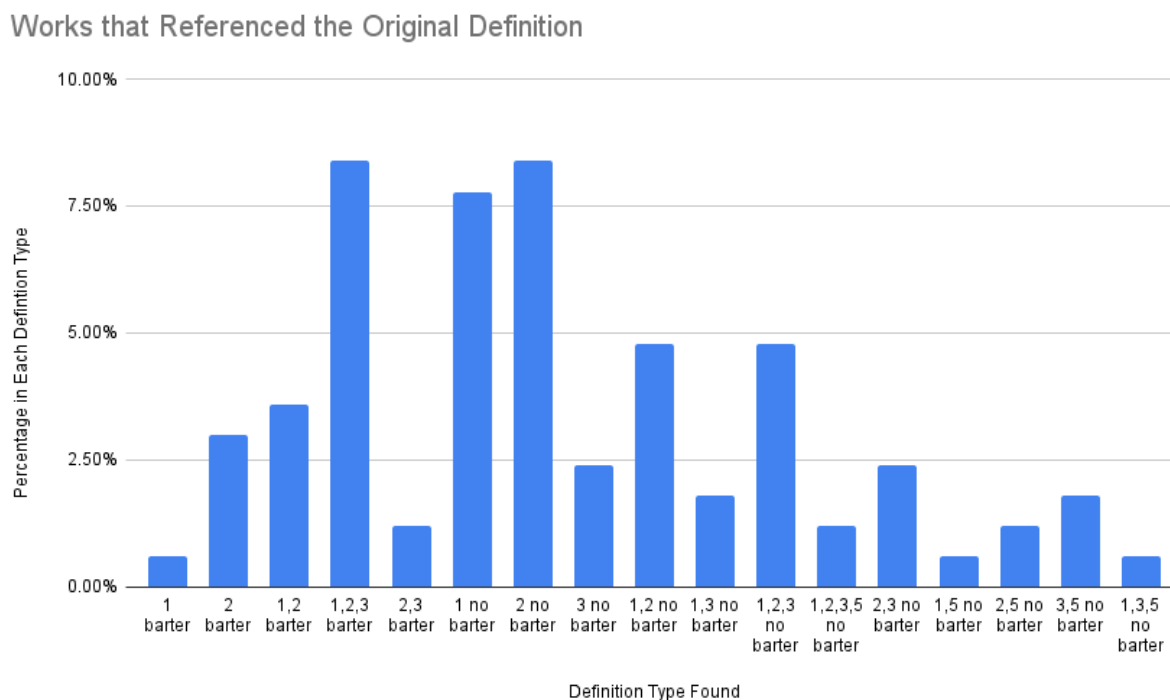
Source: Own elaboration based on the findings in this research

The above chart, Figure 3.5, shows that at least one definition is not a complete definition or a fragment of the definition.

If one filters out all definition categories that do not define the natural rate of interest with any reference to Wicksell’s original definition, rather, 0 or 5 alone that is 45.5%, without a reference to category 1,2, or 3. That is no definition or no Wicksellian definition or no Wicksellian definition but with a category 5 definition, which again is not an original Wicksellian definition. The 54.5% represents some reference to a Wicksellian definition, even if fragmented.

Figure 3.6

Works that referenced at least one definition of Wicksell’s definitions as a visual representation in percentage terms



Source: Own elaboration based on the findings in this research

As seen in Figure 3.6, even if one filters out the works that have no definition, there is fragmentation and incomplete understanding of Wicksell's natural rate of interest in academic literature.

If one aggregates the number of occurrences of a defined category regardless of which other definitions are found, there were 248 non-duplicate occurrences from the 167 papers.

Table 3.6

How many times did each of the four definitional categories have a paper that used their definitional category type

Wicksell's definition was divided by how many times each of the four definitional categories had a paper that used their definitional category type, whether it was coupled with other categories or not. These are further delineated into those which mention Wicksell's barter aspect. The percentages are the frequency of occurrence in each category.

Definition found in category	Definition found in category	Definition found in category Barter	Definition found in category No Barter
0	20.97%	0.40%	20.56%
1	22.98%	8.47%	14.52%
2	26.21%	10.89%	15.32%
3	16.53%	6.45%	10.08%
5	13.31%	0.00%	13.31%
	100.00%	26.21%	73.79%

Source: Own elaboration based on the findings in this research

As illustrated in Table 3.6, 22.98% have Wicksell's primary definition. Further, only, 8.47% contain this primary definition while mentioning the barter aspect of Wicksell's definition. As discussed in Chapter 1 and supported by evidence in Chapter 2, category 1 is Wicksell's primary definition.

This perspective is essential as it shows which definition of Wicksell's was most frequently used, even if coupled with other definitions. The most frequent definition is Wicksell's definition of the natural rate of interest, where investment and savings are equal, code number 2. For authors who attempted a new definition of Wicksell's definition, category 5 was the least occurrence of definitions found. Of Wicksell's original definitions, the least frequent is Wicksell's price stability rendition of the natural rate of interest, or code.

The inverse of the above perspective is taken to show what definition the authors did not include in the data. The definitions that are missing from the academic literature are as follows.

Table 3.7

Wicksell's definition of the natural rate of interest in three primary classifications with what is missing identified by percentage.

Of the 167 papers

Missing	Missing without respect to barter or no barter theory	Missing and no mention of 'barter' theory
1	77.02%	91.53%
2	73.79%	89.11%
3	83.47%	93.55%

Source: Own elaboration based on research data

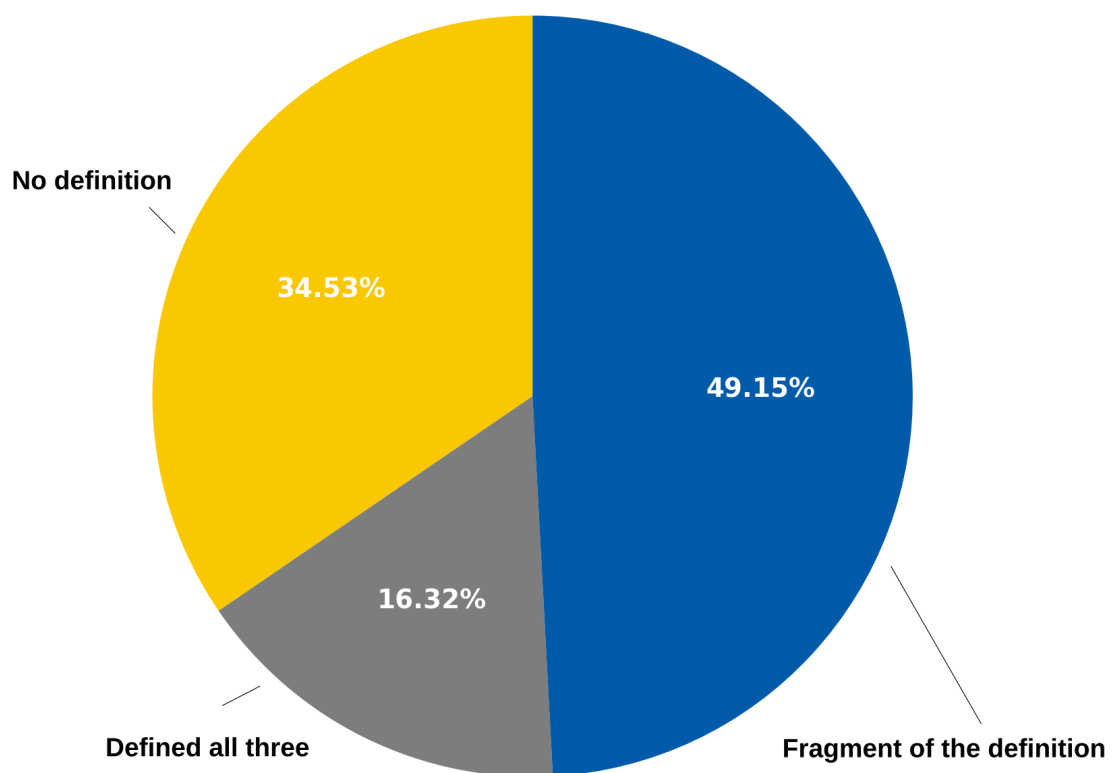
As seen in table 3.7 what is missing from works when defining the natural rate of interest is significant.

Works that had the term “Wicksell” in the Title of the Paper

Of the 167 papers, 55 had “Wicksell” in the title. However, 19 or 34.54% of the papers did not define Wicksell’s original natural interest rate.

Figure 3.7

Academic works with “Wicksell” in the title



Source: Own elaboration based on the findings in this research

Figure 3.7 visually illustrates that of the 16.3% that contained all three definitions of Wicksell. If one were to analyze it further, of that 16.3%, although not further broken out, only 28.6% did not mention Wicksell's barter economy; therefore, only 12.73% can be considered a complete definitional treatment. If a paper contains Wicksell in the title and discusses the natural rate, only a fragment of this literary sample had a complete definitional exportation, with 83.7% containing no or a fragment of Wicksell's definitions, even not considering the barter aspect delineation.

Works that Offered a New Definition of Wicksell's Natural Rate of Interest

Of the 167 papers analyzed, 33, or 19.76%, attempted to redefine the natural rate of interest. As stated above, none of the 33 papers contained all three of Wicksell's definitions and the barter component of his theory. However, taking the subset of data, the 33 papers, the following data table shows the subset of the papers that attempted to redefine Wicksell's natural rate.

Table 3.8

Papers that redefined the natural rate of interest and definitional completeness

The number of Wicksell's definitions mentioned	Did not Mention Barter	Mentions Barter
All three	6.06%	0.00%
Two of Wicksell's definitions	18.18%	0.00%
One of Wicksell's definitions	3.03%	0.00%
No mention of any of the Wicksellian definitions	72.73%	0.00%

Source: Own elaboration based on the findings in this research

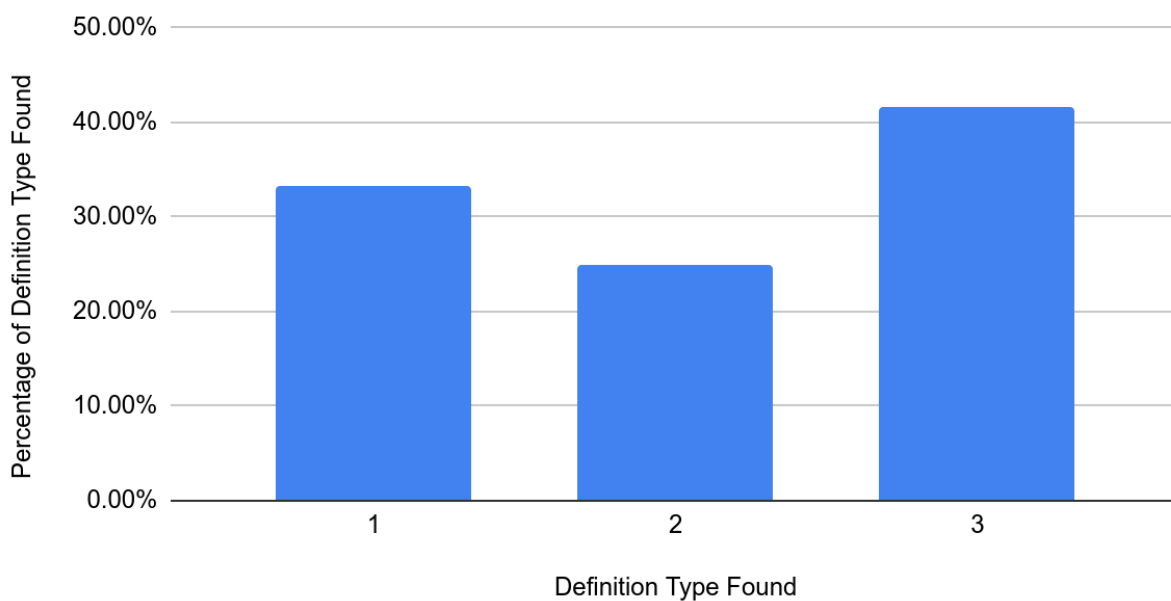
Shown in table 3.8, of this subset of data of papers that redefine the natural rate of interest, 72.73% did not mention any of Wicksell's definitions, and 0.0% mentioned Wicksell's barter economy theory. Of this subset of 33 papers, the highest category that referenced Wicksell's original definition was 18.18% and again 0.0 with any mention of Wicksell's barter economy. It should be explained that 19.77% of all papers had a new definition offered and that each of the above percentages are a percentage of this number. Table 3.2 showed only 1.2\$ of the 5 category has 1,2 and 3 and 0% included these with a mention of barter, this table 3.8 is a different perspective of the data which shows of all those that contained a 5 definition, how this data is manifest.

In the subset of the academic works that redefined the natural rate of interest and included a reference to Wicksell's natural rate of interest, there were nine papers, and twelve definitions were contained in the nine papers. The results are as follows:

Figure 3.8

Definition in academic literature by those who redefined the natural rate of interest

Percentage of the Type Found In Works that Redefined and Contained an Original Definition



Source: Own elaboration

Figure 3.8 shows those who redefine the natural rate of Wicksell and reference one of Wicksell's definitions, which is a small percentage, as seen in Table 3.1 and discussed above; this is a break out of those choosing a stable price conception of the interest rates definition they referred to. The idea of a stable price level was the most frequent reference in Wicksell's original definition, and in Chapter 4, this is the only complement that we will see is referenced. Again, in the academic papers that propose their own rendition of the natural rate of interest, the *in natura*

component of Wicksell's definition is omitted. As a note, the justification or point of reporting these further granulated data sets is to test the fragmentation of the definition not just as a whole but of even subcomponents of the data. This gives a more complete result representation of the data presented above. These results aim to test the fragmentation of the definition in academic literature.

3.2.2 Reference Fragmentation

This results section examines data looking at the references of academic works that discuss Wicksell's natural rate of interest. These statistics measure the depth at which authors examined the original source documents or Wicksell to ascertain the definition of Wicksell's natural rate of interest. It seeks to answer the question, of the 167 papers in this study, did academic works reference a fragment of Wicksell's works?

The starting point for this analysis is to quantify how many works Wicksell actually wrote.

Over 800 works by Knut Wicksell are unpublished and untranslated (Jonung, 1988; Sandelin, 2002). There are 143 published works by Wicksell. There are 52 published works translated into English. This count breaks out the compendiums of Wicksell's works (see Appendix on Works of Wicksell). Three unpublished works have been translated into English. This is a total of 55 published and unpublished translations in English. Of the total of Wicksell's works published and unpublished, an estimated 40% address monetary theory (Jonung, 1988). The results for citation count consider all of Wicksell's works in any language, both published

and unpublished. It counts Swedish, German, and English published and unpublished works of Wicksell when tallying the number of each of the academic works analyzed.

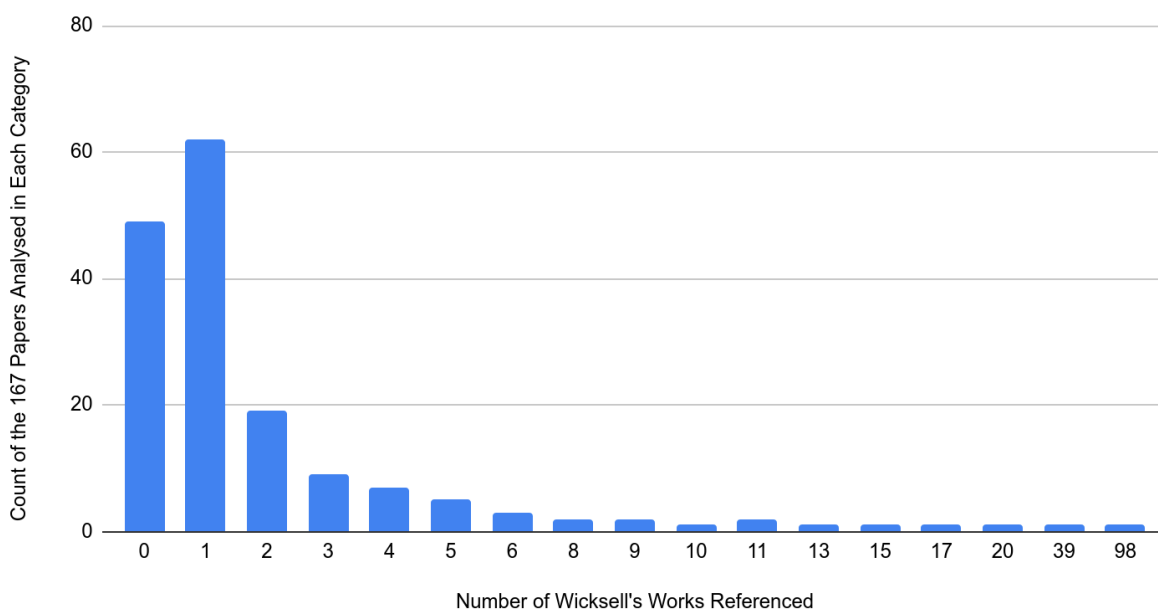
Of the 167 academic works analyzed in this study, the statistical mode of reference to the works of Wicksell was 1. That is, most commonly, authors only referenced one of Wicksell's works. The second most common mode was zero, and the third most common mode was 2. The data has a medium of 1.

- The most common number of Wicksell's 800+ works referenced: 1
- The second most common number of Wicksell's 800+ works referenced: 0
- The third most common number of Wicksell's 800+ works referenced: 2

This is seen in Figure 3.9 below, which shows the distribution of primary source references that academic literature used when writing about Wicksell's natural rate of interest.

Figure 3.9

Of the 167 Papers Analysed - Count of Wicksell's Works Referenced by Number Referenced



References to Wicksell's works in academic literature for papers that focused on the natural rate of interest

Source: Own elaboration based on the findings in this research

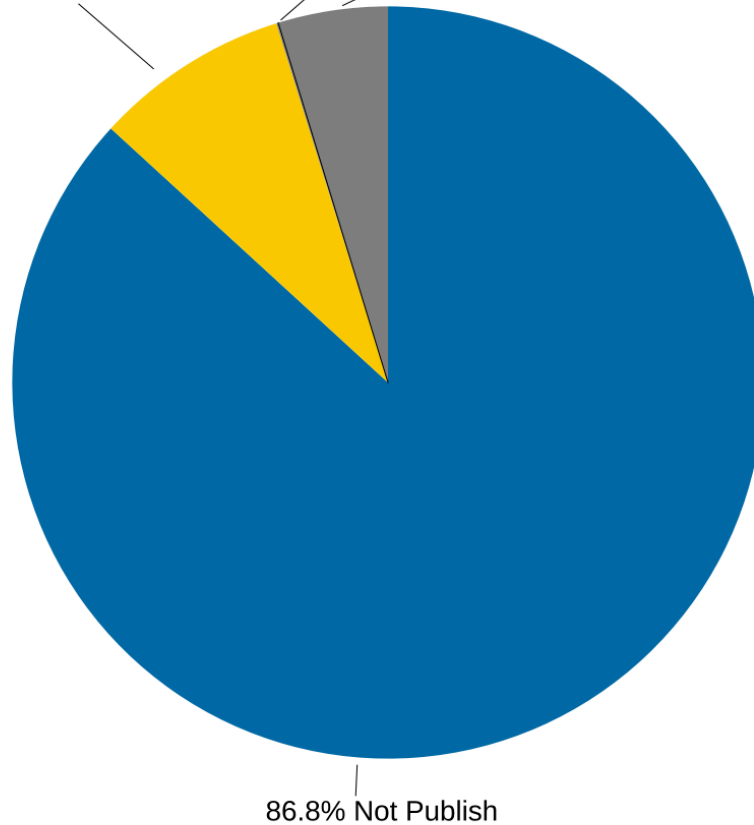
As seen in Figure 3.9, few academic works have a large percentage of Wicksell's works referenced when writing about Wicksell. 0 works referenced represent 29.34%, and 1 work referenced 37.13% or 66.47% referenced 0 or 1 work of Wicksell. The medium and mode referenced by the 167 academic works represent less than .1% of Wicksell's estimated 800 works. Figure 3.9 above is a chart that illustrates this distribution in the context of all of Wicksell's primary source writings.

