MONEY, CAPITAL, AND BUSINESS CYCLES

by

Alexander David Fernando Schibuola
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Committee:

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Money, Capital, and Business Cycles

A Dissertation submitted in partial fulfillment of the requirements for the degree of
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by

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Master of Arts
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DEDICATION

To Mom and Dad
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Alexander Schibuola
24 July 2014
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ABSTRACT

MONEY, CAPITAL, AND BUSINESS CYCLES

Alexander David Fernando Schibuola, Ph.D.

George Mason University, 2014

Dissertation Director: Dr. Tyler Cowen

Chapter 1, “New Perspectives on the Old Austrian Business Cycle Theory,”
subjects the Austrian capital-based macroeconomics to a variety of shocks and graphs the resulting time paths of key variables. Since accounts of the Austrian business cycle theory can be difficult to follow, Chapter 1 more clearly and concisely depicts exactly what occurs as an Austrian-variety business cycle unfolds.

Chapter 2, “Austrian Capital Theory and Neoclassical Capital Theory as Analytical Substitutes,” investigates how different the basic Austrian and neoclassical capital theories truly are. An Austrian-neoclassical model is constructed by replacing the capital-based macroeconomics model’s Hayekian triangle, with the Hall-Jorgenson theory of capital. These two models are then subjected to a discount rate shock. Since both models produce similar results following the shock, it implies the two capital theories are analytical substitutes.
Chapter 3, “There Ain’t No Such Thing as a Soft-Landing,” subjects the Austrian-neoclassical model developed in Chapter 2 to a monetary shock. It finds that even when agents have rational expectations and the world is described by a neoclassical capital theory, an Austrian-variety cycle of boom and bust still occurs following a money supply increase.

Overall, this dissertation suggests that Austrian capital theory may be sufficient, but is not necessary to generate cycles of boom and bust. Nevertheless, the Austrian theme of boom and bust merits serious consideration as it holds even when agents adhere to rational expectations and the world is described by a neoclassical theory of capital.
PREFACE

Generally, academic papers have the quality of stating: “So-and-so (1930) found that $X$ leads to $Y$. This study modifies $X$ to $X'$ and finds that $Y$ still results even under $X'$.”

This precise logic is not necessary, but the advancement of human knowledge proceeds in small steps. It builds closely on what others have done. This meager contribution to human knowledge is no exception, but, as I discovered, I moved from “So-and-so (1930) found that $X$ leads to $Y$. This study modifies $X$ to $X'$, finds that this implies $X''$, which in turn implies $X'''$, and this still leads to $Y$.” Therefore, the collection of papers in this dissertation makes it difficult for any one of them to stand independently. In words some may appreciate: this project is very roundabout.

Chapter 1, “New Perspectives on the Old Austrian Business Cycle Theory,” inquires: What transpires during an Austrian-variety business cycle? Existing accounts are difficult to follow and the results seem driven by exogenous events. Because there are many moving parts, graphing the time paths of variables, such as real output, consumption, investment, etc., over time, yields a new and clearer perspective.

Chapter one concludes that Austrian capital theory is indispensable for generating Austrian-variety business cycles. Under this presumption, I attempted to better model
Garrison’s Hayekian triangle for over a year. All attempts proved futile. Indeed Hayek’s *Pure Theory of Capital* (2007 [1941]) seemed to prove the general intractability of Austrian capital theory. In frustration, I asked: How different are the Austrian and neoclassical capital theories in terms of qualitative outcomes?

Chapter 2, “The Austrian Capital Theory and Neoclassical Capital Theory as Analytical Substitutes” explores the aforementioned question by constructing an “Austrian-neoclassical” model. It replaces the Austrian capital theory device, the Hayekian triangle, with the Jorgensen (1963) and Hall and Jorgenson (1967) neoclassical capital theory. This new model and the capital-based macroeconomics model are then subjected to a discount rate shock. Both models yield similar results, implying that the Austrian and neoclassical theories of capital are analytical substitutes.

Chapter 3, “There Ain’t No Such Thing as a Soft-Landing,” finds that an Austrian-variety cycle of boom and bust is still observed given a money supply increase in the Austrian-neoclassical model.

My perception that Austrian and mainstream macroeconomists tended to talk past one another stimulated this project. I felt the two schools’ macroeconomic issues were largely semantic. Of course there is the issue of mainstream emphasis on equilibrium constructs versus Austrian emphasis on disequilibrium constructs in the understanding of economic phenomenon. However, I leave this in more capable hands.

---

1 I must apologize to the many trees which were harmed in the production of this dissertation. Numerous notebooks containing an orgy of mathematics, graphs, and three dimensional triangles, turned out to be dead-ends.
Nonetheless, I believe the challenges Hayek faced in developing his business cycle theory and antecedent capital theory made him a likely author of works such as “The Use of Knowledge in Society” and “Economics and Knowledge.” Although Hayek’s shift from economic to political theory might appear as an abrupt career change, I believe only the author of the *Pure Theory of Capital* could truly appreciate the inestimably crucial role markets play in coordinating human action.

While Hayek’s latter discovery is probably more consequential than his macroeconomic theories, I felt the mainstream neglect, for the key Austrian macroeconomic insinuation that cycles of boom *and* bust arise from an expansion of credit, required attention. Chapter 3 termed this Austrian “insinuation” as “endogenous trend reversion.” In contrast, “exogenous trend reversion,” exhibited by mainstream macroeconomic theories, occurs when a positive shock produces a boom, which benignly dies off, followed by some independent negative shock which produces a bust.²

The crux of Austrian macroeconomics is endogenous trend reversion.³ Issues regarding expectations and capital theory are subordinate to it. Via shear inertia, Austrian capital theory was believed to be indispensable for generating endogenous trend reversion. To my surprise, I discovered that *Austrian capital theory may be sufficient to generate endogenous trend reversion, but it is not necessary.* Indeed further research leads me to believe that it may not even be sufficient.

The implications are this:

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² This is not universal. There’s the real business cycle’s random walk and Friedman’s plucking model. 
³ Ironically Hayek, the leading proponent of the theory, didn’t get the baseline version correct; most credit belongs to Richard von Strigl’s *Capital and Production* (2000 [1934]), which espouses the version of Austrian business cycle theory that most contemporary Austrians subscribe to. See Appendix 3-A of Chapter 3 for more.
If you are an Austrian: Austrian capital theory may be important, but it is not as important as you think. Chapter 1, which was written under the belief that Austrian capital theory was indispensable, spends some time exploring the rational expectations critique levied against Austrian business cycle theory proponents. As Chapter 3 finds, even with rational expectations and a neoclassical capital theory, endogenous trend reversion is still observed. This implies Austrians can free themselves from the bondage of Robinson Crusoe analogies to try and justify Austrian capital theory. The apparatus developed here is more tractable. It suggests that research can be focused on how market participants might fail to predict policy and how decentralized banking systems may or may not mitigate cycles of boom and bust.

My message to mainstream economists is that the Austrian-theme of endogenous trend reversion is quite plausible. As Chapter 3 shows, even with a neoclassical capital theory and rational expectations, cycles of boom and bust from unexpected money supply shocks still occur as predicted by Austrians. Therefore, the latter’s ideas merit more serious consideration. Regarding policy implications: following a period of “loose” monetary policy, there ain’t no such thing as a soft landing.

In conclusion, I hoped to accomplish more in this dissertation, and I feel it fitting to conclude this project with the words which started it when I was first applying for Ph.D. programs:

---

4 It seems worthwhile to point out that the works of Lawrence H. White and George Selgin regarding the effects of free banking do not seem to hinge on whether the world is better described by Austrian capital theory versus neoclassical theory—even though Dr. White is perhaps the world’s leading expert on the latter (he was the editor of Hayek’s *Pure Theory of Capital* after all).
“Being an academic does not make you responsible for having the right answer to any research question you are interested in as you ask it. It makes you responsible for wanting to learn more about the phenomenon that lead to your question in the first place, and for improving the understanding of the problem within the profession—most of the time this leads to a great answer. Sometimes you will learn things much more important than you set out to learn, but sometimes you will discover that the question itself was too big, or too small, then you are learning how to ask better questions. That requires great personal responsibility and a willingness to let go of a lot of pride—it is a big deal to remember from day to day.”

Speaking for myself, I can honestly say, Q.E.D.

Alexander David F. Schibuola

24 July 2014

Fairfax, VA

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5 I kept this advice on the background of my laptop to look at every day. Unfortunately, I cannot find the source or the author.
Preface References


CHAPTER 1 : NEW PERSPECTIVES ON THE OLD AUSTRIAN BUSINESS CYCLE THEORY

Introduction

Accounts of the Austrian business cycle theory are difficult to follow. This creates three side-effects: (1) Debates between mainstream and Austrian economists become confusing and redundant. (2) It stultifies the development of Austrian macroeconomic theory. Lastly, (3) it makes empirical analyses of Austrian business cycle theories difficult to conduct. This chapter provides a meager solution for the latter issues by using the capital-based macroeconomics model developed by Garrison (2001) to show the evolution of key variables following assorted macroeconomic shocks. This is the “new perspective” provided by this chapter.

Austrian macroeconomic accounts, such as Hayek (1967 [1931]), Strigl (2000 [1934]), and Garrison (2001) first show the effects of an increase in saving. Next, the effects of a money supply increase are demonstrated. This chapter adheres to this outline, but adds additional, new perspectives. As most Austrian business cycle accounts stop at the beginning of the bust phase; mine shows what a “natural recovery” might look like. I also show what effects a money supply decrease might have in the context of the capital-based macroeconomics model.