Figure 3.10

Mean and Mode of Wicksell's Works Cited by Researchers = .1%

8.4% Published Not in English

4.8% Published in English



Literature's examination of Wicksell's works total works published

Source: Own elaboration based on the findings in this research

As seen in Figure 3.10, Wicksell's works are unexplored by academic researchers, with 86.8% of Wicksell's total works unexamined. The data presented shows the gap in the literature. Even if you factor into the equation, the estimate that 40% deals with the monetary theory, the medium, and mode is .2% of the total works of Wicksell. The weight of each work can not be

assumed to be the same. The verbiage length and current notoriety do not gauge the weight of insight, or a significant aspect of the understanding could be overlooked. However, since a large portion of Wicksell's writings are unpublished, one can not objectively detail the significance or The weight attributed to those individual works is discussed in the limitations section. The results are Presented in an unweighted count.

Wicksell's mostly highly referenced or cited works in this study's 167 academic literature works and papers on Wicksell are:

1. *Interest and Prices*
2. *Lectures on Political Economy v2*
3. *Value, Rent, and Capital,*

in that order. The book *Interest and Prices* was published in 1898. However, Wicksell continued to write until 1926. Yet *Interest and Prices* today is the most referenced book, even though the evolution and development of Wicksell's thought went on for another twenty-eight years after publishing this early work. The neglect of this latter work is evident in the list above, including the appendix, which contains some latter writings. The above three are in English and were translated into English.

Citation Count Relation to Defintional Rigour

The data in this section examines whether works with higher citation count have greater rigor when defining and presenting Wicksell's natural rate of interest. The connection between highly cited works based on Google Scholar's citation count, a proxy for general influence, is examined in connection with the determinate criteria of this study in terms of conceptual rigor and presentation of the definition of the natural rate of interest. The comparisons are made based on definition count, the inclusion of Barter, how many works of Wicksell are referenced, where the definition is first encountered, and if the presentation is fragmented in the layout of the fragmentation. That is a correlation matrix was run to compare the number of citations in Google Scholar to the definitional data count from this study. In summary, the table below examines the three aspects of fragmentation analyzed in this study: definition (Citations v. Definitions and Citations v. Barter), reference (Citations v. Referenced), and presentation (Citations v. Presentation and Citations v. Fragmentation II).

Table 3.9

Correlation Matrix of Citation Count Compared to Definitional Criteria

Test	Results			
	Pearson Correlation Coefficient (rr)	t	p	df
Citations v. Definitions	-0.0931268	-1.20146	0.2313	165
Citations v. Barter	-0.09723209	-1.25491	0.2113	165
Citations v. Referenced	0.03576145	0.459658	0.6464	165
Citations v. presentation	0.05979964	0.63963	0.5237	165
Citations v. fragmentation II	-0.0413178	-0.44153	0.6597	165

Source: Own elaboration based on the findings in this research with the use of Gretl statistical software (Gretl, 2023)

Under the null hypothesis of no correlation, the data fails to reject the null hypothesis for all the tested relationships in Table 3.9.

For instance, the Pearson correlation coefficient (r) of -0.0931268 between "Citations" and "Definitions" suggests a very weak negative correlation, implying that as the number of citations increases, the number of definitions decreases slightly.

However, this relationship is weak, as shown by the t -value of -1.20146, which is close to zero. This evinces that the correlation might be due to chance. Additionally, the p -value of 0.2313 is greater than the alpha level of 0.05, providing insufficient evidence from the data to make a conclusive statement of a significant relationship between citations and definitions.

Similar results are found in the other comparisons. For all tests—definition (Citations v. Definitions and Citations v. Barter), reference (Citations v. Referenced), and presentation (Citations v. Presentation and Citations v. Fragmentation II)—the study fails to reject the null hypothesis, indicating that the variables are not significantly correlated in this sample.

Therefore, any observed relationships could be random variations or uncontrolled factors.

In conclusion, the evidence in Table 3.9 shows, a more significant number of citations, as a proxy for academic influence, does not necessarily equate to greater definitional rigor or conceptual depth when examining Wicksell's natural rate of interest.

3.2.3 Presentation Fragmentation

The section presents data that will help determine if the authors presented the definition in a fragmented way. This section on fragmentation used 91 academic works rather than 167 academic works because 52 works contained no definition of Wicksell's natural rate of interest, and 24 contained a new definition of the natural rate of interest without reference to one of Wicksell's original definitions.

Initial Fragmentation Results

The overview of the distribution is as follows. In Table 3.11, the results of what is defined as initial fragmentation are presented, showing the definition across each area of the academic work. That is where the definition of Wicksell's natural rate of interest appears initially in the academic work; the more upfront a definition appears, it is potentially easier it is for a reader to understand what is being written about.

Table 3.10

Where the first occurrence of Wicksell's definition was first encountered in academic works that defined Wicksell's natural rate of interest.

Percentage Category	Percentage of Papers' Definitions Found in Each Percentage Category
0% to 10%	15.38%
>10% to 20%	27.47%
>20% to 30%	18.68%
>30% to 40%	13.19%
>40% to 50%	8.79%
>50% to 60%	3.30%
>60% to 70%	9.89%
>70% to 80%	2.20%
>80% to 90%	0.00%
>90% to 100%	1.10%

Source: Own elaboration based on the findings in this research

Table 3.10 describes the statistical initial fragmentation found in academic works that write about Wicksell's natural rate of interest. When looking at the individual works of this data set, the data set had a mean of 25.71, a median of 25.00, a mode of 50.00, and a standard deviation of approximately 12.15. This does not include works that do not define Wicksell's natural rate of interest. Instead, only works that contained a definition and where they were found in the work.

If you qualify the initial fragmentation more specifically as the definition, not in the first 20%, one sees the following breakdown. Figure 3.9 shows which academic works have initial presentation fragmentation as defined.

Table 3.11

Initial fragmentation of the definition of the natural rate of interest in academic works.

Does not have initial fragmentation	42.86%
Does have initial fragmentation	57.14%

Source: Own elaboration based on the findings in this research

As seen in Table 3.11, initial fragmentation predominates in academic literature, with 57.14% of the data showing initial fragmentation.

Non-contiguous Fragmentation Results

Definitions are found in one section of the academic work. Another is found in another section of the academic works. Definitional fragments scattered throughout the academic work can confuse readers compared to a contiguous unified definition conception. The evidence is as follows:

Table 3.12

Analysis of the percentage of papers that contain non-contiguous fragmentation versus those that do not have non-contiguous fragmentation.

Does have Non-contiguous fragmentation	32.97%
Does not have Non-contiguous fragmentation	67.03%

Source: Own elaboration based on the findings in this research

As seen in Table 3.12, 32.97% have non-contiguous fragmentation. They offer a definition in one area of the work and another definition in another area of the work.

Initial and Non-contiguous Fragmentation Results Considered Together

If the data is a cross-reference to include both initial fragmentation and non-contiguous fragmentation, the results are as follows. This data includes only the academic works that originally defined Wicksell's natural interest rate.

The following table examines if academic works in the study had either initial or non-contiguous fragmentation.

The following table examines if academic works in the study had either initial or non-contiguous fragmentation.

Table 3.13

Presentation fragmentation of academic works when initial and non-contiguous fragmentation are considered together.

Does not have either initial and	14.29%
----------------------------------	--------

Non-contiguous fragmentation	
Does have either initial and non-contiguous fragmentation	85.71%

Source: Own elaboration based on the findings in this research

The above Table 3.13 represents the inclusive test for presentation fragmentation. That is, 85.71% of the definitions in academic literature have some form of fragmentation when presenting the definition of the natural rate of interest of Wicksell.

3.3 Discussion

The research problem is that no studies to date have analyzed and quantified how academic writers present Wicksell's definition of the natural rate of interest. If academic writers give a fragmented presentation of Wicksell's natural rate of interest, then this can perpetuate a misinterpretation of Wicksell. The research question is, do academic writers fragment their presentation of Wicksell's natural rate of interest, and if so, how? The goal is to objectively evaluate the extent of this fragmentation with quantifiable evidence and suggest its impact on the current and influential understanding of the natural interest rate.

Based on the results, there is evidence that authors writing about Wicksell's natural rate of interest in capital displayed significant definitional, reference, and presentation fragmentation.

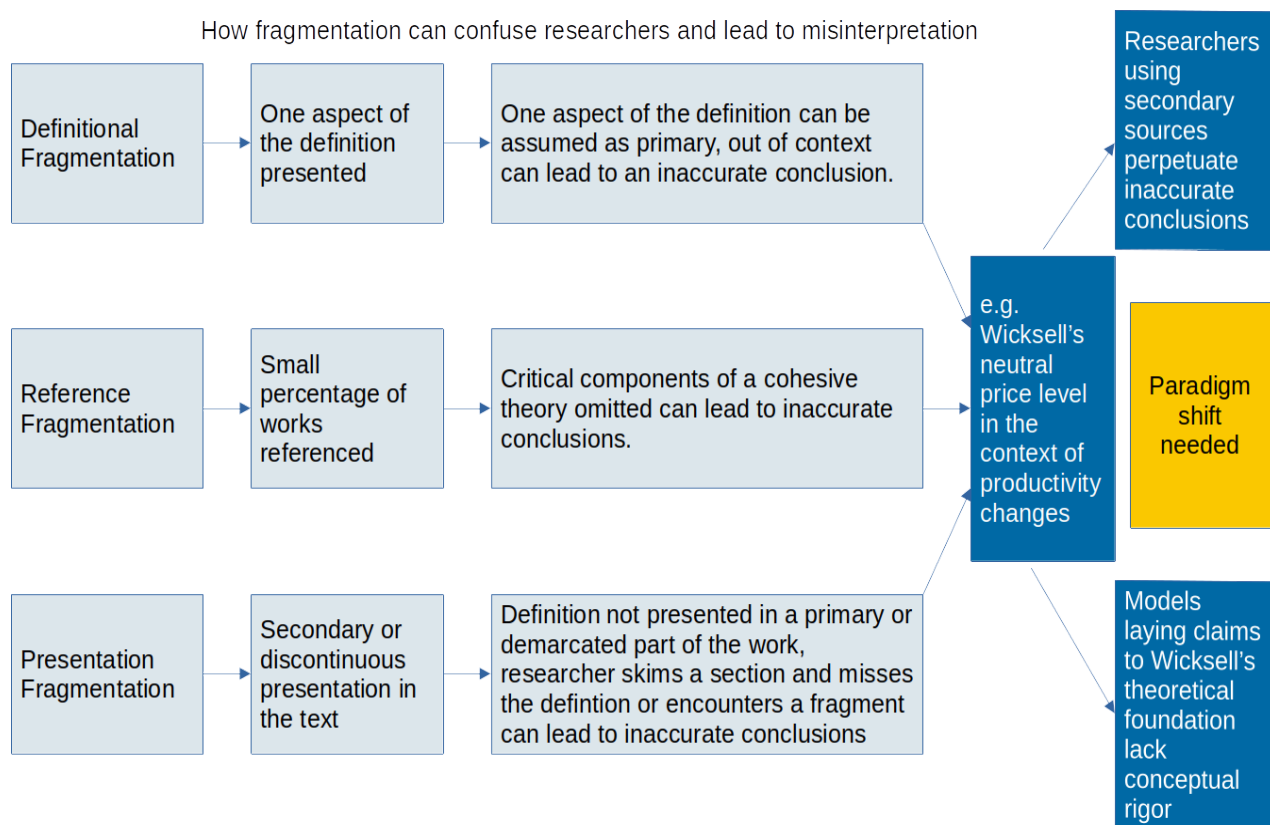
The statistical data presented in the results of each type of defined fragmentation provides convincing evidence. This supports the hypothesis that academic literature is fragmented in its presentation of Wicksell's natural interest rate from a definitional, reference, and presentation perspective in the sample derived from a systematic review. This is an essential insight that is not present in other literature to date. It is essential because a fragmented representation of Wicksell's natural rate of interest definition can and has led subsequent research and theory to a misinterpreted understanding of the natural rate of interest. This claim about subsequent research is investigated further in Chapter 4 of this study.

Further, researchers and policymakers that make claims to the Wicksellian natural rate foundation might not have the same conceptual rigor of Wicksellian theory, which has been debated for 125 years in the discourse of political economy. It is fair to assess this as using a fragment is not only not Wicksell's theory but a fragment, and even potentially out of context to the whole of Wicksell's understanding. The result is hypothetical, and it confuses the reader and the next generation regarding the Wicksell connection. This supports the discussion and evidence presented in the literature review that the Wicksell connection has been lost in current academic research.

Refer to Figure 3.10 for a summary illustration of fragmentation in literature, how this fragmentation, and the potential results of this fragmentation in economics.

Figure 3.11

Types of fragmentation analyzed



Source: Own elaboration

As depicted in Figure 3.11, three types of fragmentation have been identified in the literature and are analyzed in this study. Each one, stemming from a different perspective, may

cause potential confusion in understanding the essence of Wicksell as derived from primary source documents. Each type originates from a different interpretive perspective and may contribute to confusion in comprehending Wicksell's original ideas, as presented in primary source documents. There also could be a cumulative effect of encountering multiple types of fragmentation within a single work that can be greater than the sum of its parts, further complicating the reader's understanding. This realignment and reassessment, based on primary source data analyzed both systematically and systematically, could potentially invoke a paradigm shift in monetary theory.

The results presented here are further evaluated, below from three categorical perspectives: definitional, reference, and presentation fragmentation.

3.3.1 Definitional Fragmentation

Definitional fragmentation is an important research issue because a fragment of a definition or theory often does not capture the essence of the whole theory. Definitional fragmentation occurs when an author takes a fragment of the original definitional theory and portrays or uses it as a whole, which can lead to misinterpretation. The results from the definition fragmentation analysis have attempted to answer whether academic literature fragments the definition of Wicksell's natural interest rate.

The analysis of the results supports the theory that academic authors discuss a fragment of Wicksell's definitional ideas and largely miss the whole conception based on the presented definitions. If authors use, for example, one singular select quote from Wicksell, this is not Wicksell's theory or at least not necessarily as Wicksell intended based on the other components.

Definitional fragmentation is the most significant type of fragmentation as it often misleads the reader about Wicksell's intended theory. It might be suboptimal if one bases a policy on a fragment of Wicksell's work. Even if authors rebrand the natural rate of interest as has been done with r -star, there needs to be a thorough reexamination in the literature of the whole definition of Wicksell before one jettisons components and moves forward with only a fragment. This supports the analysis in the non-systematic review of literature that the current consensus writers do not engage in a whole definitional decision of Wicksell before assuming a fragment of his theory.

A summary of the results shows that academic literature, as examined, shows writers defined the natural rate differently, but an interesting outcome from the sample emerged. Only a fraction defined or considered the natural rate of interest with all three renditions, ultimately as Wicksell did. The following is a summary of the significant data found in the results section on definitional fragmentation. This fractional representation supports the hypothesis that the definition of Wicksell's natural rate of interest is that these fragments do not wholly represent Wicksell's definitional theory.

Perhaps most noteworthy is that 31.14% of academic research on the natural interest rate did not define it. This evidence is seen in Table 3.2. They wrote about it and drew conclusions based on it but did not explain what it was; it was just assumed to be something. However, what that something was is unclear.

Further, this 'no definition given' category was the most frequent occurrence of all the definitional categories. If 31.14% of the authors did not define the rate they were writing about, it could lead to assumptions about the natural rate of interest.

Assumptions without substantiation can lead to non-objective analysis. Without defining precisely or referencing a primary source quote from Wicksell, theoretical inaccuracies can be created. Readers will have to speculate or read perhaps from secondary sources to get 'a' definition. Secondary sources are poor substitutes for primary source documents as there is conscience or unconscious bias in the secondary source material. Some secondary source material might be dated in the sense that it does not have access to the most current translations and new insights into Wicksell. Other secondary sources are built on secondary sources themselves. Secondary sources are one or two times removed from the original text and might present evidence selectively or fragmented. Secondary sources might present claims or views unsubstantiated by comprehensive systematic and statistical analysis. Evidence for this is reasonable, considering that Researchers might consult AI, which can be based on secondary sources and can perpetuate inaccuracies. The result is an imprecise definition or at least an incomplete understanding of Wicksell's natural interest rate. This imprecision is hypothetically perpetuated as others read their works. It is a significant and important gap in the knowledge identified that is substantially based on the evidence that 31.4% did not define the natural rate in their work, which appears as a search ranking in a database search on the topic.

What is more striking is that 14.37% of the authors who propose a new theory or reference a new theory of the natural rate of interest do not define it in any other way but their

own or that of another author who gives a novel definition. This 14.37% is seen in Table 3.3. They do not start with Wicksell and then build from that primary source foundation. Rather, they assume their own definition without any theoretical discussion or primary source reference. However, they simultaneously call it “the natural rate of interest” and talk about Wicksell. This can cause further confusion and questionable objectivity. Therefore, 31.14% plus 14.37% is a total of 45.51% of the authors use the term natural rate of interest either generally or with reference to another theory and yet do not define it with support from Wicksell.

As seen in Table 3.5, only 22.98% gave the definition with a code of 1, which was ‘the expected yield on newly created capital’. This was Wicksell’s most frequently mentioned definition based on this research. As seen in Table 3.6, 77.02% was missing Wicksell’s most frequent mention or understanding of the natural rate of interest. This is significant because if Wicksell defined and conceptualized it in this way, academic literature does not represent it. It questions the connection of the original definition based on primary source data.

45.51% of the peer-revered academic literature appears relatively high in the Google Database search that does not reference Wicksell’s original definition. That is substantial. It is enough to misinterpret and give semantically incorrect information about the history of economic thought as well as future development. This point is evidence supporting the hypothesis that the definition of Wicksell is fragmented in the literature.

What is even more surprising from the results is that only 4.79% contained all three definitions. If under 5% of the total contained all three definitions, confidence is high that academic literature is definitionally fragmented. Since the evidence shows that 4.79% of the

scholarly works described all three of Wicksell's renditions of his definitions with mention of a barter exchange economy, and none of those fall into the category of offering a new rendition of all the new renditions of Wicksell in the sample of literature were not complete and insufficient to represent Wicksell. Even excluding the *in natura* aspect, the result was 8.38%. With this high percentage, 92.22%, of academic literature that takes a fragment of Wicksell's definition, there are theoretical implications that economic science must be mindful of when subsequently developing theory. The further implication is that there needs to be a reevaluation of theorists' and policymakers' fragmented representation before basing what they call the natural rate of interest, even in the r-star form.

With 8.38% of the works representing Wicksell's definition altogether and 92.22% of the works missing elements of Wicksell's works, it is reasonable to assert that Wicksell's works are misrepresented and potentially misinterpreted in academic literature.

The expected return on capital was Wicksell's most frequently mentioned rendition, as shown in chapter 2 of this study. However, 77.02% did not even mention Wicksell's most frequently mentioned definition. That is, they did not consider the Bohm-Bawerkian/Wicksellian idea that the natural rate of interest was based on the micro foundation of entrepreneurial agents making intertemporal decisions regarding capital based on expectations relative to the price of loan capital. They either did not define it or represented it instead only in the abstract aggregate. If you include Wicksell *in natura* aspect, a full 91.53% in the context did not mention the natural rate of interest as defined as the expected return on capital.

The implication is that although we have identified a core element of Wicksell's definition by a small percentage of writers, it still is a fragment. Based on the evidence, one can conclude with high confidence that it is a further misrepresentation based on the percentages. This finding is very significant.

An analysis of the definition's 'stable price level' component is essential as this is the component that modern authors use today and that is synonymous with Wicksell. Academic literature assumes this component most often in highly cited literature, as discussed in further detail in Chapter 4 of this study. However, as presented in Chapter 2 of this study, Wicksell mentioned this definitional component only 11.48% of the time.

Further, based on the non-systematic review of the literature discussion, money neutrality and in natura ideas were largely absent from authors who assume this definitional position of Wicksell. Regarding the 'stable price level definition' of Wicksell, the data shows that 24.56% of the authors mention the stable price level in the definition of Wicksell's natural rate of interest. The data shows in the results section that there are a diverse number of different combinations of definitions. Sometimes combining the renditions with the second rendition or the investment savings component as is the case 3.59% of the time, or sometimes combining with a new rendition 1.8% of the time or similarly 1.8% of the time with the expected return of capital rendition, omitting a discussion on the investment savings component of Wicksell's definition.

Authors who rely primarily on secondary sources to develop their theories face challenges related to precision and objectivity. Secondary sources can introduce subtle, consciously or unconsciously, affecting the interpretation of the original material, in this

case, Wicksell's natural rate of interest on capital theory. For example, a secondary source might highlight specific elements of Wicksell's theories while downplaying others, which can shape the reader's perspective. To maintain objectivity, it is essential to base research on Wicksell's primary texts. This approach ensures that analysis is grounded in a thorough understanding of the primary source material.

Additionally, if authors do not use primary sources as their base, including those from different time periods, to define Wicksell's concepts, it may raise the question if other aspects of his theories are also incomplete or open to misinterpretation. This highlights the risk of inaccuracies when research is based on secondary sources. Additionally, if writers fail to define the definition fully, it is reasonable to ask the question if other unexamined elements of Wicksell's theories might be fragmented or misrepresented.

3.3.2 Reference Fragmentation

The issue is that authors writing about Wicksell's natural rate of interest cite a fragment of Wicksell's works. This fragmented approach can hypothetically result in a lack of full awareness, perspective and potential misinterpretation within academic writing regarding the true nature of the natural rate of interest, as elucidated in the entirety of Wicksell's writings. This section answers the question of 'To what extent Wicksell's definition is fragmented in academic literature from a reference standpoint?' Reference fragmentation is when authors only cite a small fragment of the works available from an author they are writing about. This phenomenon of reference fragmentation mirrors the problem of definitional fragmentation, as it implies that authors present an incomplete understanding of Wicksell's theory.

The most important aspect of this data is that 29.34% of 0 works referenced represent 37.13% referenced 1 work, or 66.47% referenced 0 or 1 work of Wicksell. This would indicate that a significant part of academic literature on Wicksell's works is based on secondary source material. Figure 3.8 shows that the number of references is skewed to a small fraction of the works Wicksell referenced.

Similarly, from another perspective, what is remarkable is that the mode, the most frequent citation quantity from peer-reviewed literature that focuses on Wicksell's natural rate of interest, is one. That is the one and only one source of Wicksell referenced when authors write about Wicksell's natural rate of interest. One source from his overestimated 800 works in all languages (Jonung, 1988; Sandelin, 2002). This represents approximately .1% (not 1% but .1%) of Wicksell's total works that were referenced. Even if you factor into the equation and estimated 40% deal directly with monetary theory, it would be approximately .2%. Alternatively, 4.8% of Wicksell's works were published in English. Only one work from all his works in English. These are peer-reviewed authors writing about Wicksell's natural rate of interest that appeared high in the Google Scholar algorithm, yet referencing only one of Wicksell's works. By academic standards, only having one primary source reference is less than adequate objectively to claim well-documented research or to make an authoritative claim on the subject of Wicksell's natural interest rate.

What is more remarkable is that the second most common frequency is zero; that is, no primary source documents or citations of Wicksell on works are used in the data. These are authoritative peer-reviewed analyses of Wicksell's natural rate of interest, and as shown, have a

large percentage that mentions Wicksell and “natural rate” in the title. That is Wicksell and the natural rate of interest might have been in the title of the research paper, but the Authors did not reference Wicksell at all and relied on secondary sources or simple options. If Economic science wants to progress, economic researchers need to improve the method of research or the depth of research or at least the criteria for peer review processes. Whenever possible, primary source materials need to be examined, for example, as primary source materials are more objective and factual rather than opinions, which could have writer biases conscious or unconscious. Zero references to Wicksell means secondary sources are the primary means to substantiate a definition in the second most common statistical mode of the data sampled. The majority of the research used one or zero references. Using only secondary sources can lead to erroneous conclusions.

Of the authors who proposed a new rendition of Wicksell, the mode of one still applied. They referenced one of Wicksell’s earlier works, *Interest and Prices*, published in 1898 or *Lectures II*, and economic science assumed the research was a study of Wicksell.

Further economics science often used these new renditions to build models and policy, calling it the Wicksellian natural rate theory or a derivative of Wicksell. Again, Wicksell was a prolific writer, and it could be argued that many of his insights, as mentioned in the literature review, are not found in the earlier referenced sources.

Further, it even radically changes the interpretation of Wicksell if primary source documents are used in research. If new renditions are resting, their theoretical foundation on one reference of Wicksell, often only an early development in his theory, these foundations and

perhaps their works need to be questioned. The implications are profound for those who build upon this for policy recommendations.

As discussed in the systematic literature review, Wicksell's ideas were evolving, and what Wicksell wrote in the 1800s was not the same as what Wicksell wrote in the 1920s. Therefore, citing a quote from a single work of Wicksell's 1898 work and calling this Wicksellian is not an objective or academically rigorous approach to ascertaining the definition of Wicksell's theory regarding the natural rate of interest. Based on the evidence and data connected to this section, there is substantial evidence to support the theory that Wicksell's theory is substantially fragmented from the standpoint of reference fragmentation.

Further, there are more components to Wicksell's definition than just the literal stance. The definitions are usually supported by theory and further definitions and ideas. An analogy would be a legal document; there often is a case law precedent to determine the meaning of the idea and more convergence around the single definition. If economic science is fact-based, it needs to look at the totality of the facts. Therefore, the case in economic science needs to be understood from the context of the whole, and the more references that are brought in, the more substantial the evidence weighs that this is a proper representation. In this case, the authors from the database search have cited a fraction of Wicksell's work. This fraction is usually from the same sources. The same sources are recited without a deeper understanding of Wicksell. This analysis is not found anywhere in the academic literature known today. So, this analysis is unique.

The neglect of primary source data from historical economists is becoming increasingly prevalent due to the accessibility of contemporary journals compared to older original text. In the field of economics, there is a growing tendency among modern economists to rely on secondary sources, a practice that may overshadow the original materials. This reliance on intermediaries can lead to misunderstandings and misinterpretations, similar to the well-known phenomenon of the "telephone game." As information is passed down from the primary source through various channels and individuals, the potential for distortion grows, often culminating in conclusions that may diverge significantly from the original context and meaning. This trend underscores the importance of critically evaluating the sources and the potential implications for the integrity of scholarly research.

The study does not even consider Wicksell's non-English sources, which is both a limitation and a point for further research.

3.3.3 Presentation Fragmentation

Presentation fragmentation comes in two forms. One is where writers do not define the natural rate of interest initially, and the other is where they do not define it in a logically contiguous way. This can lead to readers' confusion about what is intended or implied in the meaning. More specifically, writers who write about the natural rate of interest yet do not define the natural rate until a percentage into the discussion of the paper, in this case, based on the data, an average of about 25%. Based on the data, many writers sometimes passed the midway point and sometimes in the last 90% of the paper, and this is not an appendix. In this study, this is referred to as initial fragmentation. It is not in a separate directions section or demarcated in any

way. This causes confusion among readers, especially since readers often skim accepted works rather than read them. That is, the data showed the results that, on average, writers would write and discuss, in their research, the natural rate of interest. However, somewhere 30% into the writing, the first definition appeared. Again, based on the data from this study, it was a fragment of Wicksell's definition rather than a robust, complete definition with reference to a complement of primary source materials. The initial presentation fragmentation of presenting a definition at the 30% mark on average concerning academic scientific writing. Scientific writing usually defines terms in a separate definitional appendix or right at the start to give writers a clarification of what is being discussed. If the paper is about the natural rate of interest, it is of vital importance rather than assuming that clarity is brought into the discussion initially.

Fragmentation can be non-continuous fragmentation in that writers define the natural rate in one way in one section of the work and then in another in another section. This causes further confusion. Presentation fragmentation of both kinds is substantially found in the academic literature analyzed in this study. The data shows that only 15.38% of the writers mentioned the decision of the natural rate in the first 10% of their work. That can be deemed significant, and further, the data set had an average of 25.71% and a median of 25%. Further with a mode of 50%, that is the most common occurrence was at the 50% mark in the work. This is coupled with the fact that about 33% did not even define the natural rate of interest.

If the average is approximately 25%, this supports the evidence that the papers reviewed had presentation fragmentation. In terms of non-contentious fragmentation, the result of 32.97% is significant. Though not the majority, if approximately $\frac{1}{3}$ of the authors define the natural rate

of interest in one way in one section and another way in another, then this further supports the hypothesis that Wicksell's work is fragmented in non-contentious fragmentation. The implications are considerable; this confuses readers and the transmission mechanism of information at the natural rate. Writers, again under time pressure and pressure to publish, often skim articles and might miss critical components, leading to misinterpretations.

The results show that only 4.29% Of the works have neither initial nor non-continuous fragmentation as defined. That means 85.74 are fragmented. When coupled with definition and reference fragmentation, this creates a fragmented and misinterpreted view of the definition of Wicksell's natural rate of interest, which gives reasonable support for the thesis of this study. That is, if one combines the potential for fragmentation, definitional fragmentation, reference fragmentation, and presentation fragmentation, as a whole and almost without exception, Wicksell's natural rate of interest is substantially fragmented. Each type of fragmentation overlaps with the other types. That is, most have a combination of all three times. This analysis is not a criticism of academic writing but instead identifies the need to reassess Wicksell to the modern audience with a more in-depth study. The limitation of this fragmentation study is that it primarily does not address all aspects of Wicksell's theory but focuses on the definition aspect.

Further research is needed to confirm the findings and explore additional theoretical dimensions. Although this study was comprehensive, other aspects might be investigated. Perhaps the most significant limitation is that an estimated over 800 of Wicksell's works are unpublished and untranslated (Jonung, 1988; Sandelin, 2002). More studies are needed on this array of works.

In conclusion, based on the statistical evidence analyzing Wicksell's works compared to a systematic and statistical analysis of peer-reviewed works, definitional, reference, and presentation fragmentation substantially exists in modern academic literature. All three types of fragmentation are shown with comprehensive statistical evidence. When examining the evidence about definition, reference, and presentation fragmentation, it becomes evident that the academic literature displays a fragmented approach to defining Knut Wicksell's natural rate of interest. When these three forms of fragmentation overlap in a work or literature as a whole, the fragmentation could be both cumulative and potentially multiplicative, which further undermines the potential validity of the research argument in contrast to a work that is not fragmenting. This fragmentation perpetuates itself in literature and puts research on a less-than-optimal trajectory. This fragmentation is exacerbated by authors increasingly depending on the interpretations of others rather than themselves looking at data and doing an impartial analysis of primary source documents. This chapter answered the question, and the evidence supports the sub-hypothesis: Academic literature primarily gives only a fragment of Wicksell's definition, the presentation is fragmented, and the literature cites only a fragment of Wicksell's works.

Chapter 4

Highly Cited Works Compared to Wicksell's Natural Rate of Interest Definition and Neutral Money Concept

This chapter identifies the most influential works today in which authors redefine the natural rate of interest and compare their definitions to Wicksell's definition, including an examination of the concept of money neutrality. Studying the most influential works is essential because they are a conceptual framework for further research and serve as policy guides. If a natural rate definitional paradigm continues on a trajectory that is not congruent with primary source data, it needs to be re-examined.

The aim of this research section is to determine if highly cited authors who create new renditions of Wicksell's natural interest rate miss the essence of Wicksell's definition of the natural interest rate and money neutrality. This chapter's study is to answer the research question: How do new definitions of the natural rate of interest developed by highly cited modern authors compare with Wicksell's original definition and understanding of money neutrality?

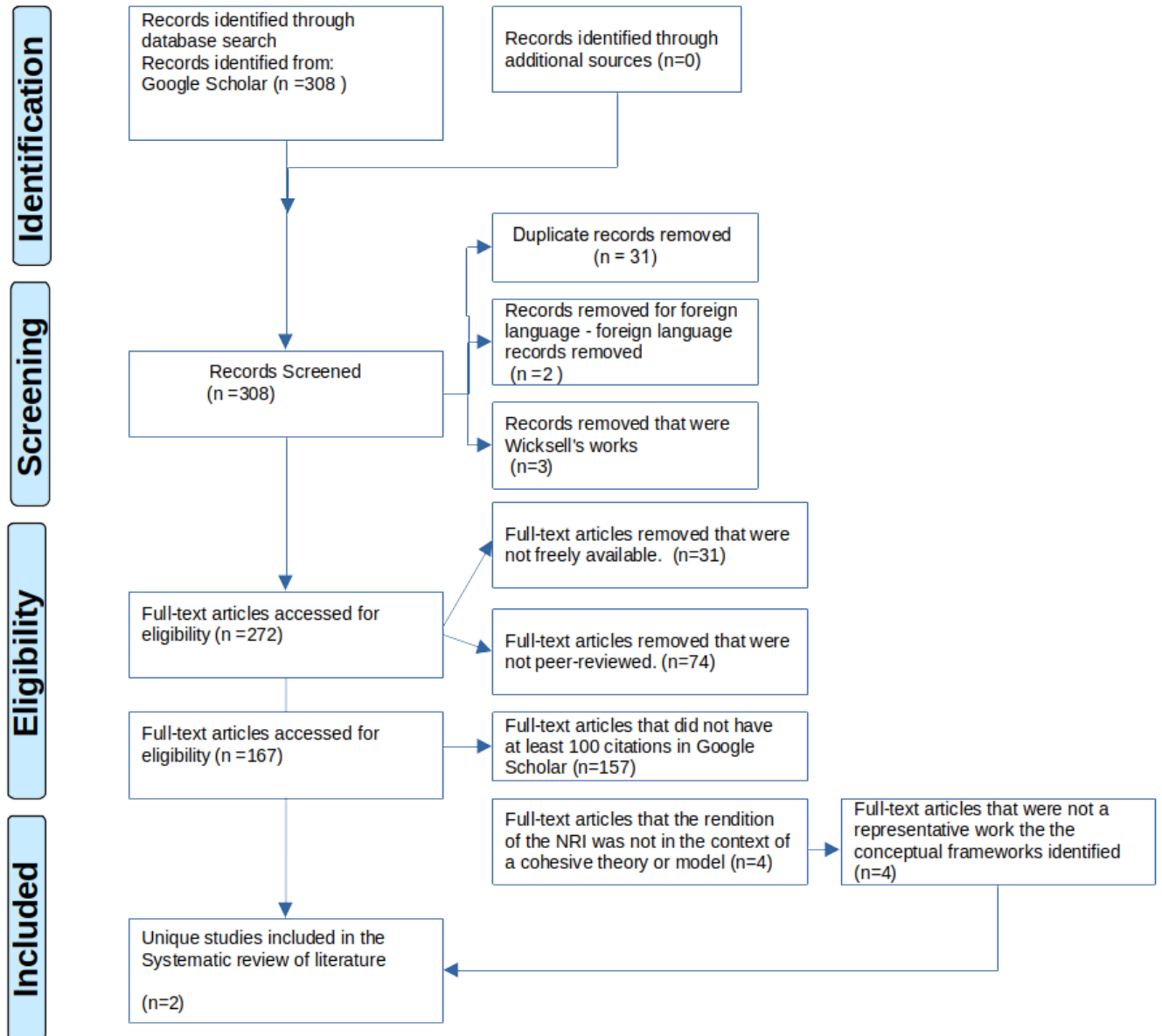
4.1 Methodology

The methodological approach employed in this chapter is a systematic literature review with comparative analysis. That comparative analysis is between selected works and those of Wicksell to examine the congruencies and divergences in two fundamental concepts: the natural rate of interest and the notion of money neutrality. The procedure is as follows. The methodological approach employed in this chapter is a systematic literature review. The methodology in this section is an extension of the previous section's systematic literature review and is presented below in the selection approach detail. It also adds additional filters to identify

the most influential works on Wicksell's natural interest rate today. This chapter used a database search with keywords for screening. Next, this study applied additional criteria to capture those works that suggested a new rendition of Wicksell's natural rate of interest that was influential, substantial, and in the context of a theoretical or model framework. The research question is: How do new definitions of the natural rate of interest developed by highly cited modern authors compare with the essence of Wicksell's original definition and understanding of money neutrality?

Figure 4.1

PRISMA systematic review flow diagram for analysis of Wicksell's natural rate of interest in highly cited authors in academic



Source: Own elaboration

As depicted in Table 4.1, the procedure replicates the initial process described in Chapter 3. A PRISMA diagram illustrates the systematic review process, through which 167 works were finalized for analysis, and then further screening was applied for a more focused study. Initially, 308 records were identified and carried forward. Given the focus on Wicksell, a more significant number of records could have been examined within deeper pages of Google Scholar. However, a cut-off point was established when citations or influence diminished to zero, resulting in 308 records for the initial identification step. Duplicates, foreign language works, and those by Wicksell were screened and removed. Often, duplicates were instances where a published article was also issued as a working paper, appearing separately in the Google database. After these eliminations, 272 records were advanced to the next stage. During the peer review screening, works not freely available were excluded. A subsequent analysis was conducted on the remaining 167 works to determine if they had at least 100 citations in the Google database and if they also proposed a cohesive theoretical model instead of merely discussing an issue related to the natural rate. Of the 4 results that met these criteria, further screening was done for author duplication, and 2 representative works were selected for analysis.

Further elaboration on this process is provided below in more detail.

The search tool

The academic search tool used in this study was Google Scholar.