This chapter proceeds as follows: Section I contains clarifications and defines key Austrian macroeconomic concepts. Section II analyzes the effects of a decrease in
household discount rates. Section III studies the effects of a money supply increase (the “old” Austrian business cycle theory) and shows what a natural recovery might look like. Section IV shows the effects of a money supply decrease. Section V contains a list of common critiques levied against Austrian macroeconomic theory and discusses some avenues through which they might be addressed. Lastly, Section VI contains the conclusion.

Section I. Some clarifications and definitions

The first subsection clarifies some aspects of Austrian macroeconomics; the second defines key terms found in the Austrian macroeconomic literature.

IA. Some clarifications

The term “Austrian macroeconomics” refers to the general equilibrium theories of economists such as Ludwig von Mises, Friedrich von Hayek, Roger Garrison, and Richard von Strigl. The capital-based macroeconomics, developed by Garrison (2001), is to Austrian macroeconomics as IS-LM/AD-AS is to mainstream macroeconomics. Thus, capital-based macroeconomics can analyze a variety of shocks from an Austrian perspective, not just positive money supply shocks.

“Austrian business cycle theory” is the hallmark of Austrian macroeconomics. It is a subset of the latter. In it, money supply increases cause an unsustainable cycle boom and bust. The diagram in Figure 1-1 categorizes the relationship between “Austrian

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6 In this chapter “mainstream” theory is a catch-all term for the textbook versions of Classical, Keynesian, monetarist, New Classical, real business cycle theory, and New Keynesian economics.
Austrian macroeconomics (box 1) begins with Menger, Jevons, Bohm-Bawerk, and Wicksell writing in the late 19th century. Capital-based macroeconomics (box 2) did not exist until Garrison (2001). Therefore capital-based macroeconomics does not apply to all Austrian macroeconomics, just a portion of it.\(^7\)

Austrian business cycle theory (box 3) was developed in the early 20th century; first by Mises (1980 [1912]) then later by Hayek (1967 [1931]). The degree to which

\(^7\) Also there are considerations that business cycles are not strictly monetary phenomenon. See Hayek (1967 [1931]), Strigl (2000 [1934]), Mises (1966), Cowen (1997), and O’Driscoll and Rasmussen (2012) for example. Shocks, such as a general industry failure due to production of goods that consumers end up not valuing as much as entrepreneurs thought they would, can lead to busts. However, the baseline capital-based macroeconomics cannot account this.
Austrian business cycle theory can be subsumed under the capital-based macroeconomics model is uncertain. The gray area\(^8\) represents some of this chapter’s focus. Within box 3 there could be a subset of boxes for Austrian business cycle theory, each containing Hayek (1967 [1931]), Mises (1966), and Strigl (2000 [1934]). Each work has elements that make fall outside the gray area. This is not surprising because these theories were developed prior to Garrison’s (1978 and 2001) capital-based macroeconomics model.

For example, Hayek’s (1967 [1931]) account has a business cycle with negative comovement between consumption and investment contrary to the accounts exhibited by Garrison (2001), Strigl (2000 [1934]), and Mises (1966). This chapter focuses on the Garrison-Mises-Strigl rendition since consumption and investment are empirically procyclical.\(^9\) Since the capital-based macroeconomics model can become unwieldy in its graphical form the time-paths of variables are shown instead.

\textit{I.B. Definitions}

This section defines frequently used Austrian macroeconomics terms. Inevitably these may clash with others’ definitions.\(^{10}\) My objectives in this subsection are to (1) provide mutually consistent definitions, (2) solicit criticism regarding them, and (3) to use them in subsequent sections to describe the evolution of variables after shocks.

The following is the list of terms and the definitions which will be applied:

\textbf{Production}—value creation

\(^8\) No pun intended.
\(^9\) The different models of Austrian business cycle theory are the source of a great degree of confusion. Cowen (1997) focuses on Hayek (1967 [1931]) whereas Garrison focuses on Mises (1966 and 1978) and Strigl (2000 [1934]). Consequently it is important to clarify which story is being worked with.
\(^10\) For example, Machlup (1963 [1943]) finds that over thirty definitions exist for forced saving.
**Inputs**—goods and services that create value (e.g., labor and capital)

**Consumption**—value destruction

**Investment**—future value creation (or future consumption supply)

**Saving**—future value destruction (or future consumption demand)

**Capital**—a produced input (it is an indirect means for the creation of value)

**Discount rate**—subjective relative value of future to current consumption (less unity):

\[ \rho = \frac{v(c_1)}{v(c_0)} - 1 \]

\( v(c_1) \) and \( v(c_0) \) are the values an agent attaches to future and present consumption.

**Interest rate**—ratio of future market values to present market values less unity:

\[ i = \frac{p_1 c_1}{p_0 c_0} - 1 \]

\[ = (1 + r)(1 + \pi) - 1 \]

\( p_1 c_1 \) is total nominal consumption spending at time period \( t = 1 \). \( p_0 c_0 \) is total nominal spending on consumption at time period \( t = 0 \). The nominal interest rate is \( i \), the real interest rate, \( r \), and \( \pi \) is the inflation rate.

**Overinvestment**—an unsustainable pattern of investments

**Overconsumption**—an unsustainable pattern of consumption

Ex ante, overinvestment and overconsumption are not recognized as being unsustainable. Ex post however, once the unsustainability is recognized, overinvestment and overconsumption result in liquidation and forced saving respectively.

**Malinvestment**—investments which fail to yield expected returns (occurs when realized future consumption demand fails to match the expected future consumption demand)
**Forced saving**—realization that the prior consumption patterns were unsustainable

**Liquidation**—realization that the prior investment patterns were unsustainable

**Capital structure**—arrangement (or order) of current inputs which yields a stream of consumption goods over time

**Derived demand effect**—the present value of inputs derived from dated-consumption claims closer to the present

**Time discount effect**—the present value of inputs derived from dated-consumption claims most remote from the present

**Natural rate of interest**—interest rate which maintains capital structure equilibrium

Austrian macroeconomics most distinct facet appears to be derived from its capital theory, which implies that (1) capital goods and consumption goods are not perfect substitutes (2) capital goods are not perfect substitutes for one another, and (3) there is an arrangement, or order, to capital which determines the pattern of consumption possibilities agents will face over time. The presence of a “sustainable” capital structure means that future supplies and demands for consumption goods will be equated over time.

Ideally, the interest rate is a sufficient statistic for equating the supply of future consumption goods (current investment) with the demand for future consumption goods (current saving). If the interest rate serves this function it is the natural rate of interest which prevails. If the interest rate is not a sufficient statistic, then the capital structure is unsustainable, and this implies that the supply and demand for future consumption goods will not be equated as expected.
As Cowen (1997) asserts I do the same here: Ex ante, all capital structures are equilibrium ex post this may not be true. This notion is also consistent with Hicks (1973), Lachmann (1973 [1965]), and Lewin (2011).

The presence of heterogeneous capital implies that there are adjustment costs. The latter in turn admit the possibility of misallocation costs. Adjustment costs arise when inputs are transferred from one employment to another. Misallocation costs represent the discounted present value of opportunity costs that arise from retaining inputs in inferior employments. If adjustment costs exceed misallocation costs an input will be kept in a sub-optimal use.

Section II. Effects of a decrease in household discount rates

A decrease in subjective discount rates means saving increases, and this decreases the natural rate of interest. Incidentally, current consumption decreases and current investment increases. The latter will allow the future level of consumption to rise.

In long-run mainstream terms, this is like a saving rate increase in the Solow growth model. Assuming that the new steady-state level of capital is less than the golden-rule level of capital, the subsequent capital accumulation will increase future consumption.

In short-run mainstream terms, from a Keynesian point of view, this is like a decrease in autonomous consumption expenditures. However instead of increasing future consumption it depresses aggregate demand, which in turn, because prices and wages are

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11 This is implicitly in Garrison (2001)’s model as the production possibilities frontier is concave.
sticky, causes real output and employment to decrease. This is Keynes’s (1997 [1936]) paradox of thrift. It is a point of contention between Keynesians and Austrians.

Figure 1-2 shows how a change in discount rates impacts the structure of capital from an Austrian perspective. The line segment $0_1O_5$ shows the progress of time. The right-side is the present; the left-side is the future. The line segment $A_tA_3$ shows the initial time path of consumption before the discount rate decrease. It is constant. Thus it represents a stationary, zero-growth economy.

Line segment $A'_2A_1$ depicts the present value of goods-in-process at $t = 0$. The goods valued at $A'_2$ will eventually be valued $A_2$ once their production into final consumer goods is complete.\(^{12}\) Triangle $0_1A_1A'_2$ is the standard Hayekian triangle as depicted in Hayek (1967 [1931]) and Garrison (2001).

\(^{12}\) It is assumed that these values are adjusted for inflation.
With the discount rate decrease, the capital structure shifts from $0_1A_1A_2'$ to $0_1B_1B_2'$. The terms labeled $A$ represent the old capital structure; the new one is depicted by the terms labeled $B$. The upward sloping line segment $B_1B_3$ represents the new path of consumption over time. Line segment $B_2'B_6$ depicts the adoption of more roundabout production processes which will support the increased demand for future consumption goods relative to current consumption goods.