The search string used was:

Wicksell AND ("natural rate of interest" OR "natural capital rate of interest" OR "real rate of interest" OR "normal rate of interest" OR "equilibrium rate of interest" OR "in natura rate of interest" OR "neutral rate of interest" OR "r-star")

The search terms are the primary descriptors of the natural rate of literature. They come from two sources: Wicksell and subsequent literature.

Terms used by Wicksell:

"natural rate of interest" ()

"natural capital rate of interest" ()

"real rate of interest" ()

"normal rate of interest" ()

"equilibrium rate of interest" ()

Terms used after Wicksell:

"in natura rate of interest" ()

"neutral rate of interest" ()

"r-star" ()

The Inclusion Criteria

This study used the first 308 database results. After 308 results, the citation count and relevancy declined. Of the 308 results, only works that fulfilled the following criteria were included.

1. Peer-reviewed
2. English language
3. Full access

This study identified 167 results after being screened for the above inclusion criteria. This result was the same result from the previous section.

The next step in this set of academic works was to determine the most influential works.

The criteria for what is influential are based on the academic citation count in the Google Scholar database.

The selection filter for determining which works were influential is those with over one hundred academic citations. After the papers were screened for influence, they had at least one hundred academic citations; as indicated in Google Scholar, there were ten academic works.

The next step was to screen for works that presented a cohesive conceptual framework. That is not simply a mention or general survey of the natural rate of interest but instead in the context of a theoretical construct to capture influential and substantial works. Of the ten academic works that were further screened, four used a new definition of the natural rate of interest in definition in the context of a survey of literature or critique of others, that is, secondary source commentary, rather than a cohesive theory or model with substantiation; therefore, they were omitted and not forwarded to the next step.

Of the six academic works that suggested a new rendition of the natural rate of interest in a cohesive framework or theory, there were two categories. Those of Laubach, T., and Williams, J. C., and of Woodford, M. following their approach. Of these six works remaining, the most substantial work from these two approaches was chosen based on the word count of the works. That is a work from the Laubach, T., & Williams, J. C. approach and from the Woodford, M. approach. In the pool of six works, a determination was made as to which one was the most representative and in-depth. Higher word count works gave a more robust theoretical treatment suitable for a more detailed analysis.

Therefore, the result is that two works were selected based on the above selection criteria at the time of this research.

1. Laubach, T., & Williams, J. C. (2003). Measuring the natural rate of interest. *Review of Economics and Statistics*, 85(4), 1063-1070.
2. Woodford, M. (1999). Interest and Prices. *Manuscript, Princeton University, April*, 30(4).

These two academic works fulfilled the inclusion criteria papers were taken forward into the analysis.

4.2 Results

The results section is divided into two primary sections. One that examines the definition of the natural rate of interest. The other examines the concept of neutral money. Both sections compare the selected academic works derived from the methodological screening of this section compared to Wicksell's primary source documents.

The natural rate of interest section compares these selected works' literal definitions of the natural rate of interest to Wicksell. The money neutrality section is divided into two sections. The first section compares these selected works' text relating to neutral money to Wicksell's earlier writings. The second section compares these selected works' text relating to neutral money to Wicksell's later writings.

The table below provides the literal definitions of the natural rate of interest from the selected representative works, compared to Wicksell. These passages were specifically chosen because each author explicitly refers to their definition as the Wicksellian natural rate of interest. That is not any understanding of the natural rate of interest. Instead, they are presenting the Wicksellian natural rate of interest, a claim supported by their own words.

4.2.1 How the Natural Rate of Interest is Defined: Wicksell Compared to the New Consensus?

Table 4.1

Wicksell’s definition of the natural rate of interest compared to highly cited consensus works definition of the natural rate of interest.

<p>Knut Wicksell</p>	<p>1) “the expected yield on the newly created capital”(Wicksell, 2013, p. 193 “the real interest of actual business. (Geschäftsgewinne, business profit)”(Wicksell 1907: 214) (78.69% of the time)</p> <p>2) “which would be determined by supply and demand if no use were made of money and all lending were effected in the form of real capital goods.” (Wicksell, 1936, p. 102)(9.84% of the time).</p> <p>3) “is neutral in respect to commodity prices and tends neither to raise nor to lower them.” (Wicksell, 1936, p. 102)(11.48% of the time)</p>
<p>Thomas Laubach & John Williams</p>	<p>“The natural rate of interest – the real interest rate consistent with output equaling potential and stable inflation. ...the Wicksellian natural rate of interest”(Laubach & Williams, 2003, p. 2).</p>

<p>Micheal Woodford</p>	<p>"the Wicksellian natural rate of interest, which may be defined as the equilibrium real rate of return in the case of fully flexible prices. Under this definition, one observes a direct correspondence with the previously introduced concept of the natural rate of output. Indeed, the natural rate of interest is just the real rate of interest required to keep aggregate demand equal at all times to the natural rate of output(Woodford, 2003, p. 248)"</p> <p>“define the “natural rate of interest” as what the equilibrium real rate of return would be if prices were not only currently flexible and expected always to be flexible in the future, but also had always been flexible in the past—so that what matters for the computation is not the capital stock that actually exists, but the one that would exist if prices had been flexible, given the actual history of exogenous real disturbances. Under that definition the natural rate of interest would be exogenous, but at the cost of less connection with equilibrium determination in the actual (sticky-price) economy. It seems odd to define the economy’s “natural” level of activity, and correspondingly the associated “natural” level of interest rates, in a way that makes the capital stock that actually exists and the effects of this upon the economy’s productive capacity irrelevant”(Woodford, 2003, p. 372).</p>
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Source: Own elaboration based on the findings in this research

As illustrated in Table 4.1, Wicksell's definitions fundamentally differ from those of the new consensus writers. Wicksell, as examined in the review of the literature and delineated in Chapter 2, primarily emphasizes a micro foundation rate predicated on entrepreneurial decisions and expectations regarding capital and anticipated profit. The primary driver with Wicksell is the microeconomic agent's decision about natural capital through time. This stance contrasts markedly with the main body of academic writers, as depicted in Chapter 4 and evidenced by the above quotations from some of the most frequently cited academic scholars today. Wicksell is a microeconomic agent making decisions about natural capital at the center, but rather an aggregate perspective in a monetary economy. It is not a subtle difference. As the evidence suggests, notably, the New Consensus's perspective aligns more closely with the Keynesian idea of full employment, where output equals potential and is complemented by stable inflation.

The quotes for this study consisted of data collected from the methodological selection that provides a definitional reference to the Wicksellian natural rate of interest. The results of the definition of the natural rate of interest from the works *Measuring the Natural Rate of Interest* by Laubach and Williams and *Interest and Prices* by Woodford are results that the authors specifically called the Wicksellian natural rate of interest. These relevant results provide a Wicksellian natural rate definition in the outcomes identified. Wicksell's quotes were based on the methodological selection of this study.

4.2.2 How is Neutral Money understood: Wickell compared to the New Consensus

This section looks at Wicksell's understanding of money neutrality compared to the two representative works. This section presents texts from each author that summarize their view on money neutrality. Wicksell's quotes are broken out into two sections. The first was his early works, and the latter was from his later writings. Wicksell was in the process of revising his Lectures at the time of his death (Uhr, 1960) to include his new insights into monetary theory. This is why the data is presented in a divided fashion in this table to emphasize the latter developments from Wicksell's early works.

How is Money Neutrality defined

Table 4.2

Wicksell's early understanding of money neutrality and Wicksell's later understanding of money neutrality compared to highly cited consensus writers.

Early theory of Wicksell	“These two rates of interest, the natural rate and the money rate which is quoted on the market tend, of course, to coincide. If the former differs from the latter, money can no longer be said to be "neutral", and monetary consequences in the shape of changes in prices are bound to ensue”(Wicksell, 1936, p. viii). “The analogous picture for money prices should rather be some easily movable
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	<p>object, such as a cylinder, which rests on a horizontal plane in so-called neutral equilibrium...Once the cylinder has come to rest, there is no tendency for it to be restored to its original position. It simply remains where it is so long as no opposite forces come into operation to push it back. It is, of course, clear that such forces can never be entirely absent”(Wicksell, 1936, p. 101).</p> <p>“There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them”(Wicksell, 1936, p. 102).</p> <p>Now if money is loaned at this same rate of interest, it serves as nothing more than a cloak to cover a procedure which, from the purely formal point of view, could have been carried on equally well without it(Wicksell, 1936, p. 104).</p>
<p>Latter theory of Wicksell - 1925 Monetary Neutrality in terms of</p>	<ol style="list-style-type: none"> 1) It seems futile to try to find a purely monetary explanation of the whole, or of the major part, of this deflation, as being due to "deflationist policy" of the Federal Reserve Board and other Central Banks(Wicksell, 1936, p. 211). 2) It is clear that this premise, namely, the shortage of goods, regarded as the primary cause of the rise in prices, leads us to an entirely different

<p>Natural rate=Bank rate, but price level movements (unstable aggregate prices) occurring outside the natural rate framework.</p>	<p>presentation of the problem from the one on which monetary theory has hitherto been based(Wicksell, 1936, p. 203).</p> <p>3) The main question at issue has referred on the one hand to the relation between a scarcity of commodities and the rise of prices and on the other hand to the relation between the cessation of such a scarcity and the subsequent fall in prices(Wicksell, 1936, p. 199).</p> <p>4) But it is this very scarcity which causes the rise in prices, and the monetary purchasing power so created is adequate to pay the sum actually demanded for the available goods and services(Wicksell, 1936, p. 201).</p> <p>5) It should a fortiori prove futile to prevent a rise in prices merely by raising interest rates(Wicksell, 1936, p. 203).</p> <p>6) ...a severe rise in prices... during the latter part of 1919 and the beginning of 1920. The cause is doubtless to be sought in the relative shortage of goods(Wicksell, 1936, p. 212)</p>
<p>Thomas Laubach & John Williams</p>	<p>A key input into the conduct of monetary policy is a measure of the “neutral” stance of policy, against which one can gauge policy’s stimulative or contractionary impetus. ...the short-term interest rate has become the primary policy instrument. In such regimes, the “equilibrium” or “natural” interest rate</p>

	provides a metric” (Holston et al., 2017, p. 2).
Micheal Woodford	One thus finds that in the case of fully flexible prices, equilibrium output is completely independent of monetary policy” (Woodford, 2003,p.152).

Source: Own elaboration based on the findings in this research

Table 4.2 On the topic of neutral money, it shows that in his early writings, Wicksell’s concept of neutral money was that prices were not influenced by money in a natural rate equilibrium, that is, in the sense that prices moved on supply and demand but not for monetary reasons. In Wicksell’s later writings, Wicksell explained or expanded this idea to include possible non-monetary price movements. That is aggregate price movements that were money neutral but

moving inversely with scarcity or abundance and implied productivity changes. In other words, a decoupling of money neutrality with ‘stable prices.’

In the table on neutral money, Laubach and Williams discuss neutral money in a cursory exposition, connecting neutral money with the natural rate of interest. That is the natural rate of interest connected to short-term interest and policy.

In the table on neutral money, Woodford writes about a flexible price output equilibrium that is not connected to monetary action. In his work, there is no discussion on money neutrality beyond this statement.

4.3 Discussion

This section examines highly cited academic works that center on the definition of the natural rate of interest and how fragmentation plays a role in their interpretation of Wicksell’s natural rate of interest. Specifically, it explores whether these influential works, as identified through the Google Scholar database systemic search, define Wicksell's natural rate in a particular way or offer a comprehensive interpretation or fragmentation.

The evidence suggests that these authors reinterpret Wicksell’s natural rate of interest by focusing on a singular fragment of his work, particularly the concept of stable prices, without fully considering the broader context of his theory. Wicksell’s rich and well-developed theory is often oversimplified into a singular axiom of stable prices. This selective interpretation distorts Wicksell’s original concept, misrepresenting both the natural rate of interest and its corollary idea of money neutrality.

The underlying premise is that highly cited authors who create new renditions of Wicksell's natural interest rate miss the essence of Wicksell's definition of the natural interest rate and money neutrality. Neutral money is studied here because the idea of neutral money is connected to the Wicksellian stable price rendition of the definition of the natural rate of interest conceptually. Clarity on these authors' ideas of money neutrality is vital because it assesses the concept of 'stable prices' compared to money neutrality, as understood by Wicksell. Conceptually, authors use the terms 'stable prices' and 'neutral' almost synonymously. However, these can be different concepts and need to be examined. The implication is that a misinterpretation of Wicksell's definition of the natural rate and money neutrality potentially creates a theory that lacks the logical rigor of Wicksell's works in its totality.

4.3.1 What is the theory of the definition of the natural rate of interest: Wicksell compared to New Consensus

The claim that highly cited works on the Wicksellian natural rate of interest miss the essence of Wicksell's understanding of the natural rate of interest on capital is being examined. It asked the question, did Laubach and Williams's work *Measuring the Natural Rate of Interest and* Woodford's work *Interest and Prices*, the most highly cited and influential works on the Wicksellian natural rate of interest today, miss the essence of Wicksell's definition?

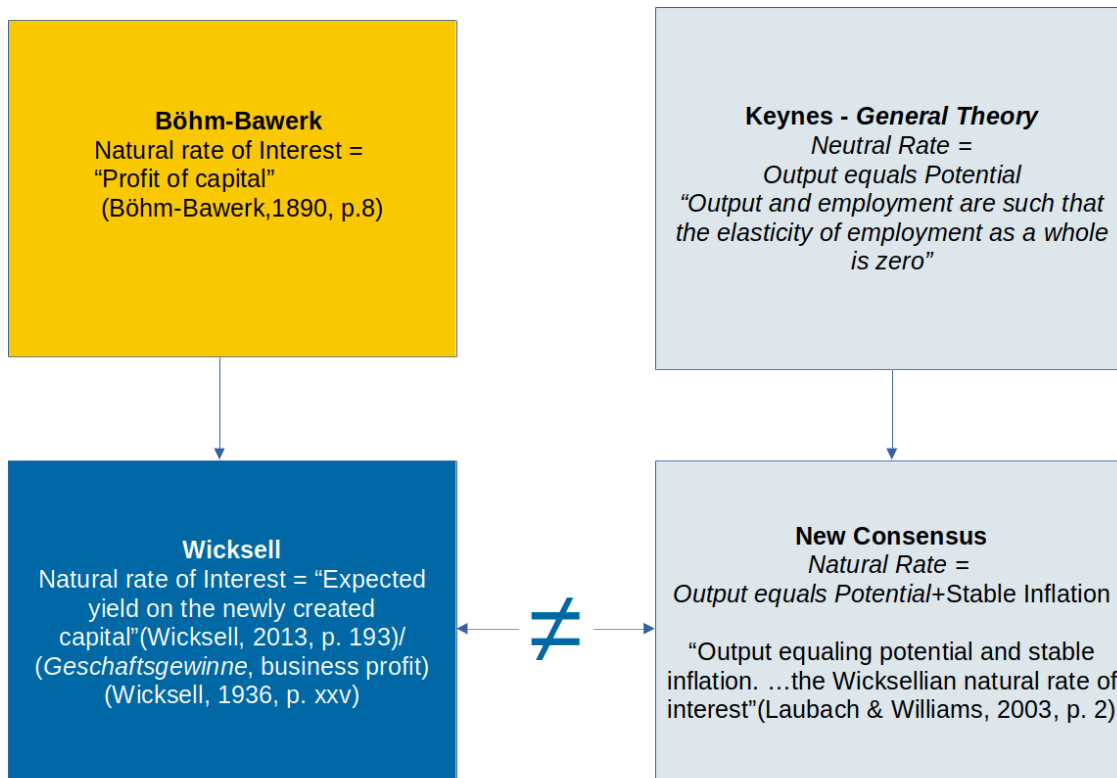
The above two representative works call the interest rate they refer to as the Wicksellian "natural rate of interest." They are writing and theorizing about Wicksell's natural rate of interest because they literally call it the Wicksellian natural rate. The results in this study show that the New Consensus developed a theory of the natural rate of interest for a modern theoretical audience and policy; it was Wicksell's rate they had in mind and no other. By using the term

Wicksellian natural rate of interest, they lay implicit claims to Wicksell's underlying theory or at least a theoretical solid connection because they verbatim call it by the same name.

The results in the table show that the New Consensus' "Wicksellian natural rate of interest" bears little resemblance to Wicksell's "natural rate of interest on capital," except in name. The essence of Wicksell's definitional understanding is not present. Based on the definitions presented in the table, they define the Wicksellian natural rate in name only, not in fact.

Figure 4.2

Comparison of Wicksell versus the new consensus understanding of the definition of the natural rate of interest.



Source: Own elaboration

As depicted in Figure 4.2, there is a clear definitional incongruence between how Wicksell and the New Consensus define the natural rate of interest. The claim is that they miss the essence of this theory. Couple this with the New Consensus explicitly referring to their interest rate as Wicksell's natural rate of interest, which is repeated in academic literature. The genesis of this confusion stems from ambiguities in Keynes's writings concerning the interest rate if you compare these ideas, as elaborated in the literature review of this study. They are replacing Wicksell's ideas and those developed by the Stockholm school, for example, with Keynesian ideas about interest. The confusion about how to define the natural rate of interest on capital and a broader understanding of the interest rate is echoed and amplified in modern academic literature, as demonstrated based on the evidence in Chapter 3 of this study, which reveals a fragmented portrayal of Wicksell's definition of the natural rate of interest. Specifically, modern writers fragment the definitional understanding of Wicksell's natural rate of interest, largely as they rely on sources that do not survey Wicksell. The critical point here is that these writers need to understand the essence of this theory. Researchers often rely on secondary sources rather than systematically analyzing primary source documents to present their theory. Economists and researchers must recognize the role of maintaining objectivity while researching the New Consensus and contributing to the literature rather than accepting it as an established paradigm without critical examination. This academic fragmentation has been transmitted to the New Consensus, akin to the emperor's new clothes, becoming an accepted paradigm rather than being objectively and systematically studied through the lens of statistical science.

The evidence in the tables above (i.e., the literal words of Laubach, Williams, and Woodford regarding their new proposed renditions of the natural rate of interest) shows that the essence of their definitions differs from Wicksell's natural rate of interest on capital. This is evident when compared to Wicksell's literal definitions. Their definitions substantially diverge from Wicksell's original conception. These deviations undermine their claim to work within a Wicksellian framework, given that their perspectives do not align with Wicksell's concept of the natural rate of interest on capital. When the authors refer to these expositions as a theory of the natural rate of interest, they are misinterpreting or misrepresenting Wicksell's theory.

The definition of Thomas Laubach and John Williams has two components:

1. Output equals potential
2. Stable inflation

The definition of Michael Woodford has two components:

1. The rate that keeps aggregate demand equal to the natural rate of output;
2. Real equilibrium rate of return for fully flexible prices

An objective analysis of Wicksell's theory based on primary source evidence shows that the two definitional components identified by Laubach and Williams and the two definitional components identified by Woodford in their highly cited works are outside the three expositions of Wicksell's definition.

Restating Wicksell's first and most frequently mentioned definitional rendition:

1) “The expected yield on the newly created capital”(Wicksell, 2013, p. 193

“the real interest of actual business. (Geschäftsgewinne, business profit)”(Wicksell 1907, 214) (78.69% of the time)

Nothing here, in essence, is found in Laubach, Williams, or Woodford. Capital is not even central in their theory or mentioned in the definition. Wicksell's rate is the rate on *capital* in any translation; it is the 'natural capital rate.' To omit capital as the centerpiece to make it something else, not Wicksellian. Woodford clearly states that capital is not essential (Woodford, 2003). If capital is not central or even mentioned, how could it be natürlicher Kapitalzins? It is important to note that this is a compound word, with natürlich meaning "natural" and *Kapitalzins* meaning "capital interest". It is the capital interest that Wicksell refers to. It also refer to a natural rate, which is also not part of the New Consensus definition. Ther fact is, capital interest, as well as natural, is omitted in the modern renditions. Therefore, the essence of the capital interest is missing from Laubach, Williams, or Woodford. This supports the claim in this study that modern renditions miss the essence of Wicksell’s natural rate of interest on capital. The natural rate of interest literally is a capital interest rate.

As significant, *entrepreneurial* expectations on the yield of newly created capital at a micro level are absent. This intertemporal calculation of capital by entrepreneurial agents that ultimately drive price movements via comparison to the bank rate is not part of the definition. This is the core idea behind Wicksell. It is a calculation based on profit and loan rates at a micro level. This first rendition is Wicksell's primary definition based on the evidence presented in this study. Not including the micro foundation of the entrepreneurial intertemporal calculation on

natural capital interest, new renditions of the natural interest rate on capital is a significant departure from Wicksell, objectively in name only. To exclude the essence of this primary Wickesllian definition severs the link to Wicksell. Based on the evidence, new renditions are linguistic polysemy homographs.

Restating Wicksell's second mentioned definitional rendition:

2) “which would be determined by supply and demand if no use were made of money and all lending were affected in the form of real capital goods.” (Wicksell, 1936, p. 102)(9.84% of the time).

No component of this rendition is found in Laubach, Williams, or Woodford. In Wicksell’s conceptual framework, the investment and savings equality flows from the microeconomic agents, entrepreneurs making intertemporal economic decisions. It is a consequence of Wicksell’s primary understanding of microeconomic agents acting on the intertemporal calculation of capital interest rather than a spontaneous generation in aggregate. Microeconomic agents drive equilibrium in supply and demand for *natural capital* through their intertemporal economic decisions. This facet is missing in Laubach, Williams, and Woodford's definitions. Further, based on the primary source evidence, the 'no use of money' is not addressed or mentioned in the definition of the authors above. The *in natura* aspect of Wicksell's rate gives the natural rate of interest on capital, the term 'natural'.

Based on the evidence of the first two renditions of Wicksell, the New Consensus is markedly different from Wicksell and theoretically connected to "output and employment are such that the elasticity of employment as a whole is zero”(Keynes, 1936, p. 121) in plain

English, which is 'output equals potential.' Therefore, no essence of the definitional components of Wicksell's first two renditions is in the definition of Laubach, Williams, or Woodford. Full utilization of resources might have been a classical assumption Wicksell was operating on, but certainly outside his formal definition, as the evidence shows. To be logically consistent, it would have to exclude the terms 'natural' and 'capital.' In that case, it is just a neutral or optimum interest rate.

Restating Wicksell's third mentioned definitional rendition:

3) "is neutral in respect to commodity prices and tends neither to raise nor to lower them." (Wicksell, 1936, p. 102)(11.48% of the time)

Most significant is this:

As presented in Wicksell's latter writings regarding prices and monetary theory, Knut Wicksell was "intent on revising his monetary analysis ... against his price stabilization norm" (Thomas, 1976, p. 22; Wicksell, 1925b). This study clearly shows the evolution of Wicksell's thought. Wicksell's understanding of monetary theory evolved; Wicksell understood that price stabilization was not a defining component of the natural rate of interest on capital. Aggregate commodity price data is what Wicksell had to work with in his time. However, aggregate measures of expected profitability were not realistic; the data was simply not available like it is today, to my knowledge, based on the research. Therefore, even though he primarily defined the natural rate of interest as the expected yield on newly created capital, based on the available data of his time, he did not think he could accurately estimate it without a proxy of prices. Wicksell writes in this regard 'If it were possible to ascertain and specify the current value of the natural

rate”(Wicksell, 1936, p. 107). In his early writing, Wicksell initially considered aggregate commodity price data as a proxy for monetary equilibrium to help ascertain the natural rate of interest’s relative relation to the observable bank rate. Commodity price data was available to Wicksell. In the context of the time of writing *Interest and Prices* in 1898, this seemed logical. However, technology and the world changed beyond what Wicksell himself could have envisioned. The proliferation of data as readily and freely available to modern writers, coupled with Wicksell's concession of prices moving inversely with productivity even in equilibrium at the end of the Davidson-Wicksell polemic, should turn model and framework construction focus from using the archaic aggregate price stability as a gauge of natural rate monetary neutrality to the data on the expected yield of capital. Hence, based on the evidence and consideration for the context of Wicksell’s writing, modern writers should consider returning to his primary definition of the expected yield on newly created capital over a defined index of aggregate prices and develop novel lines of research related to Wicksell's natural rate of interest with aq consideration of the evolution of Wicksell’s thoughts and time.

The data presented above supports the evidence presented in the literature review of this study. This study further supports it by the evidence and discussion on neutral money. Therefore, definitional renditions that rely on ‘table prices’ or ‘stable inflation’ rather than the 'expected yield on newly created capital' are not Wicksellian in essence when considering the whole of Wicksell’s writing rather than a fragment of his definition in a fragment in time.

Furthermore, 'stable inflation' is not part of Wicksell's theory and definition; it is money-neutral, with no inflation. However, it is in this fragment that Laubach, Williams, or Woodford build their claim to the Wicksell connection.

However, a careful reading of Wicksell finds that the Laubach and Williams definition is the opposite of Wicksell's. In work by Laubach and Williams, it is written, "The natural rate of interest – the real interest rate consistent with output equaling potential and stable inflation. ...the Wicksellian natural rate of interest"(Laubach & Williams, 2003, p. 2).

It is tautological that stable inflation is the contrary, even the opposite of 'no rise or fall in prices.' The unambiguous logical conclusion is that the opposite of 0% or 'nothing' is 'something' like 3%. Therefore, this work can not claim to be Wicksellian. Any definitional claim needs to include the context of money neutrality based on the complete writings of Wicksell and other aspects of Wicksell's definition(Wicksell, 1925b).

A close look at Woodford's definition of the natural interest rate appears closer to Wicksell's semantically. However, a closer examination and analysis of the data shows it is not—some points to consider regarding Woodford's exposition.

1) The definition includes the word 'equilibrium' in the definition of the equilibrium rate. If used in the definition, we need to find out what the intention of equilibrium is here in that case. When Woodford uses the term "the equilibrium rate, " What equilibrium is referred to? It is not apparent from the definition; at the very least, it is rhetorical. Is it an equilibrium of capital or intertemporal market? What does the real rate refer to? Is it a financial market equilibrium or something else? Is it a general equilibrium in the Walasian sense? Or is Woodford mirroring

Keynes's understanding of equilibrium: “The neutral rate of interest can be more strictly defined as the rate of interest which prevails in equilibrium when output and employment are such that the elasticity of employment as a whole is zero”(Keynes, 1936, p. 121)? Or as Woodford phrases it, “interest required to keep aggregate demand equal at all times to the natural rate of output.(Woodford, 2003, p. 248)” Therefore, 'equilibrium' is rhetorical unless explained in the definition's context. This non-explicit rhetorical writing can confuse readers trying to understand the meaning of Wicksell's natural interest rate as interpreted by Woodford.

2) Woodford's real rate is a polysemy homograph. At its face value, it looks the same as Wicksell's real rate but means something entirely different. The term 'real rate' alone is ambiguous at face value.

The critical follow-up question is: What is the real rate of? In economics and finance, "real rate" can refer to different things. Is Woodford referring to the real rate in the Irving Fisher sense, or the capital real rate, or something else entirely?

As discussed in the non-systematic literature review, Woodford's real rate is not the rate of capital. Wicksell's was the capital rate, and he specifies this precisely in the definition. So, does Woodford refer to a real return rate on financial assets, money, fixed previously purchased capital, land, labor investment, or something else?

In Woodford's theory, a deeper examination and interpretation of his 785-page work reveals that the real return rate ultimately connects to financial assets and his eternally lived representative household(Woodford, 2003). What is clear is that Wicksell's "real rate of return" is

the return on capital, which is why his natural rate is called the natural rate of interest on capital. Woodford's rate is not "natural" or the "rate of return on capital."

The only relevant point for the analysis is to answer the critical follow-up question: What is the real rate that Woodford is referring to? The critical point here is that Woodford specifies that his real rate is not the capital rate, as detailed in the evidence in these results and supported by the academic review of literature in this study.

This question is crucial because it has implications for understanding and applying Woodford's theory to the real world. If Woodford's real rate is not the rate of return on capital, then it is not clear what it is a measure of. Using Woodford's theory to understand the real-world economy could make it difficult.

The point is that readers can not easily discern the meaning of "real rate of return." In isolation, it is not evident, and this can cause confusion and subsequent further misinterpretation for academics who cite, as they do Woodford. However, Woodford uses the phrase "real rate of return," reminiscent of Wicksell. However, it has been established that it is not the rate of capital.

It is more a question of being semantically related rather than having any intrinsic relation to the theory of Wicksell, or at least we can not confirm by simply examining the definitions alone because there is no additional information connected to the term in the definition. Once the reader looks at Woodford's theory and it is not the rate of capital, then it is evident. However, reading this term in isolation gives writers researching based on secondary sources a sense of ambiguity and could be misinterpreted.

3) The idea of fully flexible prices. This price flexibility is similar to the ideas of rigidities versus non-rigidities, and sticky prices are the language of Keynes in the *General Theory*. Stickiness and non-stickiness parallel Laubach and Williams' Theory of output equal potential.

Woodford tributes Wicksell, naming the book *Interest and Prices* after his title. However, he is not Wicksellian based on the definitional evidence. Laubach, Williams, and Woodford's rate might more precisely be called the 'Keynesian *General theory*-neutral monetary rate of full employment' and not the Wicksellian 'natural rate of interest on capital.'

In summary, the two representative works reference output (aggregate), which is not in the formal definition of Wicksell. Laubach and Williams also define the Wicksellian natural rate as 'stable inflation.' This is not in Wicksell's definition.

Woodford connects full output specifically with aggregate demand and fully flexible prices, which is not in Wicksell's definition. For Woodford, based on the definition, that natural rate is a full aggregate output equilibrium. There is a terminology of a 'rate of return', but this is not connected to the rate of return on capital, as he writes. It is not the expected rate of return on capital. Wicksell's rate was the *natürlicher Kapitalzins*. It literally means "natural capital interest." Referring to the Wicksellian natural rate without capital makes no logical sense, as this is the rate Wicksell was referring to. Wicksell's definition, in contrast, is based on microeconomic agents calculating the expected yield *on capital*, which also brings about an equality of savings and investment, and ultimately, in equilibrium, there will exist an economy where prices are neutral with respect to commodity prices.

Therefore, supporting a claim of this study that highly cited modern renditions of the natural rate of interest are misinterpretations of Wicksell. Based on the definitions presented, these highly cited authors examined in this section are not Wicksellian as their writings claim. The implication is profound. Theory and policy can perpetually differ from Wicksell in the modern academic literature that refers to these highly cited sources. The theory that refers to these highly cited authors as using Wicksell's natural rate of interest can cause confusion in academic science. This misinterpretation can lead to potentially suboptimal policy until this is corrected. This is why further work needs to reiterate and study this point from other aspects. It needs to confirm the findings of this study further.

4.3.2 What is Neutral Money: Wicksell compared to the New Consensus

This section answers the question, 'Does the New Consensus interpret and transmit the essence of Wicksell's neutral money idea through to their modern renditions of the natural rate framework?' The findings indicate that the New Consensus misrepresents Wicksell's fundamental ideas. By comparing Wicksell's early and later writings with those of scholars linked to this methodology, it becomes clear that there is no meaningful connection between Wicksell's concept of neutral money and the contemporary, widely cited interpretations. This conclusion is based on a comprehensive examination of the material presented. This conclusion is drawn from a thorough analysis of the presented text. Notably, the modern renditions fail to articulate Wicksell's fundamental idea that money merely acts as a "cloak" (Wicksell, 1936, p. 104) in a state of monetary equilibrium, and any price movement or lack thereof results directly from the real effects of supply and demand. The results cover two periods of Wicksell's writing because the evolution of Wicksell's monetary writings did not stop in 1898 with *Interest and*

Prices. On the contrary, all thinkers develop and revise their thinking, sometimes in a revolutionary way. Wicksell was no exception; in this case, his neutral money took a new dimension in the context of his later writing (Wicksell, 1925b).

4.3.2.1 Wickeall's Early Works 1898-1924

Wicksell's neutral terminology found in his text in the above results section refers specifically to the neutrality of price tendencies relating to monetary equilibrium. The results show the phrases "The analogous picture for money prices" (Wicksell, 1936, p. 101) "in the shape of changes in prices"(Wicksell, 1936, p. viii), and "neutral in respect to commodity prices (Wicksell, 1936, p. 102)." These results confirm that Wicksell, in his earlier writings, refers neutrally in the context of prices. Wicksell's Money Neutrality was neutral because it did not influence prices, but economics could have been carried on equally well without it (money) (Wicksell, 1936, p. 104). Wicksell did not assert the neutrality of economic output or a natural rate of output. There is no reference to output in the context of neutrality. Instead, his monetary theory focused on the neutrality of money and credit on the workings of supply and demand and, ultimately, prices. Wicksell's explanation of fluctuations in output is connected to real factors rather than monetary ones (Wicksell, 1906, 1907a, 2013), nor are they an indirect expression of monetary distortions or price rigidities(Boianovsky & Trautwein, 2001, 2003a). Therefore, based on the results, in Wicksell's mind, money neutrality was specific to money and prices or, rather, the *non-influence* of money on prices that consequently are determined in the real sector supply and demand changes in a money-neutral equilibrium.

Based on the resultant text, Wicksell believes that aggregate price movements are at rest like a “cylinder has come to rest (Wicksell, 1936, p. 101),” and this neutrality tends neither to raise nor to lower them”(Wicksell, 1936, p. 102). Wicksell’s understanding when writing *Interest and Prices*, was aggregate prices not moving up or down, an absence of a cumulative process. Therefore, according to Wicksell's early works, it is about prices and a tendency not to move in the aggregate when neutral.

Wicksell put this understanding of equilibrium and money neutrality in the context of the natural rate of interest and the money rate of interest being equal and bringing about equilibrium. In this equilibrium, it is as if money does not exist or is a ‘cloak’ for transactions that would occur if there was no use of money(Wicksell, 1936). Reiterating Wickell’s point here, Wicksell writes, “Now if money is loaned at this same rate of interest, it serves as nothing more than a cloak to cover a procedure which, from the purely formal point of view, could have been carried on equally well without it. The conditions of economic equilibrium are fulfilled in precisely the same manner” (Wicksell, 1936, p. 191).

Wicksell’s money neutrality was not an inflationary or deflationary equilibrium caused by central bank action (Wicksell, 1925b), as restated in the evidence or quotes presented (Boianovsky, 1998). Wicksell’s understanding is an absence of a monetary force to disturb prices beyond the supply and demand conditions dictate. It also should be noted that Wicksell wrote in the time of the classical gold standard, which acted as an anchor for price movements and bank rate tether to the natural rate(Wicksell, 1916b, 1918, 1936, 2013). Therefore, his initial conception differed from his latter as the world around him changed. However, and importantly,

fundamentally, there is a consistency in Wicksell's ideas: money without influence on aggregate prices, but its outcome was modified to fit the context.

4.3.2.2 Wicksell's latter works 1924-1926

In Wicksell's later writings, the data provide convincing evidence and theoretical support for Wicksell's explanation that aggregate price movements occur outside his natural rate of interest monetary theory explanation framework. That is, the price level could move up or down in aggregate while the system is at a natural rate of monetary equilibrium. The text in the results sections is consistent with the findings in the literature review and, taken together, supports the premise that stable prices do not necessarily indicate monetary equilibrium. This is demonstrated in the following passages, when Wicksell writes, "It seems futile to try to find a purely monetary explanation of the whole, or of the major part, of this deflation (Wicksell, 1936, p. 211)" and "It is clear that this premise, namely, the shortage of goods, regarded as the primary cause of the rise in prices, leads us to an entirely different presentation of the problem from the one on which monetary theory" (Wicksell, 1936, p. 203). Based on this evidence, monetary equilibrium, money neutrality, is not synonymous with stable prices, according to Wicksell.

This is further supported by Wicksell's assertions in the results section text that scarcity (and logically the converse), real sector supply and demand conditions, can move the aggregate price level without the cause being attributed to a monetary natural rate disequilibrium. Specifically, Wicksell will write about "scarcity which causes the rise in prices" (Wicksell, 1936, p. 201) or a "severe rise in prices... The cause is doubtless to be sought in the relative shortage of goods"(Wicksell, 1936, p. 212). Therefore, when Wicksell uses words like "doubtless," "which cases," "It is clear," or "a fortiori prove", these are phrases that are strongly worded. In fact, "a

fortiori prove” literally means an idea supports a conclusion and overturns a previous thought, conclusion, or idea. These words expressed with such conviction are convincing evidence in favor of the claim that Wicksell’s latter writings had a non-monetary explanation for aggregate price fluctuations, which logically negates the stable price criteria of the natural rate equilibrium or a definition based on stable prices and revises the understanding of neutral money. If one were to call the natural rate of interest the price stabilizing rate, that contradicts the evidence presented in the results section.

Therefore, these findings would suggest that stable prices are not necessarily determinant criteria for monetary equilibrium and money neutrality. This textual finding, supported by Wicksell’s later writings, is evidence of this premise. I would encourage researchers to reexamine Wicksell’s later writings in this regard and continue further research.

If one puts the context of Wicksell’s later writing with the dialogue he had with David Davidson, it supports the general picture emerging that neutral money is not equated with stable aggregate price, which is not a disjointed theory. The evolution started in the early 1900s, only a few years later, when he was writing David Davidson in *Ekonomisk Tidskrift* in 1907 and after (Davidson, 1909, 1913, 1925). These *Ekonomisk Tidskrift* (started by David Davidson and evolving into the modern *Swedish Journal of Economics* today)(Uhr, 1960) writings are significant in the history of economic thought. Subsequently, Davidson presented a preponderance of evidence in the form of empirical data on prices from the WWI experience(Davidson, 1925; Thomas, 1976). That is, monetary suppositions do not explain price movements but rather scarcity, the workings of supply and demand. Although initially, Wicksell

did not accept Davidson's premise, he later conceded. Stable prices were no longer a part of the equilibrium norm(Myrdal, 1931; Wicksell, 1925b, 1936). Hence, money neutrality takes a different dimension not connected with stable prices. The reason is connected to changes in the supply of goods. That is a scarcity or increase of goods. According to Wicksell, the above data shows that stable prices are not synonymous with monetary equilibrium(Wicksell, 1925b). Instead, money might be neutral, but aggregate prices might move because of relative scarcity or abundance. In one sense, this was what Wicksell was writing about all along, even in his early works, that supply and demand determine prices rather than money in equilibrium. Lindhal and Uhr confirmed this. "If productivity changes, factor quantities being given, then the aim of monetary policy, preservation of the real value of contracts... required the price level of consumption goods should vary in a manner inversely proportional to changes in productivity"(Uhr, 1960, p. 298). These were not 'stable prices'.