This illustration demonstrates that the later stages of production, do not contract *per se*, as the Keynesian models suggests. Rather, firms in these stages make investment decisions which will satisfy successively higher future demands for consumer goods.
The present-day increase in investment is manifest as a long-run increase in consumption via the time-discount effect.

The positive time discount effect is partially observable as the line segment $B_iA_1$ while the line segment $B_1A_i$ partially represents the offsetting negative derived demand effect. Both the Keynesians and Austrians subscribe to the derived demand effect however the time-discount effect does not exist in the Keynesian model.

In the Austrian story, since the value of future consumption goods increases relative to present consumption goods, firms will gear investment toward production techniques yielding greater future output. In other words, a positive time discount effect is the present manifestation of future, positive derived demand effects. The latter can be partially observed by the line segments $B_iA_4$ and $B_4A_i$ in Figure 1-2. The beneficence of the capital-based macroeconomics model is that it marries the long-run and the short-run into one.¹⁴

These effects are borne from the assumption of a structure to capital. This is appealing because real world entrepreneurs seek to match the production of future supply of consumption goods (current investment) to the future demand for consumption goods (current saving). In the next section, an instance in which the “paradox of thrift” appears to hold true is observed.

¹³ The reader will also note this figure too, is somewhat mistaken: The intervals of time for which new products become consumer goods (e.g., $0_10_2$, $0_20_3$, etc.) should extend since the adoption of more roundabout production processes implies that it takes longer for raw materials and intermediate goods to reach the final stages of production. For simplicity this aspect is omitted.

¹⁴ Solow (1997) laments that mainstream macroeconomics has failed to accomplish this task.
Lastly, in terms of the desired, “new” perspective this chapter means to offer, the overall effects of a decrease in household discount rates are summarized in Figure 1-3 below. At $t = 0$ the discount rate shock occurs. In the initial period, real output, $Y$, is unaffected, as seen in panel (a). Investment, $I$, and saving, $S$, increase as observed in panel (b). The increased saving drives down the prevailing real market interest rate, $r$, as observed in panel (c). In panel (d) consumption, $C$, decreases in the immediate term. However, as the capital structure grows, consumption eventually increases above its initial, $t = 0$, value. Overall, rather than using three-dimensional triangles, graphing the evolution of variables over time makes it easier to appreciate what transpires following a shock.
Section III. Effects of a money supply increase\textsuperscript{15}

The evolution of variables in the case of an Austrian-variety business cycle is shown here. This represents the “new” perspective on the “old” Austrian business cycle theory. I apologize in advance for failing to have more economics with it. However, the intention is to better illustrate exactly what transpires. This allows for a clarification of some contentious issues and facilitates empirical investigations.

\textsuperscript{15} I am indebted to my former intermediate macroeconomics instructor W.T. Coppedge (University of North Florida) for leading me to the idea represented here.
The following is assumed: (1) there is a one-time increase in the supply of money by a central bank. (2) The central bank then remains passive for the remainder of the cycle. This is important to recognize as it is seldom true. It implies that the effects of a business cycle, as depicted in what follows, become more complex if the actions of a central bank are endogenous to the development of events. (3) The liquidity effect is operational. This implies agents do not adhere to rational expectations or that the money supply increase is unanticipated.

An additional, new perspective, is given as the path of a recovery is shown. Austrian business cycle accounts generally conclude with a bust, but don’t say much about recoveries. The general conclusion is that central banks should avoid allowing the market of rate of interest to diverge from the natural rate of interest in the first place.

Figure 1-4, below, is constructed from Garrison (2001 and 2004). Initially it’s assumed the economy is in a stationary-state (no growth) prior to $t = 0$. The money supply increase creates a gap between ex ante saving and ex ante investment, to use the terms of Horwitz (2000) and Myrdal (1965 [1939]). This gap prevails between $t = 0$ until $t = 3$.

The liquidity effect causes ex ante saving to fall and consumption to increase. Ex ante saving represents the quantity supplied of loanable funds which is consistent with the actual time preferences of households, i.e., in absentia of non-neutral money. The

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16 See Figures 2 and 3 in Garrison (2004).
17 In this paper it is assumed that the demand for loanable funds emanates solely from entrepreneurs.
18 In Hayek’s (1967 [1931]) version, consumption either holds constant or decreases depending on how one reads into it. But this seems plausible only if the supply of loanable funds curve is perfectly inelastic.
19 Note: Adoption of this conception necessitates rejection of the IS-curve concept because the latter equates ex ante saving with ex ante investment by definition. See Horwitz (2000, pp. 8-9, p. 89)
lower interest rate causes investment to increase. These two effects are overconsumption and overinvestment. This is the initial part of the boom phase. The overall boom occurs over $t = 0$ to $t = 2$.  

![Figure 1-4: Time path of variables given an increase in the money supply at $t = 0$](image)

Note that the intervals of time between time indices are not necessarily fixed. For simplicity it is assumed that each period of time is equal. See Luther and Salter (2012) for more related to the costs and speed of adjustment.  

This figure was drawn by plotting out the points for the variables that exist in the capital-based macroeconomics model of Garrison (2001 and 2004, Figure 3). For $Y, C, I,$ and $S$, it is assumed that these represent real values, although it is not immediately clear what the relevant price indices are.
During the boom phase, more “roundabout methods of production” are being adopted. Hicks’s (1973) Fundamental Theorem proves a decrease in interest rates will never result in a decrease in the length of time a project is carried on. These are projects which were not profitable to undertake before the liquidity effect took hold.

The simultaneity of overconsumption and overinvestment implies that the capital structure is unsustainable. Nonetheless agents are not cognizant of this yet. If they were, the boom would fizzle out before it ever really began.\textsuperscript{22} The lower interest rate signals that the demand for future consumption goods is greater than it truly is. Consequently overinvestment will beget malinvestment.

In this instance, there is a \textit{positive} derived demand effect and a \textit{positive} time discount effect occurring simultaneously.\textsuperscript{23} This implies that resources are concentrating toward particular stages of the capital structure at the expense of other stages. Or equivalently, the distribution of resources in the capital structure is not evenly distributed. In terms of mainstream macroeconomic terms: there’s been a positive shock to aggregate demand and there’s a movement upward along the short-run aggregate supply curve. Everything that goes on in a typical aggregate demand-aggregate supply model is still occurring—Phillips Curve and all. The one key difference is that the structure of capital is unsustainable. The latter feature is omitted in the mainstream models.

As “entrepreneurs encounter resource scarcities that are more constraining than implied,” to use Garrison’s (2001, p. 72) phrase, they must choose whether to (1) attempt

\textsuperscript{22} Again Austrian business cycle theory presents multiple possible equilibrium stories.
\textsuperscript{23} With the discount rate decrease analyzed in the section above there was a positive time discount effect and a negative derived demand effect \textit{offsetting} one another.
to complete their project or (2) liquidate it. This is not only an issue of sunk costs here, but one of attempting to at least break-even, or to attempt to modify projects in order to cope with the unexpected cost developments, or to merge with other firms to achieve some measure of scale economies, etc. Again, what seems to prevent the boom from smoothly fizzling out is the presence of adjustment costs, which makes redistributing resources toward more efficient ends less desirable.

The effect is to lead to “distress borrowing.” It causes an increase in the demand for loanable funds. This increases investment and the interest rate and causes consumption to decrease. This phenomenon is observed between \( t = 1 \) and \( t = 2 \) as per Figure 1-4 above. This may also be mutually reinforced by the central bank tightening to respond to the increasing rate of inflation.\(^{24}\)

One cannot help to note that the term distress borrowing implies that agents observe something is wrong. However, at this phase the economy is still in a boom. Seemingly exogenous events like this lead me to assert that the Austrian business cycle theory seems to have many seemingly exogenous events occurring in order to drive the boom and bust result.

At \( t = 1 \) overconsumption peaks. The lack of available resources in the stages of production temporally closer to final consumption forces consumers to save more, i.e., forced saving. This is the mutual consequence of the lack of available resources and the increased competition for resources from the entrepreneurial community who are attempting to complete projects, i.e., distress borrowing.

\(^{24}\) Again however, we assume that the central bank remains passive over the course of a cycle.
As more roundabout projects become operational it is discovered that the supply of goods provided is inconsistent with the demand for consumption goods. This occurs during $t = 2$ to $t = 3$. Why however, does the price of consumption goods from $t = 2$ to $t = 3$ not adjust downward to eliminate the excess supply? Perhaps sticky prices and wages play a role here. It is in this situation that the Keynesian story appears to become relevant.

At $t = 2$ and after, the boom in investment reverses itself. The subpar returns lead the most unprofitable investments to be liquidated first. At this juncture sticky prices and wages and regime uncertainty can become binding. As Fisher (1933), Bernanke (1983), and Minsky (1986) argue, negative changes to balance sheets may increase the costs of financial intermediation making a gap between ex ante saving and investment increase, leading to a sudden increase in money demand which has the exact opposite effect of an increase in the money supply. $t = 4$ and $t = 5$ represent the bust.

Between $t = 4$ and $t = 6$ the real balances effect operates to increase consumption and the increased demand for real money balances. This lowers the interest rate and prompts investment to return to its initial level and the capital structure to return to equilibrium.

How does this story pare up with the old Keynesian story? The temporal order of events suggests that the paradox of thrift appears between $t = 2$ and $t = 4$, as saving increases and consumption decreases. Then animal spirits kick-in, and the herd starts running away after $t = 4$ as investment spending decreases. In the Keynesian story, the

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25 Perhaps this is Keynes’s (1997 [1936]) “collapse in the marginal efficiency of capital.”
increase in consumption at $t = 4$ and afterward is either the result of an adjustment of prices and wages or a well-intended government deficit-financed spending program.