4.3.3 Laubach and Williams' Money Neutrality

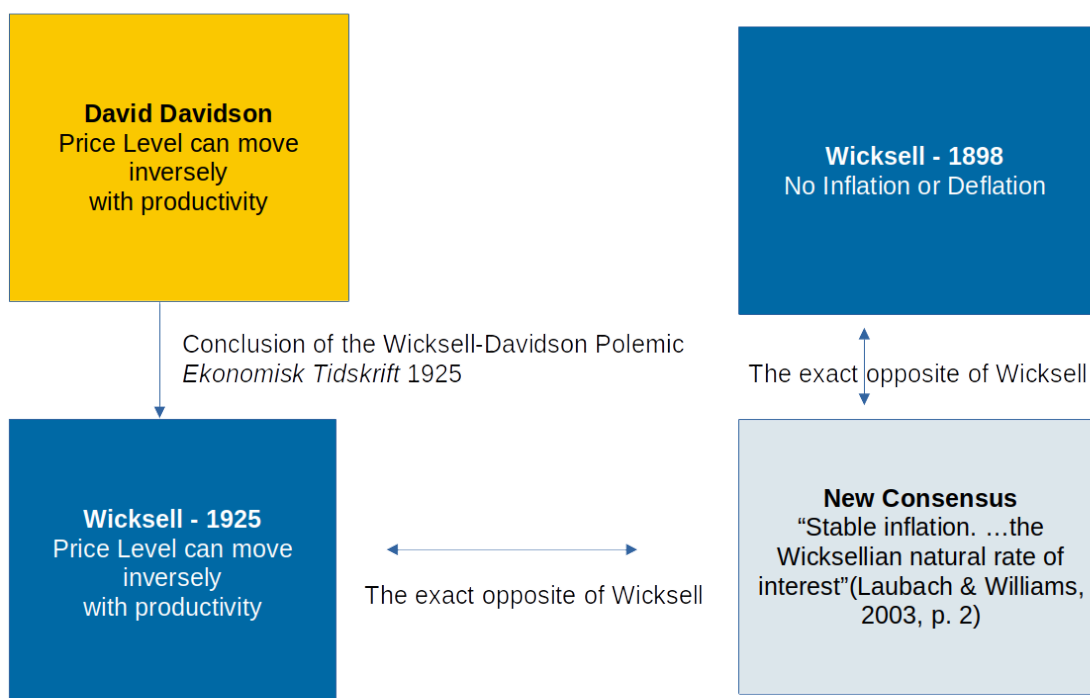
In the highly cited work of Laubach and Willams, they do not describe or define the precise meaning of money neutrality. Instead, they generally articulate that short-term rates of interest can be the policy tool to create or bring about a neutral policy stance. This stance refers to the natural rate of interest. Laubach and Willams allude to a neutral monetary policy stance regarding stimulative or contractionary output and relates to short-term interest rates, but prices are not explicitly mentioned. The table presents evidence that the word neutral is an undefined vague notion connected to the output Rather than an immediate connection to the Wicksellian idea. Or any in-depth explanation about neutrality. Precisely when they write "a measure of the "neutral" stance of policy" (Holston et al., 2017, p. 2). It is assumed they are writing about

output, but this does not give any additional information about the Wicksellian concern of prices. They further use the language as “the “equilibrium” or “natural” interest rate provides a metric” (Holston et al., 2017, p. 2). This seems to make a general claim to a Wicksellian term of natural rate but with a different meaning. Specifically, the Keynesian *General Theory* idea of output-focused economics may have merit but is based on the evidence of Wicksell’s writing, not characteristically Wicksellian.

However, if the natural rate of interest is the metric for a policy-neutral stance; in that case, one needs to refer to the definition of the natural rate of interest to understand what neutral means. Their definition of the natural rate of interest suggests that the neutral monetary equilibrium of Laubach and Williams means “stable inflation, but also output.” Stable inflation is not the Wicksellian early or later understanding of neutral money; it is it found in any of Wicksell’s twenty-one published English translated works that Wicksell discusses the interest rate directly, or any of the forty-nine articulation of the definitions of the natural rate of interest as shown in this study. It is not applicable to the definition of the natural interest rate on capital if you consider Wicksell’s evolution on money neutrality. Therefore, Laubach and Willams's ideas on the Wicksellian natural rate of interest, prices, and money neutrality are disjointed and without historical precedence when referring to the primary source data of Wicksell. Laubach and Willams miss the essence of Wicksell’s neutral money relating to Wicksell’s natural rate of interest on capital based on the data in the tables presented evidence.

Figure 4.3

Price level changes based on Wicksell's latter insights compared to the New Consensus.



Source: Own elaboration

As illustrated in Figure 4.2, it is crucial to recognize that the Wicksell-Davidson Polemic has been overlooked by the New Consensus, a point addressed in the literature review of this study. When considering this alongside Wicksell's later insights, prices should not move with stable inflation but rather remain constant or even deflate as productivity increases the supply of goods. However, and importantly, the position put forward by the New Consensus as Wicksell's natural rate of interest directly contradicts Wicksell's actual theory and writings.

4.3.4 Woodford's Money Neutrality

Woodford does not explicitly discuss money neutrality in his 2003 *Interest and Prices* or use the word neutral in connection to money (Boianovsky & Trautwein, 2006; Woodford, 2003). Woodford does not discuss or mention money neutrality in this work. Woodford does not elaborate on the prevailing perspective in the New Neoclassical Synthesis, which states that money impacts the economy in the short term but is neutral in the long term. Instead, Woodford interestingly omits any reference to the term 'neutral' throughout the book. Neither the phrases 'neutrality' nor 'non-neutrality' of money or monetary policy are mentioned (Boianovsky & Trautwein, 2006, p. 183) in this 785-page book. However, Woodford, as presented in the evidence of his own words above, Woodford refers to a monetary policy that does not influence equilibrium output under fully flexible prices. Based on the primary source textual data, it is evident that his monetary policy refers directly to output, arguably a Keynesian idea from the *General Theory*. If Woodford does not discuss neutrality in the Wicksellian context, that is in relation to supply and demand and prices and not in the context of stable or nonstable price framework of the Wicksellian natural rate of interest *on capital*, the evidence presented suggests he circumvents the essences of Wicksell. This chapter answers the research question, and the evidence supports the sub-hypothesis: Highly cited authors who develop new renditions of Wicksell's natural interest rate miss the essence of Wicksell's natural interest rate and money neutrality.

Chapter 5

Conclusions, Limitations, and Future Research

5.1 Conclusions

The conclusions of this work are based on the findings from testing the hypotheses.

This dissertation's primary objective was to understand better Knut Wicksell's definition of the natural interest rate and how it is represented in modern academic literature. The underlying premise is that modern literature has misdefined and fragmented Wicksell's natural rate of interest. The significance is that if authors lay claims to the Wicksellian theoretical foundation, yet misdefine or fragment the definition of Wicksell, then their claims to Wicksell's lineage are in question and potentially lack the conceptual rigor of Wicksell's micro foundation-based natural rate of interest. This misunderstanding is perpetuated by authors that subsequently rely on secondary source information rather than in-depth research of the primary source documents of Wicksell or the early Wicksellians before the Wicksell connection was lost. As illustrated in Table 5.1, the data for each hypothesis test was accepted. This acceptance corroborated the thesis. The systematic analysis, coupled with statistical evidence, supports the sub-hypotheses, and, in turn, these sub-hypotheses reinforce the central thesis.

The thesis that Wicksell's natural rate of interest is misdefined or fragmented in academic literature was proven with statistical evidence derived from an analysis of Wicksell's works and an analysis and comparison of modern literature. The statistical data supported this claim with confidence.

Therefore, reject the null hypothesis and accept the alternative hypothesis

Null: Wicksell's natural rate of interest is not definitionally fragmented in academic literature, and new renditions do not miss the essence of his theory.

Alternative: Wicksell's natural rate of interest is definitionally fragmented in academic literature, and new renditions do miss the essence of his theory.

Answers to a series of research questions with support for the thesis.

Table 5.1

Research Questions with highlights of empirical and contextual evidence in this study

Research Questions	How it was answered	Results
<p>RQ1: How did Wicksell define the natural rate, based on all published texts of Wicksell translated into English?</p>	<ul style="list-style-type: none"> ● Definition 1 78.95% Expected yield on newly created capital ● Definition 2 10.53% Investment equals savings ● Definition 3 10.53% neutral, stable price 	<p>Wicksell's articulations of the definition of the natural rate of interest were varied, yet there was a primary and consistent theme across the texts: the expected yield on newly created capital, which constituted 78.95% of the definitions found. This theme was congruent with the genesis of this rate in Böhm-Bawerkian theory and</p>

	level	logically consistent with the micro-workings of Wicksell's thought experiment regarding entrepreneurial intertemporal decisions pertaining to capital and the money rate.
<p>RQ2: How completely does academic literature define the natural rate of interest, how well cited is this definition, and how fragmented is the definition in the presentation?</p>	<ul style="list-style-type: none"> ● Definition - 31.14% no definition and 8.38% all definitional criteria ● Reference - 66.47% referenced to 0 or 1 work of Wicksell's 800+ Works ● Presentation - 85.71% are fragmented in presentation 	<p>Based on a systematic analysis of 167 highly ranked works in the Google Scholar database, the academic literature concerning Wicksell's natural rate of interest revealed significant fragmentation. When discussing the natural rate of Wicksell, the majority of these works either provided no definition or only a fragment of the definition, thereby demonstrating high definitional fragmentation. Additionally, these works predominantly referenced only 0 or 1 of Wicksell's works, leading to high reference fragmentation. Both</p>

		<p>initial and presentation fragmentation were observed in the majority of these works, further corroborating the high level of definitional fragmentation. When considered collectively, there is strong evidence to suggest that the academic literature highly fragments Wicksell's natural rate, potentially leading to its misinterpretation.</p>
<p>RQ3: How do new definitions of the natural rate of interest on capital developed by highly cited modern authors compare with the essence of Wicksell's original</p>	<ul style="list-style-type: none"> ● Wicksell Natural Rate: Expected return on newly created capital ● New Consensus Natural Rate: Output equaling potential and stable inflation, 	<p>The most highly cited authors of the New Consensus refer to their rate as the specifically Wicksellian natural rate. However, their definition bears no resemblance to the essence of Wicksell's definition, as evidenced by primary source documents. This has implications for neutrality is implied.</p> <p>The New Consensus misinterprets</p>

<p>definition and understanding of money neutrality?</p>	<p>aggregate demand equal at all times to the natural rate of output</p> <ul style="list-style-type: none"> ● Wicksell Monetary Neutrality: If the rates "coincide," they are "said to be neutral" (Wicksell, 1936, p. viii) neutral in respect to commodity prices" (Wicksell, 1936, p. 102) ; money "serves as nothing more than a cloak"(Wicksell, 1936, p. 104) ● "the shortage of goods, regarded as the primary cause of the 	<p>Wicksell's natural rate of interest by implying it to be a stable inflation concept without addressing his evolving view of price neutrality.</p> <p>Wicksell redefined money neutrality to account for price fluctuations within a money-neutral equilibrium.</p> <p>This divergence from Wicksell's original ideas reveals a critical gap in economic theory.</p> <p>This understanding can only be derived from Wicksell's definition of the natural rate of interest and not the new consensus, which has stable intrinsic inflation in its core definition.</p>
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	<p>rise in prices...the cessation of such a scarcity and the subsequent fall in prices” (Wicksell, 1936, pp. 199-203)</p> <ul style="list-style-type: none"> • New Consensus <p>Monetary Neutrality: Not clearly addressed, or referenced to, implied through the definition.</p>	
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As seen in Table 5.1, all questions were answered with an analysis of primary source documents. The data provided convincing evidence supporting the hypothesis, which supported the thesis.

The first research question (RQ1) examined Wicksell's definition of the natural rate of interest, drawing from all of his works translated into English. A comprehensive review of Wicksell's writing shows that Wicksell's conceptualization of the natural rate of interest can be characterized by three primary renditions: the expected yield on newly created capital, the

equality between aggregate Investment and savings, and a stable aggregate price level that does not fluctuate due to monetary influences.

Most notably, the rendition of the expected yield on newly created capital, along with its analogous forms, was cited most frequently in Wicksell's literature, occurring 78.95% of the time. This conception was an extension of the Böhm-Bawerkian micro foundation and Böhm-Bawerk's term 'natural rate,' from which Wicksell acknowledged accedence. Within Wicksell's theoretical framework, extending Böhm-Bawerk's theory of capital, microeconomic agents make intertemporal decisions concerning resource allocation. These decisions are grounded in the expected profit rate relative to the market rate of interest that banks would offer for loans. Succinctly put, it encapsulates the expected yield on newly created mobile capital. 78.95% of Wicksell's description of the natural rate of interest on capital is strong supporting evidence.

The evidence further indicates that the equality between aggregate investment and savings was mentioned 10.53% of the time, and the concept of a neutral aggregate price level, which neither increased nor decreased for monetary reasons, was also cited 10.53% of the time.

The data unambiguously demonstrates, with statistical significance, that Wicksell's primary articulation was the 'expected yield on newly created capital' rendition. This is logically consistent, as it serves as the micro foundation from which the other two renditions derive, constituting the aggregate manifestations of the first.

Research Question 2 (RQ2) aimed to analyze how academic literature interprets and defines Wicksell's natural rate of interest. This objective was achieved through a thorough and

systematic review of the literature, employing statistical analysis to objectively assess three types of fragmentation, definitional fragmentation, citation fragmentation, and presentation fragmentation, in the academic literature's representation of Wicksell's natural rate of interest.

This analysis yielded evidence that supported the thesis's claim, revealing a fragmented comprehension within the academic literature. Specifically, the findings indicated that only fragments of Wicksell's actual definition were typically represented. The most prominent outcomes included the following: 31.14% of the examined works did not present any definition of the natural rate of interest; merely 8.38% contained all three aspects of Wicksell's definition, including the *in natura* conception; and 0% of the works proposing modern renditions of the natural rate of interest for theoretical and policy considerations encompassed all three definitions of Wicksell, incorporating the *in natura* conception. From this perspective, based on these summary statistics and the in-depth statistics presented in Chapter 3, Wicksell's definition is fragmented in academic literature. Therefore, considering all the evidence presented objectively and systematically, it can be concluded that the scholarly literature's interpretation only reflects a portion of Wicksell's definition and does not fully capture the essence and core of his theoretical framework regarding the natural rate of interest on capital.

Regarding citation fragmentation, the literature often cites only a portion of Wicksell's original works, leading to an interpretation that is unsubstantiated by an array of primary source documents. The most frequent number of works academic writers cited was 1, and the second most frequent was 0. In other words, those doing scholarly research into Wicksell's natural rate do not utilize a diverse foundation of primary source documents, primary source documents being the most objective when doing research. That is, of an estimated 800 total works by

Wicksell (Jonung, 1988; Sandelin, 2002), academic works today only cite 1 or 0 works of Wicksell when writing about his natural rate of interest on capital. In the analysis of academic literature on the natural rate of interest, 66.47% of the examined works cited only 0 or 1 reference from Wicksell's primary source material., the average being .1% of Wicksell's total works. This limited referencing of Wicksell's works raises questions regarding the depth and interpretation of the literature in the context under examination. The findings thereby lend support to the assertion that scholarly articles frequently cite only a fragment of Wicksell's contributions when engaging in peer-reviewed discourse on the natural rate of interest.

Concerning presentation fragmentation, when a definition was presented, it was presented on average 29.84% into the work, rather than upfront or in a separate definition section. That is, the position of the first definition appeared on average after 29.84% of the article's text was presented. If the definition is not apparent to readers upfront, assumptions could be made. Of the works that did present a definition, 32.97% had a non-contentious presentation of the definition; that is, the components were scattered throughout the work. This can further exacerbate confusion for the reader when trying to ascertain a coherent understanding of the natural rate of interest. Presentation fragmentation can lead the reader to miss or confuse the definition.

When definitional fragmentation, citation fragmentation, and presentation fragmentation converge or are combined, this can have a cumulative effect on the reader and lead to misinterpretation of Wicksell's natural rate of interest. This is significant for economic science because as new generations of researchers investigate Wicksell's work, and relying on secondary

sources can perpetuate these misinterpretations, compounding inaccuracies in the scholarly research and our understanding of a great historical economist.

Therefore, based on the statistical analysis detailed in Chapter 3 of this study, substantial evidence supports the claim that modern literature offers a fragmented interpretation of Wicksell's concept of the natural rate of interest. This conclusion is drawn from the substantial evidence presented therein. When compared with the findings from Chapter 2, which outlines Wicksell's concept of the natural rate of interest, a clear pattern of potential misinterpretation through fragmentation becomes evident.

Research Question 3 (RQ3) aimed to extend the insights from RQ2 by examining how the most influential modern interpretations of the natural interest rate align with Wicksell's original definition and his concept of money neutrality. To address RQ3, a systematic literature review was conducted focusing on the most highly cited authors in contemporary economics. This systematic is evidence-based and centered on primary source documents text comparison. These authors, prominent in shaping economic theory and policy, lay claims to the Wicksellian heritage and propose new renditions based on this heritage. However, as revealed by this research, their interpretations do not, in essence, represent Wicksell's natural rate of interest. These authors, although highly cited in Google Scholar, have the same fragmentation issues presented in Chapter 3 and miss the essence of Wicksell's definition presented in Chapter 2.

These authors, most highly cited and written about, are prominent in shaping economic theory and policy. They lay claims to the Wicksellian theoretical heritage and propose new renditions of the natural rate while simultaneously claiming lineage to Wicksell by name.

However, as revealed by this research, their interpretations miss the essence of Wicksell's natural rate of interest.

The analysis methodically showed that these highly cited authors, instrumental in shaping the discourse on the natural rate of interest, miss the core of Wicksell's conception. They represent only a tiny fragment of Wicksell's definition, derived from a limited selection of his works. Remarkably, Wicksell's primary definition, namely, "the expected yield on the newly created capital" (Wicksell, 2013), is absent from these authors' interpretations.

Furthermore, these authors overlook Wicksell's later developmental ideas, as evident in their writings on Wicksell. Wicksell (1925b, 1936) clarifies: "It is clear that this premise, namely, the shortage of goods, regarded as the primary cause of the rise in prices, leads us to an entirely different presentation of the problem from the one on which monetary theory has hitherto been based" (p. 203). These reflections and conclusions, along with other writings, are relevant to the fragmentary definition of the natural rate of interest employed by these highly cited authors. Wicksell's words signify an informal rejection of his 'stable price' definitional rendition, particularly when interpreted in light of his understanding of neutral money, especially outside the context of the classical gold standard era, in which his initial theories were conceived. Support for this perspective can be found in the works of the Stockholm and Austrian schools of economics that studied Wicksell in the early 20th century.

Thus, based on Wicksell's interpretation of stable prices within the context of non-monetary explanations of price movements illustrated in the Davidson-Wicksell polemic and his writings on neutral money, the 'stable prices' or 'stable inflation' definition of the natural rate

of interest appears to be misconstrued by these predominant authors. This misinterpretation of Wicksell's natural rate and neutral money transmits a potentially less-than-optimal conceptual framework to policymakers and a misunderstanding of a historical figure. Hypothetically, policymakers could realign interest rate policy, based on ideas more on par with Wicksell, with a measure of the profit rate in contrast to aggregate price stabilizing for example (Macovei, 2021) or a productivity norm, for example (Fregert, 1993; E. Lindahl, 2016; E. R. Lindahl, 1929; Selgin, 2018).

Moreover, the emphasis on the full of resources is not found in the definitional articulation of Wicksell. Instead, the conception of interest presented by these highly cited authors, based on the primary source evidence, appears to be influenced by the ideas of Keynes' neutral rate and is more dissimilar to Wicksell than to Keynes. Each research question answered the sub-hypotheses through strict and transparent methodological analysis. Each sub-hypothesis supported the case for the thesis.

Table 5.2

Table of hypotheses and results

	Hypotheses	Accepted	Rejected
1	Wicksell defined the natural rate of interest as the expected yield on newly created capital, which was the micro foundation for the rate of interest that equates investment to savings and maintains a neutral price level.	X	
2	Academic literature primarily gives only a fragment of Wicksell's definition; the presentation is fragmented, and the literature cites only a fragment of Wicksell's works.	X	
3	Highly cited authors who develop new renditions of Wicksell's natural interest rate miss the essence of Wicksell's natural interest rate and money neutrality.	X	

Source: Own elaboration based on the research findings

Therefore, based on the above sub-hypotheses, they are accepted and supported with evidence. The evidence and data support the thesis:

Wicksell's natural rate of interest is definitionally fragmented in academic literature, and new renditions miss the essence of his theory.

Based on the evidence, the implications are a misinterpretation of a pivotal historical figure in economics. This misrepresentation is perpetuated and embedded in academic works on the subject of the natural rate of interest, which is used for modeling and further development of theory. Consequently, this misaligned trajectory has been transmitted to new theoreticians and policymakers, potentially guiding them by a less-than-optimal theory and policy.

This divergence underscores a need for the discipline and study of economic science to reengage with Wicksell's primary source works to foster a more accurate and comprehensive understanding of his ideas.

In conclusion, this dissertation offers an in-depth look at Knut Wicksell's natural rate of interest, and it encourages further exploration of his ideas. By refocusing on Wicksell's original texts and insights, this study aims to support the development of economic theories and policies that more accurately reflect his conceptualization of the natural rate of interest. The research findings provide a solid foundation for continued study of Wicksell's theories and their application in our rapidly evolving, technology and productivity-driven economy.

5.2 Limitations

A limitation of this study is that the research was conducted in English and did not include Swedish and German text. It did not include the unpublished and untranslated works of Wicksell. It did not cover every aspect of Wicksellian monetary theory but focused on the definitional presentation of the natural rate of literature. It did not include articles that were not peer-reviewed, which would have been a more comprehensive selection.

5.3 Future Research

Historical researchers could conduct future studies on Wicksell's unpublished and untranslated works, including his notes on revisiting his monetary theory away from a price-stable policy norm. This research would start with the articles in *Ekonomisk Tidskrift* and existing archives in the library of Lund University LUSEM in Sweden. Lund University in Sweden contains the known existing works of Wicksell to be rediscovered and brought into greater availability for research. From these works, a further confirmation of the ideas of Wicksell could be ascertained and brought to light in the context of the current discussion and research into Wicksell's natural rate of interest on capital.

Empirical researchers could develop models based on the expected return on capital as the central definitional premise for the natural rate of interest. A model could be developed with consideration of a productivity index. Based on Wicksell's natural rate of interest, these models could be tested in the context of game simulations with artificial intelligence (e.g., as AI tests new lines with chess) and optimization techniques specifically designed for macroeconomic policy evaluation.

5.3 Concluding Remark

Great minds, such as Knut Wicksell, are often forgotten, or the power of their insights is misunderstood with the passage of time. Paradym-changing economists like Wicksell often come about, only once in a century. Therefore, a primary objective of this study is to stimulate further academic research. This effort serves not merely as a tribute to a great mind but aims to augment our understanding of economic history and science in all its dimensions.

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Appendices

Appendix 1 Definitions

Interest rate terms

The natural rate of interest: Wicksell defined the natural rate of interest in three ways; concisely and succinctly, it is the expected return of capital, investment equal savings, and a neutral aggregate price level. The expected return of capital is the primary definition in the sense it was derived from Bohm Bowerks natural rate of interest term and theory. However, also, explicitly, at the micro foundation level, the natural rate of interest is capital's marginal productivity, which has intertemporal time preferences embedded and manifests the expected profit rate. The marginal productivity of capital is the marginal benefit of investing for an economic agent. The cost of capital is the loan rate entrepreneurs take on a loan. The incentive exists where the marginal cost equals the marginal benefit. That is, the marginal cost of borrowing equals the marginal benefit of investing or investment, and savings are equal *ex-ante* in equilibrium. When the marginal cost of borrowing equals the marginal benefit of investing, it will create an equilibrium between the real and monetary worlds, and the aggregate price level is neutral for commodity prices. In Wicksell's initial rendition, the natural interest rate existed in a non-monetary world with barter exchange ratios. Wicksell did not specifically redact nor subsequently reiterate the *in natura* component of his definition; rather, he changed the concept subtly to base it on the marginal value productivity of real capital and referred to it as the real rate of interest (lectures 192).

The marginal productivity of capital: Wicksell defined it as the marginal physical productivity of natural capital where entrepreneurs borrow and pay with tangible goods rather than money. The marginal productivity of capital embodied time preference and roundabout means of production based on Böhm-Bawerk. The marginal productivity of capital was replaced by the marginal value productivity of capital (192) lectures, Uhr 227) to mitigate the difficulty of comparing multiple physical productivity rates of different goods. However, Wicksell emphasized that "the expected yield on newly created real capital" defines capital's (192) marginal productivity or the marginal value productivity of capital.

Loan Rate - The prevailing rate at the bank represents the borrowing cost.

The marginal efficiency of capital: Keynes used the marginal efficiency of capital to describe the expected return on investment, essentially Wicksell's natural interest rate.

The neutral rate of interest: Keynes's neutral interest rate in the General Theory where "where output and employment are such that the elasticity of employment as a whole is zero" (potential GDP equals actual GDP).

r-star: An interest rate where potential GDP equals the actual GDP (full utilization of resources) and a low, stable inflation rate.

Economic terms

Capital (relating to the natural rate): Wicksell defined capital in the context of the natural rate of interest as newly created mobile capital or liquid capital, loan capital (p.118 Interest and Prices). Capital loaning is possible in a hypothetical world with barter exchange ratios instead of money.

Money Neutrality: Wicksell's money neutrality was where the introduction of money into Wicksell's non-monetary world of barter exchange ratios does not alter the interest rate or the price level. The money would serve as nothing more than a clock to cover a procedure" (Interest and Prices, 191).

Equilibrium: Wicksell's money macro equilibrium relates specifically to an economy where the loan rate of interest conforms to the natural rate of interest. It is a world without monetary influence over prices. In this economy, money is a veil, and aggregate prices do not tend to increase or decrease due to monetary influence. In Wicksell's early theory, this was synonymous with a stable aggregate price level. After the Wicksell-Davidson polemic, Wicksell has conceded that rather than a stable price level as a manifestation of equilibrium, aggregate prices could move inversely with productivity in macro equilibrium when the loan rate of interest and the natural rate of interest is in agreement.

Fragmentation terms

Presentation demarcation in this study is defined in two ways.

Initial Fragmentation: If the definition is not found in the first 25% of the work or a separate definitions section. The importance of this is if a paper deals specifically with Wicksell's natural rate of interest and yet the definition is embedded into a paragraph deeper in the work, then the essence of the understanding of the natural rate of interest could be confused. A clearly upfront, initial demarcated claim as to how the natural rate of interest is defined is critical.

Non-contiguous Fragmentation If the definition is defined one way in one part of the work and subsequently defined in another way in another part of the work. Although these definitions do not necessarily contradict each other, they can cause confusion to the reader, or the second definition might be missed. If the natural rate of interest definition is presented in a disjointed or disconnected manner, without clearly linking them with a logical transition. In that case, this definitional analysis affects the overall coherence and clarity. This disintegration makes it difficult in some cases to follow the main argument.

Appendix 2 Definitions of Wicksell

Wicksell's Text	Essence of the Definition	Code	Barter	Reference
<p>natural rate of interest, i.e. to the real rate of return on capital in production.</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 81)</p>
<p>since the banks thus have increased means available for lending, they put their interest rates down, while the natural rate of return on capital remains unchanged; and it is only on account of the rise in</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, p. 35)</p>

<p>prices that results from this state of affairs that the increased quantities of gold come out into circulation and the reserves held by the banks are reduced, so that sooner or later, they are forced to return to their original, normal interest rates.</p>				
<p>the equilibrium must also be disturbed, and the disturbance ought to tend in the same direction, whether it is the money rate of interest that has sunk</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, pp. 29–30)</p>

while the rate of interest on capital has remained constant or the rate of return on capital				
the natural or real rate of interest on capital	return on capital	1	n	(Wicksell & Sandelin, 1999, p. 35)
The natural rate of interest, the real yield of capital in production	return on capital	1	n	(Wicksell, 2013, p. 205)
the natural, real rate of return on capital	return on capital	1	n	(Wicksell & Sandelin, 1999, p. 6)

<p>..undertaken raising or lowering of their interest rates, the major banking institutions in the different countries would have a fully adequate means of keeping the general price level at a constant average or at least of protecting it from excessively pronounced and persistent fluctuations, though naturally, as long as minted gold remains the measure of value, they must be supported in this by</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, p. 30)</p>

<p>the governments' own monetary policy; and fundamentally, there is nothing artificial about this system, since as long as the theory is correct, the rates around which the money rate of interest in each individual country would thus come to oscillate would be nothing but the level of the natural rate of return on capital.</p>				
<p>earnings of capital, or its rate of interest.</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1936, p. 132)</p>

<p>Increased productivity without any change in real capital inevitably means a higher real rate of return on capital, and there can never be equilibrium on the market unless the money rate of interest is brought into line with this, i.e., in this case, is raised</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, pp. 43–44)</p>
<p>the rates around which the money rate of interest in each individual country would thus come to oscillate would be nothing but</p>	<p>return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, p. 35)</p>

the level of the natural rate of return on capital.				
the relation between the bank (loan) rate and the natural rate of interest on capital, the real rate of return to capital in production.	return on capital	1	n	(Wicksell & Sandelin, 1999, p. 177)
The so-called natural or real rate of interest on capital, by which, in theory, the money or loan rate of interest is regulated, is, of course, fundamentally merely an abstract	return on capital	1	n	(Wicksell & Sandelin, 1999, p. 6)

<p>concept, an average of the real yield of capital in all existing commercial enterprises, of which some in fact yield returns many times in excess of this average, others less, while still others, not so few in number, even make a loss.</p>				
<p>the average yield on capital than does the bank-rate. Again, as far as this yield, i.e. the real rate of interest</p>	<p>yield on capital</p>	<p>1</p>		<p>(Wicksell, 2013, p. 250)</p>
<p>Interest on money and profit on</p>	<p>profit rate</p>	<p>1</p>	<p>n</p>	<p>(Wicksell,</p>

<p>capital are not the same thing...</p>				<p>1907b, p. 214)</p>
<p>the current value of the natural rate of interest on capital. The economic equilibrium of the system is ipso facto disturbed. If prices remain unchanged, entrepreneurs will in the first instance obtain a surplus profit (at the cost of the capitalists) over and above their real entrepreneur profit or wage. This will continue to accrue so</p>	<p>profit rate</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1936, p. 106)</p>

long as the rate of interest remains in the same relative position				
Thus the profits of entrepreneurs will remain at the old level and no increase whatever in the real rate of interest will actually occur.	profit rate	1	n	(Wicksell, 2013, p. 199)
What has fallen is the rate of interest on liquid capital and the thing that is usually termed entrepreneur profit , i.e. the surplus profit, over and above the remuneration for	profit rate	1	n	(Wicksell, 1936, p. 195) Interest and Prices 195

<p>services rendered, which accrues to the entrepreneurs at times of prosperity.</p>				
<p>It does not provide them with the means of paying a higher rate of interest—except in the case where the prevailing rate of interest is lower than the natural rate, i.e. than the profit which the entrepreneurs would obtain if prices did not alter.</p>	<p>profit rate</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1936, p. 166)</p>

<p>commodity prices fall to begin with, entrepreneurial profits have also gone down, or in other words, the natural, real rate of interest is again on a par with the money rate of interest, so that everything will now come into equilibrium at the lower prices that have thus arisen</p>	<p>profit rate, unchanged commodity prices</p>	<p>1,3</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, p. 42)</p>
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<p>For the difference between the two rates, which constitutes the entrepreneurs' profit as such, constantly tends towards zero under the influence of competition among entrepreneurs; or at least it tends towards a certain small amount which is not very different from zero. There is only one case in which the difference cannot be neglected. This arises when it is a question of a change in the average level of</p>	<p>profit rate, unchanged commodity prices</p>	<p>1,3</p>	<p>n</p>	<p>(Wicksell, 1936, p. 135)</p>
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<p>commodity prices expressed in money.</p>				
<p>The natural rate is roughly the same thing as the real interest of actual business (Geschäftsgewinne). A more accurate, though rather abstract, criterion is obtained by thinking of it as the rate which would be determined by supply and demand if real capital were lent in kind without the intervention of money</p>	<p>profit rate, demand and supply of capital</p>	<p>1,2</p>	<p>y</p>	<p>(Wicksell, 1936, p. xxv)</p>

<p>the normal natural rate, on an average be able to offer the same high price, because they have reason to expect the same increased prices for their own products (or rents or freights, etc.) in the future. If, therefore, the banks maintain the lower rate of interest, it will act as a tempting extra profit to entrepreneurs and by competition between them will force up still further the price of labour and materials and</p>	<p>profit rate, price changing rate</p>	<p>1,3</p>	<p>n</p>	<p>(Wicksell, 2013, p. 196)</p>
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indirectly of consumption goods, and so on				
<p>interest on money is regulated in the long run by the profit on capital, which in its turn is determined by the productivity and relative abundance of real capital, or, in the terms of modern political economy, by its marginal productivity. This remaining the same, as, indeed, by our supposition it is meant to do, would it be at all possible for the</p>	<p>profit on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 214)</p>

<p>banks to keep the rate of interest either higher or lower than its normal level, prescribed by the simultaneous state of the average profit on capital?</p>				
<p>on the relativity of the conception of interest on money, its necessary connection with profit on capital. The rate of interest is never high or low in itself, but only in relation to the profit which people can make with the money in their hands,</p>	<p>profit on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 216)</p>

and this, of course,				
<p>that profit on capital is far from being a uniform conception, but varies greatly in different undertakings according as they are more or less successful. In addition there is the difference between interest on short and interest on long dated loans, of which only the latter corresponds to the real rate.</p>	<p>profit on capital</p>	1	n	(Wicksell, 2013, p. 191)
<p>The connecting link between interest and</p>	<p>profit on capital</p>	1	n	(Wicksell, 1907b, p. 215)

<p>Profit? .. precisely the effect on profit that would be cause by the difference... the rate of interest ... to the average profit on capital.</p>				
<p>At any moment and in every economic situation there is a certain level of the average rate of interest which is such that the general level of prices has no tendency to move either upwards or downwards. This we call the normal rate of interest. Its magnitude is</p>	<p>capital rate, neutral prices</p>	<p>1,3</p>	<p>n</p>	<p>(Wicksell, 1936, p. 120)</p>

<p>determined by the current level of the natural capital rate, and rises and falls with it.</p>				
<p>If, nevertheless, present goods and services, for which payment need only be made in the future, fetch on the average a higher price corresponding to the level of loan interest—and this is the essence of every loan transaction and every advance of money—this is due simply to the ordinary laws of interest ...a</p>	<p>marginal productivity, marginal productivity of waiting</p>	<p>1, TP</p>	<p>n</p>	<p>(Wicksell, 2013, p. 185)</p>

<p>greater (marginal) productivity, a greater yield... in value (= the marginal productivity of waiting)</p>				
<p>We have hitherto considered production, distribution, and exchange as if they were effected without the assistance of money; in other words, as if laborers, landowners, and capitalists received an apportionment of the product in kind—...Interest was regarded as the direct</p>	<p>marginal productivity of capital, marginal productivity of waiting</p>	<p>1, TP</p>	<p>y</p>	<p>(Wicksell, 2013, p. 5)</p>

<p>expression of the marginal productivity of real capital itself, or as the difference between the marginal productivity of saved and current (present) labour and land ; or, more correctly, as the marginal productivity of "waiting",</p>				
<p>normal rate, i.e., the rate consistent with the then existing marginal productivity of real capital.</p>	<p>marginal productivity of capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 217)</p>

<p>the interest rate... what I have called above its normal level...that one prescribed by the simultaneous state of the marginal productivity of real capital.</p>	<p>marginal productivity of capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 219)</p>
<p>the marginal productivity of capital becomes the primary determinant of interest</p>	<p>marginal productivity of capital</p>	<p>1</p>	<p>n</p>	<p>(Sandelin, 2002, p. 36)</p>
<p>the marginal return on the last prolongation of production will determine the</p>	<p>marginal productivity of capital</p>	<p>1</p>	<p>n</p>	<p>(Sandelin, 2002, p. 32)</p>

<p>interest-rate level.</p>				
<p>An interest rate is neither high or low in itself but in relation to what one can or thinks one can earn with the money at one's disposal by using capital in production. And this latter factor, the natural rate of interest on capital.</p>	<p>expected return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 1907b, p. 82)</p>
<p>the essential factor must be the relative height of the rate of interest in relation to the return the borrower expects to get from the loan,</p>	<p>expected return on capital</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 2013, p. 250)</p>

<p>i.e. to the real rate of interest.</p>				
<p>the expected profit on capital had considerably increased, owing, for example, to technical improvements in production or increased demand for capital (i.e. a general increase in the marginal productivity of waiting).</p>	<p>expected profit, marginal productivity of waiting</p>	<p>1,tp</p>	<p>n</p>	<p>(Wicksell, 2013, p. 186)</p>
<p>the 'natural rate of interest' or, to put it more simply, between what one can earn or thinks</p>	<p>expected profit rate</p>	<p>1</p>	<p>n</p>	<p>(Sandelin, 2002, p. 222)</p>

<p>one can earn with cash in hand, and the interest rate actually charged by financial institutions.</p>				
<p>by the productive use of which he hopes to be able to acquire not merely the equivalent of their price, but also a surplus value, which constitutes the real rate of interest</p>	<p>expected profit</p>	<p>1</p>	<p>n</p>	<p>(Wicksell, 2013, p. 191)</p>