The Keynesian story’s issue is that it treats the symptom, i.e., insufficient aggregate demand, as the cause of the disease, i.e., the bust. While the Keynesian theory may appear accurate, it only plays out because a cycle was initiated by an earlier, increased supply of money. This implies that the Keynesian story is a special case of Austrian business cycle theory.

Section IV. Effects of a money supply decrease

Austrian business cycle theory is often treated as a synonym for Austrian macroeconomics. This is a mistake. While Austrian business cycle theory applies exclusively to money supply increases, Austrian macroeconomics encompasses not only this, but also the seldom discussed effects of money supply decreases. This topic is now discussed. Once again, it is assumed that the central bank remains passive following the money supply decrease.

Figure 1-5 below shows the effects. Before the money supply decrease (i.e., before $t = 0$) the economy is in a stationary, no-growth equilibrium. At $t = 0$, the money supply is exogenously decreased. This raises the market interest rate above the natural rate of interest and creates a gap between ex ante investment, which decreases, and ex ante saving, which increases.

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26 To my knowledge this is the first analysis of a money supply decrease in the context of the capital-based macroeconomic model. Similar to the section above it is devoid of clear economic content.

27 Mises (1966, pp. 566-68) is an exception. His analysis seems consistent with the one provided here.
At $t = 1$ both consumption and investment contract. This might be termed underconsumption (or forced saving) and underinvestment (or liquidation), which are the natural inverses of overconsumption and overinvestment. Real output, $Y$, decreases immediately. At $t = 2$ the decrease in investment leads the demand for loanable funds to decrease. This in turn decreases the interest rate. This is the reverse of distress borrowing. The lower interest rate causes saving to decrease and consumption to increase. Once prices, wages and real money balances adjust, the economy returns to its initial equilibrium at $t = 4$. 

Figure 1-5: Time path of variables given a money supply decrease at $t = 0$
Like the Austrian business cycle theory story, this one seems ad hoc. However it the consequences of a decreased money supply are compelling because it causes an immediate contraction in economic activity. This particular case is interesting because it may explain the severity of the Great Depression and the Great Recession in a more elaborate context with respect to the Austrian macroeconomics perspective. While the non-Austrian stories of Friedman and Schwartz (1963) and Eichengreen (1992) ascribe blame for the Great Depression to central banks allowing the money supply to collapse, Austrians attribute the Great Depression to an accommodative monetary policy by central banks in the 1920s. Capital-based macroeconomics gives us a new perspective on the old Austrian business cycle theory story: If a central bank’s monetary policy was too accommodative there will be a sequence of boom and bust. If monetary policy tightens in the bust phase it will only exacerbate the contraction. The standard Austrian business cycle only admits that a central bank money supply increase creates a cycle of boom and bust. However, it does not very clearly state that a central bank may make matters worse by contracting the money supply during the bust phase.

Section V. Discussion

V.A. Rational expectations

Caplan (2002) and Tullock (1988) criticize Austrian business cycle theory on the grounds that agents do not adhere to rational expectations, i.e., why do entrepreneurs commit systematic errors? There are multiple avenues through which rational expectations might be justifiably omitted or violated.
(1) Evidence for rational expectations is weak. In almost all experimental economic studies of asset markets agents fail to adhere to rational expectations. See Smith, Suchanek, and Williams (1988) for example.

(2) Garrison (2001) distinguishes between local knowledge and global knowledge. With local knowledge, an entrepreneur might act rationally within their realm of expertise (i.e., in the industry he or she knows), but in terms of global knowledge he or she may not be aware of the monetary policy literature on vector autoregressions. In other words, entrepreneurs may treat interest rates as exogenous when making investment decisions.\(^{28}\)

This may sync with the two theories of rational expectations: Nash (1950) and Muth (1961). As Smith, Suchanek, and Williams (1988) describe them: “…[rational expectations in the Nash (1950) sense] implies only that expectations are sustained (or reinforced) by outcomes, while [rational expectations in the Muth (1961) sense] implies that expectations are sustained by outcomes that in turn support the predictions of some theory.” Essentially, Nash (1950) argues that asset prices may follow a random walk \textit{with drift}, whereas Muth (1961) argues that asset prices should strictly follow a random walk. So perhaps agents may not adhere to the Muth’s (1961) stronger rational expectations concept, but they may adhere to it in the Nash (1950) sense of it.\(^{29}\)

\(^{28}\) Contrary to my reasoning above: Where then are the entrepreneurs in the financial sector that would profit from having this local knowledge?  
\(^{29}\) It should be noted that Smith, Suchanek, and Williams (1988) find that neither version seems to hold. Their empirical results support adaptive expectations. This result is robust under a variety of experimental asset markets studies. It should also be noted that experience is a key factor in determining whether bubbles will be mitigated in the lab: Agents with more experience end to not generate bubbles.
(3) As Cowen (1997, p. 86) points out: Entrepreneurs may be subject to signal extraction errors because they cannot decipher whether or not a real interest rate decreases is due to a liquidity effect or a change in saving. Consequently, if both factors are sufficiently variable, entrepreneurs may mistake a transitory liquidity effect for a permanent decrease in household discount rates.

(4) In finance the following rule-of-thumb is often advanced: “Don’t Fight the Fed!” Even if agents attempt to get the Fisher effect to operate in the short-run a central bank may just capsize the effort with liquidity. Consequently, would-be arbitrages avoid fighting the Fed.

(5) For whatever reason, so long as there is a liquidity effect, the Austrian story carries weight if its capital theory is truly consequential. If the ultimate end of monetary theory is to discover those policies which remove any negative effects of changes to the money supply, the best answer monetary policy is one which is not sensitive to how agents form their expectations.

(6) Lastly, Austrians could say okay to rational expectations and amend future accounts to state: “Given an unanticipated money supply increase…” one observes a boom and bust cycle.

Overall, the Austrian-mainstream debate reduces itself to the following question: Which has a better capital theory? If capital structure stories don’t matter, then it becomes a simple aggregate demand-aggregate supply world; Austrians might as well

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30 See the title of Chapter 9 of Stigum and Crescenzi (2007) Stigum’s Money Markets, for example.
become monetarists or New Classical proponents. However, if capital structure matters, then the impact of monetary policy shocks needs to be more carefully considered.

**V.B. Inelasticity of investment with respect to interest rates**

Austrian business cycle theory is critiqued because investment is insensitive to interest rates. Therefore, a loose monetary policy won’t have a large enough effect to generate the Austrian-variety business cycle. Some points merit consideration:

1. Figure 1-3 above shows that investment increases over a significant portion of the cycle following a money supply increase. If one only estimates the proximate response of investment to a liquidity effect, then a significant effect might not be observed. If the time horizon over which elasticity is estimated is increased, a larger effect might be observed.

2. As Cowen (1997) points out: “Investment-based cyclical scenarios also involve changes in the composition of investment, rather than changes in the aggregate, these effects will not necessarily show up in measurements of aggregate statistics.” In support of this, Bernanke and Gertler (1995) find that residential investment is very sensitive to federal funds rate shocks. Also, Leamer (2007) finds that residential investment drives business cycles rather than investment at-large.

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31 See Lucas (1981) for example.
32 This is one aspect of Hayek’s (1944) charge that “Mr. Keynes’s aggregates conceal the fundamental mechanisms of change.”
33 They don’t actually elaborate on this result, they only recognize that it’s a puzzle, and seem surprised that monetary policy has such asymmetric effects.
34 Leamer (2007) also finds that consumption expenditure decreases precede contractions to real output, and not investment as was commonly postulated by Keynesians. He also finds that consumption expenditures recover before investment recovers. This is not surprising from a Keynesians perspective however this finding also fits the Austrian anticipation of a “natural” recovery as discussed in Section III.
(4) Skousen (2010) argues that conventional measurements of investment are insufficient. He recommends using gross domestic expenditures (GDE) instead of GDP for measuring aggregate economic activity. GDE includes the value of final goods plus goods-in-process. His findings show that while consumption accounts for two-thirds of GDP, it constitutes only one-third of GDE in the United States.\textsuperscript{35}

\textit{V.C. The sunk cost fallacy-fallacy}

Krugman (1998) astutely inquires why malinvestments, now sunk costs, impinge upon current economic activity as the Austrian business cycle theory purports. The sunk cost fallacy implies, correctly, that basing present decisions on the basis of irrecoverable costs is a mistake. However, it is a further fallacy to ignore the avoidable costs related to specific capital projects that have incidentally been the subject of sunk costs:

(1) Krugman’s (1998) critique rests on the assumption that capital is homogenous, which implies no adjustment costs. In contrast, capital is heterogeneous in the Austrian story. Therefore, capital is subject to adjustment costs. These costs, applicable to human capital as well as physical, may lead to resources being unemployed for a prolonged duration. If entrepreneurs estimate that misallocation costs are low relative to adjustment costs, then they may choose to hoard capital. Furthermore, entrepreneurs may decrease variable costs, such as expenses on labor and raw materials and delay future investment decisions until further information is received.\textsuperscript{36} This notion is espoused by Mises (1966, 30)

\textsuperscript{35} One might consider this an in between to Irving Fisher’s notion of $MV = PT$ rather than the usual $MV = PY$. Where $T$ represents all transactions in an economy in a given time period, and $Y$ represents final goods and services produced in a given time period. Skousen’s (2010) measurement is somewhere between $T$ and $Y$, and represents both final goods and services and those which are in process in a given period of time.

\textsuperscript{36} This is one approach adopted in Cowen’s (1997) risk-based business cycle theory.
pp. 563-4) and Pindyck (1991). Consequently, an economy may suffer a “hangover.” The fact that particular investments costs are sunk is incidental. It is still the avoidable costs (i.e., adjustment costs), which happen to be related to the sunk costs by virtue of being the same capital projects, which matter.

(2) Bankruptcy costs and financial intermediation costs may also delay a rapid redeployment of resources. From a contemporary perspective, the Austrian theory implies that the housing bubble is crucially intertwined to the recent business cycle and the anemic recovery as Leamer’s (2007) results suggest they would be. If entrepreneurs want to avoid bankruptcy costs they may attempt to keep their projects active for as long as possible.

Bernanke and Gertler (1989) argue that net worth signals to lenders the prospective desirability of lending to a particular entrepreneur. If the net worth of entrepreneurs decreases—constituting an increase in the costs of financial intermediation—lenders decrease the supply of credit.

V.D. Sticky prices and wages

Sticky prices and wages play a crucial role in mainstream macroeconomics. While Austrian macroeconomics has no resounding role for them this is no coincidence. Mises (1966) and Horwitz (2000) willingly entertain their existence however the effects of sticky prices and wages are of second-order importance in Austrian macroeconomic theory.

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37 I like to joke that Ed Leamer is the best empirical Austrian economist even though he claims no preferences for one school of macroeconomic thought over another.
From an Austrian macroeconomics perspective, as argued above, sticky prices and wages become binding given a non-neutral monetary policy change in the first place. In other words, sticky prices and wages are a second-order effect: they may only serve to exacerbate monetary policy-induced business cycles. More concretely, if positive monetary policy shocks introduce, what will become disequilibrium between the future supplies and demands for consumption goods, then sticky prices and wages may subvert these intertemporal markets from clearing as they become current markets for final consumption goods. Consequently, one may assert that sticky prices and wages only become binding problems given an increase in the money supply.

Section VI. Conclusions

This paper explored some new perspectives on the old Austrian business cycle theory. In particular:

(1) Definitions were provided for key terms that unified them with respect to satisfying agents’ wants. The key theme was that the interest rate must be a sufficient statistic to maintain capital structure equilibrium, i.e., the natural rate of interest.

(2) The time paths of key macroeconomic variables given a money supply shock were shown. It was also demonstrated that the paradox of thrift appears to be a special case of Austrian business cycle story.

(3) The path of a “natural recovery” was drawn out. It showed that a recovery in consumption spending precedes a recovery in investment spending. This is consistent with the empirical findings of Leamer (2007) and the Keynesian theory of the multiplier effect.
(4) The time paths of key macroeconomics variables given a decrease in the money supply were shown. It implied that a central bank, after a period of accommodative monetary policy generates the old Austrian business cycle of boom and bust, can exacerbate a bust further by adopting a tight monetary policy. This interpretation suggests that monetarist explanation of the Great Depression is a special case of the Austrian story.

(5) Lastly, critiques of the Austrian business cycle theory were discussed. It was shown that there are many potential ways to circumvent these critiques.

Overall, Austrian macroeconomics has a lot to say: (1) Capital-based macroeconomics can tell us more than just the standard Austrian business cycle story. (2) Working further with the capital-based macroeconomics model shows some new perspectives on the causes of the Great Depression. (3) The key question for the Austrian-mainstream macroeconomics debate is not: Does rational expectations apply? But rather: Is there a structure to capital? If there is a structure to capital, it implies that mainstream macroeconomists ought to take Austrian macroeconomics more seriously.
Chapter 1 References


CHAPTER 2: AUSTRIAN CAPITAL THEORY AND NEOCLASSICAL CAPITAL THEORY AS ANALYTICAL SUBSTITUTES

Introduction

Solow (1997) observes that the “…one major weakness in the core of macroeconomics…is the lack of real coupling between the short run picture and the long run picture. Since the long run and the short run merge into one another, one feels they cannot be completely independent.” Operationally this works as follows: In long-run growth models, such as Harrod-Domar, Ramsey-Cass-Koopmans, or Solow-Swan, an increase in saving leads real output to increase. However, in short-run macroeconomic models, such as the Keynesian model, an increase in saving leads output to contract. If you ask an economist, should the rate of saving in the US be higher or lower? Their answer would depend on whether they were thinking about the long-run or short-run picture.

Garrison (2001)’s capital-based macroeconomics model addresses this concern and also sheds light on the macroeconomic theories of Hayek, Mises, and Strigl, key proponents of the Austrian business cycle theory. However, the extreme complexity

38 See Harrod (1939) and Domar (1946).
39 See Ramsey (1928), Cass (1965), and Koopmans (1965).
40 See Solow (1956) and Swan (1956).
inherent to the Austrian theory of capital complicates Garrison’s endeavor to depict Austrian business cycle theory in a more concrete way.\textsuperscript{41}

Strangely, no one has asked the question: How different are the qualitative results when one uses a neoclassical theory of capital instead of the Austrian theory of capital? Although there is a literature discussing the two approaches\textsuperscript{42} we are left with the inference that neoclassical capital theories ought to be abandoned for Austrian capital theory. It implies that Austrian capital theory is necessary to generate an Austrian-variety business cycle of boom \textit{and} bust.

Before exploring the business cycle aspect, this chapter explores how different the qualitative results are between the Austrian capital theory and neoclassical capital theory in a money-neutral environment. To do this, an Austrian-neoclassical model is developed. It contains elements of Garrison’s (2001) capital-based macroeconomics model while employing the neoclassical capital theory developed by Jorgensen (1963) and Hall and Jorgensen (1967). The latter replaces the Hayekian triangle contained in the capital-based macroeconomics model. Then the Austrian-neoclassical model and capital-based macroeconomics model are subjected to a shock and the outcomes are compared.

The two models produce similar qualitative results. This implies that the Austrian and neoclassical capital theories may be analytical substitutes. Said another way, Austrian capital theory may be sufficient to generate an Austrian-variety business cycle, but it is \textit{not necessary}.

\textsuperscript{41} The material demonstrated here is not generally consistent with the current mode of the Austrian school; here more mainstream economic theoretical tools are used to analyze Austrian macroeconomic theory.
There’s been little reconciliation between the Austrians and mainstream in terms of business cycle theory because Austrians adopt a capital theory that mainstream economists view as peculiar. Consequently, the two schools tend to talk past one another because of the issues related to capital. However, the finding that the two schools’ capital theories can be treated as analytical substitutes, allows me to demonstrate in the next chapter that the Austrian theory of boom and bust is plausible, even when a neoclassical capital theory is utilized. However for the moment, this chapter focuses on why the Austrian and basic neoclassical theories of capital can be treated as analytical substitutes.

This chapter is organized as follows: Section one offers some background and propositions. Section two builds the Austrian-neoclassical model. Section three subjects the new model and the capital-based macroeconomics to identical shocks. Section four contains the conclusion and discussion.

Section I. Background and propositions

The Hayekian triangle depicted in Figure 2-1 below, shows that production of consumption goods requires time. Pure inputs (Hayek’s (2007 [1941]) term) or originary inputs (Strigl’s (2000 [1934]) term) are continuously applied at some initial date, \( \tau \) and increase the value of goods-in-process over a time span equal to \( \tau - t \), until consumption goods, \( C_t \), are yielded.

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\( ^{43} \) See Schibuola (2014a) for evidence of this.

\( ^{44} \) The concept is originally due to Jevons (1970 [1871]).

\( ^{45} \) Pure (or originary) inputs represent land and labor.
Böhm-Bawerk (1891 [1888]) refers to the length of this time-span as roundaboutness. More roundaboutness implies a greater degree of capital intensity, which graphically, implies a longer average period of production, i.e., an increasing distance between $\tau$ and $t$.

The Hayekian triangle employed in the capital-based macroeconomics model, as depicted in Figure 2-1, assumes a continuous input-point output case, to use Hayek’s (2007 [1941]) classificatory scheme. This scheme focuses on the production of non-durable goods (i.e., circulating capital), whereas neoclassical capital theory focuses on durable goods production (i.e., fixed capital).46

The treatment of fixed capital requires a continuous input-continuous output construct. However, this has a complication: The value of fixed capital good returns back

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46 Solow (1964) states that, “Böhm-Bawerk, who seemed to be thinking mainly about the age at which trees should be cut down, seemed to worry too little about the implement to be used in felling them.”
as an input, and the value and location of the capital good in the Hayekian triangle are
difficult to follow. As Hayek (1994) points out: “…things become so damn complicated
it’s almost impossible to follow it.”

Following the Keynesian revolution in the 1930s, work on the intricacies
underlying Hayek’s capital theory languished; the Cambridge Capital controversies,47
Lachmann (1973 [1965]), and Hicks (1973)48 were exceptions. Ultimately, Hayek’s
(2007 [1941]) Pure Theory of Capital, rather than demonstrate a case in favor of Austrian
macroeconomic ideas, showed it would unwise to proceed further. This led to stagnation
in Austrian macroeconomic research. A notable exception is Garrison’s (1978, 2001)
works which develop the capital-based macroeconomics model. Nevertheless, the
conceptually ambiguous concepts of the average period of production and the Hayekian
triangle remain.