<p>distinguishing in due form between the loan rate of interest and the natural rate of interest on capital, then no dualism or inconsistency of any kind arises; the entire phenomenon is governed by a single law. A rise in prices—to limit the discussion to this—is always caused by increased pecuniary purchasing power, whether this is due to an increased quantity of money or in the heightened</p>	<p>expected profit</p>	<p>1</p>	<p>n</p>	<p>(Sandelin, 2002, p. 29)</p>
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<p>exploitation of money, the accelerated physical or virtual circulation of money that arises above all when credit is offered on unusually cheap terms relative to the borrower's expected profit</p>				
<p>the money rate of interest depends upon the supply of and demand for real capital, or..as Adam Smith, and later Ricardo, expressed it, that the rate of interest is regulated by the profits from the employment of</p>	<p>demand and supply of capital, profit rate</p>	<p>1,2</p>	<p>n</p>	<p>(Wicksell, 2013, p. 190)</p>

<p>capital itself and not by the number or quality of the pieces of metal which facilitate the turnover of its products.</p>				
<p>The rate of interest at which the demand for loan capital and the supply of savings exactly agree, and which more or less corresponds to the expected yield on the newly created capital, will then be the normal or natural real rate.</p>	<p>demand and supply of capital, expected yield on capital</p>	<p>1,2</p>	<p>n</p>	<p>(Wicksell, 2013, p. 193)</p>

<p>described in exemplary fashion by Böhm-Bawerk. The productiveness of the roundaboutness of production provides, so to speak, the material for the capital interest, on true productive capital, that is, in distinction to loan capital in consumer lending.</p>	<p>capital interest</p>	<p>l</p>	<p>n</p>	<p>(Sandelin, 2002, p. 47)</p>
<p>annual interest for the capital sacrificed at a single time, and this interest corresponds to the premium between</p>	<p>agio of capital in production</p>	<p>tp</p>	<p>n</p>	<p>(Sandelin, 2002, pp. 45–46)</p>

<p>the means of production in the present and the next year. Embodied</p>				
<p>Interest is an agio which comes into being when present and future goods are exchanged. It rests solely on the relationship between present and future in human economy and simply expresses the fact that present goods (at least according to the contemporary valuation) are as a rule more valuable than future goods of the same kind and</p>	<p>agio</p>	<p>tp</p>	<p>n</p>	<p>(Wicksell, 1954, p. 107)</p>

<p>number. ... There can be no doubt that this formula governs the problem of interest in its whole extent—and it is no mere tautology ... marginal utility will play the same part in the theory of interest as in the theory of ordinary exchange. And this applies to 'natural interest' as well as to interest on loans.</p>				
<p>fundamentally, the object of the method would merely be to bring the money rate of interest into agreement with the</p>	<p>marginal productivity of waiting</p>	<p>tp</p>	<p>n</p>	<p>(Wicksell & Sandelin, 1999, p. 50)</p>

real rate of interest—the marginal productivity of waiting , or however one wants to put it				
the normal rate (determined by the existing demand for capital and the volume of savings)	demand and supply of capital	2	n	(Wicksell, 2013, p. 201)
the rate at which the demand for new capital is exactly covered by simultaneous savings ... formula of supply and demand for commodities and	demand and supply of capital	2	n	(Wicksell, 2013, p. 190)

services				
<p>There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them. This is necessarily the same as the rate of interest which would be determined by supply and demand if no use were made of money and all lending were effected in the form of real capital goods. It comes to much the</p>	<p>neutral prices, demand and supply of capital</p>	<p>2,3</p>	<p>y</p>	<p>(Wicksell, 1936, p. 102)</p>

same thing to describe it as the current value of the natural rate of interest on capital.				
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Codes: 1= expected yield on newly create capital, 2= savings equals investment, 3= neutral price level; Barter y/n = ‘no use of money’; explicit =defintion in the quote, implicit=definition in the context of further passages around the quote.

Appendix 3 Works of Wicksell

Wicksell's Economics Works	Year	English Title
Några ord om samhällsolyckornas viktigaste orsak	1880	A Few Remarks on the Chief Cause of Social Misfortunes and the

<p>och botemedel med särskildt afseende på dryckenskapen</p>		<p>Best Means to Remedy Them, With Particular Reference to Drunkenness</p>
<p>"Vilka äro de allmännaste orsakerna till dryckenskapslasten och hur kunna de undanrotas?" January or February, in a temperance society in Uppsala (opening a discussion). Recorded in Uppsalaposten. 25 February the same lecture was delivered to an academic society in Gillesalen, and was followed by a discussion in the newspapers, with contributions from Professor Davidson among others. The lecture has been printed. Svar till mina granskare, med ett tillägg om nymalthusianismens ställning och utsikter i Europa</p>	<p>1880</p>	
<p>"Om utvandringen, dess betydelse och orsaker," Lecture in</p>	<p>1881</p>	

Stockholm and Uppsala: published 1882 (?)		
Om folkokningen i Sverige och defaror den medfb'rfor det allmdnna vdlstdndet och for sedeligheten, with a preface dated London, October, 1887.	1887	
"Oberproduktion—oder Uberbevdlkerung," Zeitschrift fur die gesamte Staatswissenschaft	1890	Overproduction—or Overpopulation?
"Kapitalzins und Arbeitslohn,"	1890	
Om dktenskapet och dessframtid. De sexuella frdgorna, gransking av Hrr. Emit Svensens, Bjornstjerne Bjornsons och professor Seved Ribbings bro- schyrer, with a postscript dated Paris, April, 1890.	1890	

<p>"Kapitalzins und Arbeitslohn," Jahrbucherfur National- okonomie 1892 (pp. 852-874). Summary in the same periodical, 1893.</p>	1892	
<p>Uber Wert, Kapital und Rente nach den neueren national- okonomischen Theorie</p>	1893	Value, Capital and Rent
<p>Vdra skatter, vilka betala dem, och vilka horde betala? Synspunkter och forslag av Sven Trygg, Stockholm, 1894.</p>	1894	
<p>Zur Lehre von der Steuerinciden</p>	1895	On the Theory of Tax Incidence
<p>Finanztheoretische Untersuchungen nebst Darstellung und Kritik des Steuerwesens Schwede</p>	1896	

"Der Bankzins als Regulator der Warenpreise,"	1897	
"Der Bankzins als Regulator der Warenpreise," Jahr- bucher fur Nationalokonomie, 1897 (pp. 228-243).	1897	
Review of V. Pareto, Cours cTeconomie politique, in Zeitschrift fur Volkswirtschaft in the Economic Journal, Sept. 1926, p. 512	1897	
1897 and 1899 Review of V. Pareto, Cours cTeconomie politique, in Zeitschrift fur Volkswirtschaft	1897	
Geldzinz und Güterpreise. Eine Studie über die den Tauschwert des Geldes bestimmenden Ursachen	1898	Interest and Prices

<p>Léon Walras, Études Déconomie Sociale Bokrecension: Jahrbülcher für Nationalökonomie und Statistik</p>	<p>1898</p>	<p>Léon Walras, Studies in Social Economy Book Review</p>
<p>"Peningrantans innflytande pa varuprisen," National- ekonomiska Fo'reningens forhandlingar, 1898, pp. 47-70. Bibilography 173</p>	<p>1898</p>	<p>The Influence of the Rate of Interest on Prices</p>
<p>Fernando Linderberg, Karl Marx Og Den Historiske Socialisme Bokrecension: Ekonomisk Tidskrift</p>	<p>1899</p>	<p>Fernando Linderberg, Karl Marx and Historical Socialism Book Review</p>
<p>Léon Walras, Études Déconomie Politique Appliquée Bokrecension: Jahrbücher für Nationalökonomie und Statistik</p>	<p>1899</p>	<p>Léon Walras, Studies in Applied Economics Book Review</p>

Gide, Charles: Nationalekonomiensgrunddragin Ekonomisk Tidskrift 534-537	1899	
Klassisk nationalekonomi och vetenskapelig socialismin Ekonomisk Tidskrift 462-469	1899	
Nationalekonomiens grunddragby Charles Gide – reviewed by Wicksell	1899	
Om ofverflytting av skatt. Ytterligare om ofverflytting av ska	1899	
Edwin R.A.Seligman, The Shifting and Incidence of Taxation Bokrecension: Jahrbücher für Nationalökonomie und Statistik	1900	Edwin R.A.Seligman, The Shifting and Incidence of Taxation Book Review

Zur Verteidigung Der Grenznutzenlehre	1900	In Defence of the Theory of Marginal Utility
Om grdnsproduktiviteten sdsom grundval for den nationalekonomiska fordelningen. Rysslands ekonomiska forhdllande	1900	Marginal Productivity as the Basis of Distribution in Economics
Rysslands ekonomiska förhållanden	1900	
Foreldsningar i nationalekono	1901	Lectures on Political Economy I
Om acker ur nationalekonomisk synpunt	1901	On Usury From the Perspective of Economic Theory
Om afvecklingen af de dldre nyttjanderdtterna d svenska statens skogar	1901	The Inheritance Tax

Mjolkkor sdsom dragar	1901	
Om arfsskatten	1901	
John Bates Clark, The Distribution of Wealth: a Theory of Wages, Interest and Profits, and John A. Hobson, the Economics Of Distribution Bokrecension: Ekonomisk Tidskrift	1902	John Bates Clark, The Distribution of Wealth: a Theory of Wages, Interest and Profits, and John a.hobson, the Economics Of Distribution Book Review
Till fordelningsproblemet	1902	On the Problem of Distribution
Professor Fahlbeck om nymalthusianismen	1902	The Monetary Problems of the Future
Hobson, John A.: The Economics of Distribution, and Clark, John Bates: The Distribution of Wealth. A Theory of Wages, Interest	1902	

and Profitsin Ekonomisk Tidskrift 85-90		
Jordbruksarbetaren i Forenta staterna in Ekonomisk Tidskrift 195-199	1902	
Den dunkla punkten i penningteorien	1903	
III. Neue Beiträge zur Theorie der Verteilung	1903	
Jordbrukets produktionskostnader	1903	
Om begreppen produktivitet, rentabilitet och relativ afkastning in jordbruket in Ekonomisk Tidskrift in Ekonomisk Tidskrift 169-174	1903	

Om begreppen produktivitet, rentabilitet och relativ afkastning inom jordbruket	1903	
Tyskland vid skiljovdgen	1903	
Mdl och medel i nationalekonomie	1904	Ends and Means in Ecoeconomics
Framtidens myntproblem	1904	
Foreldsningar i nationalekono	1906	Lectures on Political Economy II
Charles Gide, Nationalekonomiens Grunddrag Bokrecension: Ekonomisk Tidskrift	1907	Charles Gide, The Principles of Economics Book Review

Georg Friedrich Knapp, Die Staatliche Theorie Des Geldes Ekonomisk Bokrecension: Tidskrift	1907	Georg Friedrich Knapp, The State Theory of Money Book Review
"Krisernas gata," Statsokonomisk Tidsskrift, 1907. "The Influence of the Rate of Interest on Prices," Economic Journal', 1907, vol. xvii, p. 213.	1907	
Knapps penningteori	1907	
Ndgra felkallor via1 forsok till verifikation af	1907	
Penningvardets stadgande, ett medel att	1908	Stabilizing the Value of Money: a Means of Preventing Crises

Varför inskränkes fabriksdriften, Ekonomisk Tidskrift, 1908.	1908	Why Are Factory Operations Being Curtailed?
En lektion i banklagstiftning	1908	
Forebygga Kriser	1908	
Hvarfb'r inskrdnkes fabriksdriften	1908	
lagen for jordens aftagande afkastning	1908	
Landtarbetarfrågan I och II	1908	
Spak, H. J.: Landtarbetarfrdgan I och Iiin Ekonomisk Tidskrift 287-292	1908	

Penningrdnta och varupris	1909	The Money Rate of Interest and Commodity Prices
"Laran om befolkningen," Verdandi Smdskrifter, dated Ystad State Prison, October, 1909	1909	
"Uber einige Fehlerquellen bei Verifikation des Boden- gesetzes," Thiinen-Archiv, 1909. "Zur Verteidigung der Grenznutzenlehre," Zeitschrift fur die gesamte Staatswissenschaft, Social Tidsskrift, 1909, pp. 97-102.	1909	
Aarum, Th.: Arbeidets okonomiske vardiin Ekonomisk Tidsskrift 260-264	1909	
Ett nytt arbete i befolkningsfrågan; Formerelse og	1909	

fremskridt; Ett nytt arbete i befolkningsfragan;		
Wieth-Knudsen, K. A.: Formerelse og Fremskridtin Ekonomisk Tidsskrift 178-184	1909	
Originally published as Emigrationsutredningen, bil 18.	1910	From the Emigration Inquiry, Appendix Statements by Swedish Men of Science
Fritz H:son Brock, Om den ekonomiska fördelningen och kriserna (reviewed by Wicksell)	1910	
Bohm-Bawerk kapitalteori och kritiken draf	1911	Böhm-Bawerk's Theory of Capital
Kapital—und kein Ende	1912	Kapital—und Kein Ende! (Reply to Docent Brisman)

Tullar och arbetsloner	1912	Tariffs and Wages
Alderdomsforsdkringskommittens betdnkande	1912	
Monopolvinsten och dess beskattning jdmte	1912	
nagot om gross-och detaljhandelspris	1912	
Penningvardets reglerande	1913	The Regulation of the Value of Money
Review of V. Pareto, Manuel d"economic politique, in Zeitschrift fur Volkswirtschaft.	1913	
Anmdrkningar till doc Brocks Uppsats	1913	

Resultatet	1913	
Review of V. Pareto, Manuel d"economic politique, in Zeitschrift fur Volkswirtschaft.	1913	
Vorlesungen uber Nationalokonomie auf Grundlage des Marginalprinzipes	1913	
Kan ett land fa for litet folk	1914	Can a Country Become Underpopulated?
Dyrtid, tullar och arbetsloner	1914	High Prices, Tariffs and Wages
Lexis och Bohm-Bawerk, I & II	1914	Lexis and Böhm-bawerk I & II

Ludwig Von Mises, Theorie Des Geldes Und Der Umlaufsmittel Bokrecension: Zeitschrift für Volksivirtschaft, Sozialpolitik und Verwaltung	1914	Ludwig Von Mises, The Theory of Money And Credit Book Review
Riksbankens guldkassa	1914	The Gold Reserve of the Riksbank
Fritz Hiison Brock Remark	1914	
Professurer i statistik	1914	
Wicksell's rejoinder to Fritz Hiison Brock	1914	
Karl Helfferich, Deutschlands Volkswohlstand 1888–1913 Bokrecension: Ekonomisk Tidskrift	1915	Karl Helfferich, Germanys National Wealth 1888–1913 Book Review

Växelkurs och bankränta, Ekonomisk Tidskrift	1915	The Rate of Exchange and the Bank Rate
Frivilliga besparingar eller tvungna	1915	Voluntary or Forced Savings?
Ekonomiska gator	1915	
Finansiell krigsberedskap i Tyskland in Ekonomisk Tidskrift 230-233	1915	
Marknadsprisets inverkan pa utlandet in Ekonomisk Tidskrift 39-42	1915	
Nationalformogenhet, nationalinkomst och	1915	
Victor Moll Remark	1915	

Goetz Briefs, Untersuchungen Zur Klassischen Nationalökonomie Bokrecension: Weltwirtschaftliches Archiv	1916	Goetz Briefs, Studies in Classical Economics Book Review
Den "kritiska punkten" i lagen for jordbrukets aftagande produktivitet	1916	The 'Critical Point in the Law of Decreasing Agrecultural Productivity
"Hinauf mit den Bankraten," Archiv fur Sozialwissen- schaft und Sozialpolitik, 1916.	1916	
Davidson's rejoinder	1916	
Medel mot dyrtiden. (Wicksell's rejoinder.)	1916	
Remark by Davidson to an article (Wicksell's) in Dagens Nyhete	1916	

Remark by Rohtlieb	1916	
John Stuart Mill, Om Friheten Bokrecension: Forum	1917	John Stuart Mill, On Liberty Book Review
Det skandinaviska penningväsendet efter kriget', Bidrag till frågan om ett ekonomiskt närmande mellan de skandinaviska länderna. Inlägg av skandinaviska ekonomer,	1917	The Scandinavian Monetary System After the {first World} War
Review of L. v. Mises, Theorie des Geldes, und der Umlaufsmittel, in Zeitschrift fur Volkswirtschaft.	1917	
Brisman, Sven: De moderna affdrsbankernain Ekonomisk Tidskrift 19-28	1917	

Goschen om vdxelhurserna (a correction)in Ekonomisk Tidskrift 320-321	1917	
Keilhau, Wilhelm: Grundrentelcerenin Ekonomisk Tidskrift 393-397	1917	
Penningrdnta och varupris (remark in a discussion)in Ekonomisk Tidskrift 309-311	1917	
"International Freights and Prices," Quarterly Journal of Economics, 191	1918	
Genmdlein Ekonomisk Tidskrift 138-140	1918	

Grundrentelceren. Rejoinder by Keilhau to Wicksellin Ekonomisk Tidskrift 134-137	1918	
Petander, K.: Goda och ddrliga tiderin Ekonomisk Tidskrift 66-75	1918	
Smd anmdrkningar	1918	
Strbdda reflexioner	1918	
Varupris och fraktsatser	1918	
Vdxelkursemas gdta	1919	The Riddle of Foreign Exchanges
Die Grundziige der modernen Werttheorie sowie der damals soeben erschiedenen Bohm-Bawerkschen Theorie des Kapitals.	1919	

Ett angrepp pa kvantitetsteorien	1919	
Professor Cassels nationalekonomiska system	1919	
Frihandel och utvandringin Ekonomisk Tidskrift 124-125	1920	
Rdvaruexport och utvandring—II. Remark to Heckscherin Ekonomisk Tidskrift 229	1920	
Karl Menger	1921	Carl Menger
Inflation, penningmdngd och rdnta Remark to Akerman	1921	

Inkomstbegreppet i skattehndseende och ddrmed	1922	The Concept of Income as Regards Taxation, And Some Associated Tax Issues
Rejoinder to Akerman	1922	
Rejoinder to Heckscher {Alltings dterstdllelse)	1922	
Remark by Davidson	1922	
Reply by Akerman	1922	
sammenhdngande skattefragor	1922	
Några erinringar, Ekonomisk Tidskrift	1923	A Few Comments

Inkomstbegreppets historiska utveckling, Statens Offentliga Utredningar, no. 70, 1923.	1923	The Historical Development of the Concept Of Income
Davidson Remark to Wicksell	1923	
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Tullskydd och frihandel	1924	Protection and Free Trade
Mengers Grundsätze i ny upplaga	1924	The New Edition of Menger's Grundsätze
Järnvägsreformer och-reformatorer	1924	
Ett skolexempel i tullfrågan	1925	An Objective Lesson in the Tarrif Question
Matematisk nationalekonomi	1925	Mathematical Economics

Valutaspersmdlet i de skandinaviska landern	1925	
Zur Zinstheorie, in Die Wirtschaftstheorie der Gegenwart, Vienna: Hans Mayer, Verlag von Julius Springer, 1928.	1928	On the Theory of Interest (Böhm-Bawerks 'third Ground)

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<p>Kahn, R. (1978). Some aspects of the development of Keynes's thought. <i>Journal of Economic Literature</i>, 16(2), 545-559.</p>	<p>76</p>
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