This chapter asks the following question: If we replace the Hayekian triangle with
the Jorgenson (1963) and Hall and Jorgenson (1967) model of capital, do the key
predictions of the model regarding output and employment change? Although there are
different candidates of investment theory for neoclassical capital theory, such as Tobin’s
q (or adjustment cost models),49 the Kydland and Prescott (1982) time-to-build model, or
Pindyck (1991)’s irreversible investment model, I use the Jorgenson (1963) and Hall and
Jorgensen (1967) theory since it constitutes a baseline for the other theories and
simplifies the current task.

47 See Cohen and Harcourt (2003) for a summary of the Cambridge Capital Controversies
48 Interestingly, Hicks, who was a student of both Keynes and Hayek at LSE in the 1930s, had his feet in
both boats here. Hicks’ (1937) focus is on Keynesian ideas, and gave birth to IS-LM, whereas Hicks (1973)
revisits Hayek’s ideas.
49 See Abel (1982), Hayashi (1982), and Summers (1981) for external adjustment cost models.
To demonstrate that the mainstream and Austrian capital theories convey similar properties, I offer the following propositions:

**Proposition #1:** An increased capital stock implies a greater degree of roundaboutness, and vice versa (Qualitative Equivalence Property).

From a Ramsey-Cass-Koopmans and a capital-based macroeconomics perspective, it is implied that there exists an optimal steady-state level of capital for a given set of technology and preferences, and that this outcome is Pareto efficient. Let the Austrian analogue to a steady-state level of capital be called the optimal degree of roundaboutness. For various combinations of time preferences and technology there are different potential steady-state levels of capital/optimal degrees of roundaboutness. The terms, “a higher steady-state level of capital” or a “greater optimal degree of roundaboutness,” both signify a more capital-intensive economy.

**Proposition #2:** There is a unique, steady-state level of capital for which consumption is maximized; likewise there exists a unique, optimal degree of roundaboutness for which consumption is maximized (Golden-Rule Property).

In mainstream macroeconomics, this is the golden-rule level of the capital stock. Let its Austrian analogue be called the golden-rule degree of roundaboutness. At any steady-state level of capital that is less than the golden-rule level of the capital stock, consumption can be increased by accumulating more capital. Conversely, consumption

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50 This is not the case for the Solow growth model since it is a structural model and not a model where consumers and firms solve a constrained optimization problem.
decreases if the steady-state level of the capital stock exceeds the golden-rule level of the capital stock. Analogously from the Austrian perspective: At any degree of roundaboutness that is less than the golden-rule degree of roundaboutness, consumption can be increased by adopting more roundabout production processes. Conversely, consumption decreases if the prevailing optimal degree of roundaboutness exceeds the golden-rule degree of roundaboutness.

**Proposition #3:** All economic decision-makers have discount rates greater than zero (Time Preference Property).

I.e., agents value future consumption less relative to present consumption.

**Theorem #1:** If propositions #1, #2, and #3 hold, then the prevailing steady-state level of the capital stock will always be less than the golden-rule level of the capital stock. In Austrian terminology: the prevailing optimal degree of roundaboutness is less than the golden-rule degree of roundaboutness.

The latter is implicit in the Austrian macroeconomics literature: Any increase in saving leading to the adoption of more roundabout production methods results in an increase in consumption once those investments come to fruition.\(^51\)

Regarding the dynamics of the transition from one-steady state to another convergence is anticipated by both the neoclassical and Austrian theories of capital. In mainstream general equilibrium models: if the prevailing capital stock exceeds the

\(^{51}\)This is not necessarily the case if money supply changes drive capital accumulation.
steady-state level of capital, capital depreciation will exceed gross investment and the capital stock will shrink. On the other hand, if the prevailing capital stock is less than the steady-state level of capital, gross investment will exceed capital depreciation and the capital stock will increase. Ergo, the capital stock will converge to its steady-state.

Strigl (2000 [1934]) tells a similar story. If the prevailing degree of roundaboutness is less than the optimal degree of roundaboutness, agents will find that they could have increased their consumption by choosing a greater degree of roundaboutness. Conversely, if the prevailing degree of roundaboutness exceeds the optimal degree, consumption will be less than it could have been, and less roundabout methods adopted. All this implies is that if agents learn or are able to make the proper calculations in advance, they will optimize their consumption over time given the constraints they face.

Therefore both Austrian and mainstream models anticipate convergence to a steady-state level of capital or an optimal degree of roundaboutness. I will demonstrate later that definitive transitions from one optimal degree of roundaboutness to another are more difficult to find in the Austrian case.

All this begs the question: What are the substantive differences between the mainstream and Austrian capital theories?

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52 The exact quote from Strigl (2000 [1934]) is: “…the ‘correct’ length of the roundabout method of production is determined by the size of the subsistence fund or the period of time for which this fund suffices. If a shorter roundabout method of production were begun with a subsistence fund that suffices for one year, then the output would be smaller than it could have been. However, if the roundabout method of production is too long, then it could not be completed without interruption.”

53 The Austrians are less sanguine than their mainstream counterparts on this aspect. In particular, the Austrians are unwilling to accept the notion of a stable vector of consumption goods, so often assumed in mainstream models. Consequently, they will observe that the adoption of new production techniques and the development of new products may not, even if money is neutral, preclude the possibility of economic downturns. See Hayek (1967 [1931]), Mises (1966), and Strigl (2000 [1934]) for example.
(1) The Austrian models do not guarantee efficient outcomes. Indeed Hayek (1967 [1931]), Strigl (2000 [1934]), Mises (1966), and others, observe that there exists an element of radical uncertainty that makes the resolution of some investments difficult to anticipate. For example, if an entirely new product is created for which there is very little past information on which to predict its success, an economy may find that it produced too much of this new good and a bust may occur.

Mainstream models typically assume a single consumption good, or a stable vector of consumption goods. Consequently, there is no real role for the radical uncertainty component in these models. Mainstream models can cope with risk but we are still left with the ex ante expectation of efficient outcomes. Furthermore if we accept Lucas’s (1972) rational expectations theory as largely descriptive of reality, then errors will cancel one another out over time such that the efficient result is achieved.\(^{54}\)

(2) Mainstream models, employing the neoclassical capital theory, treat time as passing in fixed intervals. In Austrian macroeconomics production intervals are not fixed. The intervals at which consumption goods are delivered vary with the adopted degree of roundaboutness.

For example, suppose the rate of interest falls from \( r_0 \) to \( r_1 \). At \( r_0 \) a firm produced $10,000 worth of consumption goods in a year. Now, given lower interest rate, \( r_1 \), the firm produces $12,000 worth of consumption goods over 1.5 years (since it will at lower

\(^{54}\) Hayek (1966 [1933], pp. 69-70) anticipated the theory of rational expectations in his response to the formerly popular overproduction/underconsumption theories of business cycles: “...as to this prospective price of the product concerned [by the entrepreneur], that it is just as likely to be lower than the equilibrium price as to be higher and that, on the average, it should more or less coincide, since there is no reason to assume that deviations will take place only in one direction.”
rates of interest adopt more roundabout production processes). The complication is that time becomes a variable itself. This makes it difficult to keep track of the start dates and delivery dates of goods-in-process. It also makes determining the value of capital complicated because the interest rate and investment time horizon become interdependent variables.

In mainstream models intervals of analysis are fixed. I.e., time is not a variable. This creates focus on how much capital is accumulated or depleted from one time to another as an economy adjusts to a new steady-state level of capital.

In this paper, the first difference (radical uncertainty) is ignored. The second difference, regarding how time and capital interact, is this chapter’s topic. So, do the qualitative results of the capital-based macroeconomics model differ if Austrian capital theory is replaced with a neoclassical theory of capital?

**Section II. An Austrian-neoclassical model**

Before answering the aforementioned question, an Austrian-neoclassical model, containing four elements, (1) the loanable funds market, (2) the production possibilities frontier, (3) the $Y-K$ space, and (4) the $UC-K$ space, is constructed. The properties of this model are summarized in this section.

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55 For a proof of this see Hicks’s (1973) Fundamental Theorem.
56 This also holds for continuous time models as well.
Panel (a) in Figure 2-2 shows the loanable funds market. It represents the real quantities of loanable funds supplied and demanded at various real interest rates. The supply of loanable funds curve is represented by the curve labeled $SLF$; the demand for loanable fund curve is designated $DLF$. The corresponding quantities supplied and quantities demanded of these two curves represent saving, $S_t$, and investment, $I_t$. Consumer borrowing is excluded. Additionally it is assumed here that money is neutral.
II.A.i. Supply of loanable funds

The quantity supplied of loanable funds is a function of the following variables.\(^{57}\)

\[
S_t = SLF\left[ r_t, \rho, Y_t, \left( \frac{M_t^S}{P_t} - \frac{M_t^D}{P_t} \right) \right]
\]

It is increasing in the interest rate, \(r_t\), and income, \(Y_t\), and decreasing with consumer discount rates, \(\rho\). With respect to the difference between real money balances supplied and real money balances demanded, \(\left( \frac{M_t^S}{P_t} - \frac{M_t^D}{P_t} \right)\) it is increasing. In this chapter, money is assumed to be neutral, therefore \(\left( \frac{M_t^S}{P_t} - \frac{M_t^D}{P_t} \right)\equiv 0\).

It is also assumed that the utility function of households is embedded in the function above. This is adopted for the sake of simplicity.

II.A.ii. Demand for loanable funds

The quantity demanded for loanable funds is summarized by the following:

\[
I_t = DLF\left[ r_t, \phi, \alpha, A_t, p_t^K, \delta, E[p_t^K], L_t, K_t \right]
\]

The quantity demanded for loanable funds is increasing in the capital factor share, \(\alpha\), technological knowledge, \(A_t\), expected rate of change of capital’s price, \(E[p_t^K]\), and labor supply, \(L\). It is decreasing in the interest rate, \(r_t\), price of capital, \(p_t^K\), and capital.

---

\(^{57}\) The value, in relation to zero, of a partial derivative with respect to a particular determinant is signified by a plus or minus sign above the determinant. A plus sign signifies the partial derivative is greater than zero, a minus sign that it is less than zero, and a ‘u’ indicates that the partial derivative’s relation to zero is uncertain.
depreciation rate, $\delta$. The relationship is uncertain for the partial adjustment parameter, $\phi$, and the existing capital stock, $K_t$. The share of income attributable to capital, $\alpha$, comes from the neoclassical production function, $Y_t = A_t F(K_t, L_t)$, which is assumed to be Cobb-Douglas and exhibits constant returns to scale, such that $Y_t = A_t K_t^\alpha L_t^{1-\alpha}$, subject to the constraint that $0 < \alpha < 1$.

The structural form of gross investment is such that:

$$ I_t = \phi(K_T^+ - K_t) + \delta K_t \tag{3} $$

$K_T^+$ is the desired capital stock which will be realized at some date, $T$, where $T > t$. $\phi$ is the partial adjustment parameter. It is bounded such that $0 < \phi \leq 1$. If $\phi = 1$, it indicates that the desired steady-state level of capital will be realized at time period $t + 1$. Assuming $0 < \phi < 1$ implies that the capital stock will adjust at a slower rate, such that $T - t > 1$. It is assumed that within a given time period, $t$, the existing capital stock is fixed. This assumption is represented by designating the current capital stock, $K_t$, as $\overline{K}_t$. The desired capital stock is determined in subsection II.D below.

II.A.iii. Loanable funds market equilibrium

The real interest rate, which equates the quantity supplied of real loanable funds with the quantity demanded of real loanable funds (or saving and investment) is the real natural rate of interest, $r_t^N$, as developed by Wicksell (1936 [1898]).

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The partial adjustment parameter will be discussed in greater detail below.
For a given set of parameters and exogenous variables it is assumed that there is a unique real rate of interest which equates the quantity supplied and quantity demanded of loanable funds:

\[ S(r^*) = I(r^*) \]

If money is neutral, as assumed here, then the equilibrium real interest rate is equal to the equilibrium real natural rate of interest such that \[ r^*_t = r^N_t \]. Furthermore, it is assumed that any prevailing equilibrium rate of interest is strictly nonnegative.

\textit{II.B. Production possibilities frontier (PPF)}

The prevailing equilibrium rate of interest determines the mix of consumption goods and capital goods (investment) produced in a given time period. This relationship is depicted in panel (b) of Figure 2-2. The \textit{PPF} is drawn such that:

\[ \{ \text{PPF} | A, F(\bar{K}, \bar{L}) - (C_t + I_t) \equiv 0 \} \]

The \textit{PPF} is drawn assuming that the labor market is in equilibrium, such that the expected real wage is equated to the actual real wage. It also assumes that capital and technological knowledge are fixed. The \textit{PPF} is an analogue to the mainstream’s long-run aggregate supply curve. In the short-run, it is possible that consumption, \( C_t \), and investment, \( I_t \), can move above the \textit{PPF} if there is an increase in the labor supply. The full-employment level is given by \( L_t^* \).

\( L_t^* \), prevails when the expected real wage is equal to the actual real wage:

\[ L_t^* = \{ L_t | (W_t / P^*_t) = (W_t / P_t) \} \]
The $W_t$ term is the prevailing nominal wage, $P^e_t$ is the expected price level, and $P_t$ is the actual price level. The following relationships between the actual level of employment and the full-employment level should be noted:

$$
(7) \quad \left\{ L_t \left( \frac{W_t}{P^e_t} \right) > (W_t/P_t) \right\} > L^*_t
$$

If the expected real wage exceeds the actual real wage, then the actual level of employment will exceed the full-employment level. Conversely:

$$
(8) \quad \left\{ L_t \left( \frac{W_t}{P^e_t} \right) < (W_t/P_t) \right\} < L^*_t
$$

If the actual real wage exceeds the expected real wage, then the actual level of employment will be less than the full-employment level.

A deviation from the prevailing full-employment level is manifest as a movement off the PPF. In the first case, represented by equation (7), the consumption-investment production mix would lie above the PPF. In the latter case, represented by equation (8), the consumption-investment mix would lie inside the PPF.

It is assumed here that perfect information holds; therefore $P^e_t = P_t$. Furthermore, it is assumed that the labor supply is completely inelastic with respect to the real wage. Consequently, there are no deviations off a given PPF in the short-run when the capital stock is fixed.

Lastly, the PPF differs from that of Garrison (2001) because it is linear rather than concave to the origin.\(^{59}\) This signifies that there are no adjustment costs. The vertical

\(^{59}\) Overall Garrison’s concave PPF implies the presence of adjustment costs. The linearity found here is a consequence of assuming the partial adjustment parameter is constant. Cost of adjustment models endogenize this parameter and produce a concave PPF.
intercept in $C-I$ space (and also horizontal intercept) represents the economy’s total output, $Y$. The underlying intuition is that if an economy opted to consume all of its output, investment would be zero and consumption would be equal to real output, i.e., $(I \equiv 0; C \equiv Y)$.

**II.C. Y-K space**

Total output allows for the determination of the capital stock as represented in panel (c) of Figure 2-2 which shows the $Y-K$ space. The output curve, labeled $Y|L = L_0$, represents the relationship between output and capital, holding labor and technology constant. As stipulated above, the production function is Cobb-Douglas with constant returns to scale:

$$\tag{9} Y = A K^{\alpha} L^{1-\alpha}, \quad 0 < \alpha < 1$$

With respect to capital: $dY / dK > 0$ and $d^2Y / dK^2 < 0$.

The investment curve, labeled $I$, shows the magnitude of gross investment associated with a particular saving rate for different levels of the capital stock:

$$\tag{10} I = s A K^{\alpha} L^{1-\alpha}$$

Although the $Y-K$ space looks like the Solow growth model graph the saving rate is not exogenous. It is determined endogenously by the amount of saving in the loanable funds market relative to real output, which depends on technology and time and labor-leisure preferences. Thus the saving rate, $s$, is given implicitly by the prevailing loanable funds market equilibrium.
The depreciation line (labeled $D$) represents the portion of the existing capital stock that is consumed in a given period. Therefore depreciation is given by:

\begin{equation}
D_t = \delta K_t
\end{equation}

A steady-state level of capital, $K^*$, prevails wherever the investment curve and depreciation line intersect one-another:

\begin{equation}
\{ K_t = K^* \left| I_t = D_t \right. \}
\end{equation}

If gross investment exceeds capital consumption then capital accumulation occurs:

\begin{equation}
\{ K_t < K^* \Rightarrow \frac{dK}{dt} > 0 \left| I_t > D_t \right. \}
\end{equation}

If gross investment is less than capital consumption then capital depletion occurs:

\begin{equation}
\{ K_t > K^* \Rightarrow \frac{dK}{dt} < 0 \left| I_t < D_t \right. \}
\end{equation}

The state of technological knowledge and corresponding labor supply determine the level of output which prevails at a given time. This in turn determines the capital stock, which is incidentally determined by the user-cost and marginal product of capital.

\textit{II.D. UC-K space}

The comparative statics of the capital market are represented in panel (d) of Figure 2-2, titled \textit{UC-K space}. This represents the properties underlying the capital theory of Jorgensen (1963) and Hall and Jorgensen (1967). The marginal product of capital is:

\begin{equation}
MPK = \frac{\partial Y}{\partial K} = \alpha \left( \frac{A_t K_t^\alpha L_t^{1-\alpha}}{K_t} \right)
\end{equation}
The demand for capital in a given period of time is determined by the MPK curve. It is subject to diminishing returns and is drawn under the assumption that the labor supply and state of technological knowledge are fixed.

The uc-curve represents the prevailing real user cost of capital. It depends on the price of capital, real interest rate, the depreciation rate, and the expected rate of change of the price of capital.

\[
uc_t = p^K_t \left( r_t + \delta - E \left[ \frac{\dot{p}^K_t}{p^K_{t+1}} \right] \right)
\]

Capital market equilibrium exists when the user cost of capital is equated with the marginal product of capital, such that:

\[
uc_t = MPK_t
\]

II.E. National income

The distribution of gross real national income is:

\[
Y_t = \frac{W_t}{P_t} L_t + uc_t K_t + \pi_t
\]

\((W_t / P_t)L_t\) is income accruing to labor, \(uc_t K_t\) represents income accruing to capital, and \(\pi_t\) is profit. The distribution is not a major concern here because households supply labor, rent capital, and are the claimants of all residual sources of income.

II.F. Timing

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60 Here “gross” indicates that capital depreciation is not netted out of the equation.

61 Since the distributional effects of a shock may be of interest in more real world settings, the effects of a savings shock to income distribution are covered in Appendix 2-A below.
The last thing to consider in laying out the comparative statics of Austrian-neoclassical model is the relevant time periods of adjustment. Let the short-run be defined as the period for which the capital stock is fixed and labor is the only variable input. Let the medium-run be defined as the period of time for which the capital stock is adjusting toward a new steady-state. Lastly, let the long-run be described by the outcome in which the prevailing level of the capital stock is equal to the desired steady-state level of the capital stock.\footnote{It is assumed in this chapter that population growth is zero and that there is not continuous non-zero growth in technological knowledge. This serves to keep the analysis simpler.}

Having described the model the comparative statics are now explored to determine the extent to which the Austrian-neoclassical model differs from the Garrison (2001) capital-based macroeconomics model.

**Section III. Comparative statics**

This section compares and contrasts the effects of an increase in households’ discount rates in the Austrian-neoclassical model and the capital-based macroeconomics model. The $UC-K$ space is omitted since it is not a critical feature for this chapter. Since it is relevant for an ancillary matter, namely the distribution of income, it is discussed in Appendix 2-A.

In Figure 2-3, it is assumed that the initial interest rate, saving, investment, consumption, and capital stock were the values: $r_0, S_0, I_0, C_0, Y_0, \text{ and } K_0$. Additionally, via proposition #3 above, which assumes positive discount rates, the steady-state level of
capital is below the golden-rule level of the capital stock, implying that an increase in the saving rate will lead consumption to increase in the long-run.

Now, let there be a decrease in the discount rates of consumers. This causes the supply of loanable funds to shift rightward, i.e., \( SLF_0 \rightarrow SLF_1 \) and the equilibrium natural rate of interest decreases. This increases the quantity demanded for loanable funds, i.e., \( I_0 \rightarrow I_1 \). In the short-run, since the capital stock is fixed and the labor supply is perfectly inelastic, the level of output remains unchanged, i.e., \( Y_0 = Y_1 \). What occurs is that labor is substituted from consumption-goods production into capital goods production. This fact is depicted by the movement along the PPF from \( (C_0, I_0) \) to \( (C_1, I_1) \).

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63 See Romer (2011), Chapter 2, part A for a proof.
In the $Y-K$ space in the top-left panel of Figure 2-3 the increased saving, holding real output constant, means the saving rate rises. This is observed as the upward shift in the investment curve, i.e., $(I|s_0) \rightarrow (I|s_1)$. The new steady-state level of capital, $K_T$, is given by the point where the new investment curve intercepts the depreciation line.

In the long-run the capital stock attains its new, higher steady-state level, $K_T$. In the loanable funds market the supply of loanable funds curve shifts rightward, i.e.,
$SLF_1 \rightarrow SLF_T$, as does the demand for loanable funds, i.e., $DLF_0 \rightarrow DLF_T$. The latter shift allows the new higher steady state level of capital to be maintained.

Now, the capital-based macroeconomics model, employing Austrian capital theory, is subjected to the same shock. Figure 2-4, below, depicts the effects of an increase in saving in the capital-based macroeconomics model. The decrease in the household discount rates is manifested as a rightward shift of the supply of loanable funds, i.e., $SLF_0 \rightarrow SLF_1$, which decreases the natural rate of interest and leads investment to increase at the expense of consumption. This is shown as the movement along the PPF curve. This is identical to Austrian-neoclassical model shown above. What is different is the Hayekian triangle. In the capital-based macroeconomics model, more “roundabout production processes,” i.e., more capital-intensive production according to Proposition #1, are adopted. This is manifested as the Hayekian triangle becoming shorter and more elongated.

Over time, as the newer, more roundabout production processes yield final products, the supply and demand for loanable funds curves shift right and the PPF shifts outward just as in the Austrian-neoclassical model. As the more roundabout production processes come to fruition the Hayekian is seen to become taller and more elongated.

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64 This facet has important implications for the business cycle element discussed in the subsequent chapter.
Figure 2-4: Effects of an increase in savings in the capital-based model

Aside from the different renditions of capital, one key difference between the Austrian-neoclassical model and the capital-based macroeconomics model is that the latter shows no convergence. Indeed, no specifications are given on the limits to capital accumulation. Conversely, the Austrian-neoclassical model does show convergence to a new steady-state. Aside from this however the qualitative results are largely identical: An increase in saving creates a short-run reduction in consumption followed by a long-run increase.
Figure 2-5, below, compares the time paths of key variables following the increase in saving. Prior to $t = 0$, all the variables had constant time paths. At $t = 0$ the shock occurs. The dashed lines represent the time-paths of selected variables in the capital-based macroeconomics model while the solid lines represent the time-paths of variables in the Austrian-neoclassical model.

Panel (a) shows the path of consumption: From time $t = 0$ to $t = T$ consumption follows an identical path in both models. However there is a difference: In the Austrian-
neoclassical model convergence to the new steady-state occurs at $t = T$; whereas in the capital-based macroeconomics case there is no such convergence.

Panel (b) shows the path of investment and saving. Again both models show an identical path from time $t = 0$ to $t = T$. After time, $T$, however investment and saving continue to grow, whereas in the Austrian-neoclassical model convergence occurs.

Panel (c) shows the path of the capital stock. It applies only to the Austrian-neoclassical model. It shows that the capital stock is fixed in the short-run (from time, $t = 0$ to time, $t = 1$). Then positive net investment leads the capital stock to increase in the medium-run ($t = 1$ to $t < T$). This occurs until the long-run is attained at $t = T$, at which time the actual capital stock is equated to the desired capital stock.

Panel (d) depicts roundaboutness. It applies only to the capital-based macroeconomics model. It represents the time interval for which a good’s production is initiated until it becomes a final consumption good. In this case we don’t observe convergence to a new, optimal degree of roundaboutness. In the Austrian-neoclassical model, capital intensity, i.e., the capital stock, reaches a steady-state; whereas in the capital-based macroeconomics model, capital intensity, i.e., roundaboutness, expands indefinitely.

Most importantly, as panels (a) and (b) in Figure 2-5 show, key variables in both models follow similar paths. Therefore the argument that roundaboutness and the capital stock level are both metaphors for capital-intensity is accurate. Consequently, I argue that the two can be treated as analytical substitutes.
Section IV. Discussion and conclusion

For the reader’s benefits, the three propositions and the one theorem stipulated in Section I are restated:

**Proposition #1:** An increased capital stock implies a greater degree of roundaboutness, and vice versa (Qualitative Equivalence Property).

**Proposition #2:** There is a unique, steady-state level of capital for which consumption is maximized; likewise there exists a unique, optimal degree of roundaboutness for which consumption is maximized (Golden-Rule Property).

**Proposition #3:** All economic decision-makers have discount rates greater than zero (Time Preference Property).

**Theorem #1:** If propositions #1, #2, and #3 hold the prevailing steady-state level of the capital stock will always be less than the golden-rule level of the capital stock. In Austrian terminology: the prevailing optimal degree of roundaboutness is less than the golden-rule degree of roundaboutness.

Proposition #2 is well-defined in the mainstream macroeconomics models; this is not the case for the Austrian capital-based macroeconomics model. The Ramsey-Cass-Koopmans model demonstrates that if proposition #3 holds, then any steady-state level of capital will be less than the golden-rule level of the capital stock.\textsuperscript{65} Proposition #3 is a mainstay in the Austrian literature. Thus the Austrians have little concern to address the

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\textsuperscript{65} See Romer (2011), Chapter 2, part A for the proof.
issues raised by proposition #2, since it is taken for granted that the prevailing level of the roundaboutness is less than the golden-rule level of roundaboutness.

The latter reasoning and inherent complexity of the Hayekian triangle component are the reason for why there is no convergence to a steady-state in the capital-based macroeconomics model. Certainly, the proponents of the latter are not averse to diminishing returns to roundaboutness; however, the overall complexity of the Hayekian triangle conception leaves this unaddressed.

This brings me to my key point: I have demonstrated that both models produce similar qualitative results, with the exception that the new Austrian-neoclassical model produces convergence to a steady-state and the capital-based macroeconomics model does not. Consequently, if the Hall-Jorgensen capital theory is easier to work with, why not use it to understand the inherent dynamics of the Austrian business cycle theory?

In the realm of business cycle theory: The mainstream’s mistake is that their short-run models focus too much on labor market dynamics rather than the dynamics of both labor and capital markets. The strategic mistake on the part of the Austrians was to use an overly complicated capital theory to explain the boom-bust cycle since it was (is) thought that Austrian capital theory is necessary to generate Austrian-variety business cycles. In the next chapter, I demonstrate that even with mainstream analytical constructs, the overall Austrian business cycle argument of boom and bust is still correct.

To reiterate the overall finding of this paper: Radical uncertainty and Austrian capital theory may be sufficient conditions for an Austrian-variety business cycle to occur but they are not necessary conditions. The implication here is that the simpler versions of
mainstream capital theory can be employed to understand Austrian business cycle theory. Additionally, if one wishes to evaluate the role of radical uncertainty, it may not be necessary for one to augment it with the more complex Austrian theories of capital.
Chapter 2 References


Kaldor and H.M. Croome, New York: Augustus M. Kelley


Appendix 2-A: Effects of a real interest rate change on real gross national income

A decrease in household discount rates, as analyzed above, can affect the distribution of income in three different ways. Substituting equation (16) for the real user cost of capital, $uc_t$, into equation (18), yields the gross national income equation:

\begin{equation}
Y_t = \frac{W^t}{P^t} L_t + p^K_t \left( r_t + \delta - E_t \left[ p^{K*}_{t+1} \right] \right) K_t + \pi_t
\end{equation}

As shown above, a decrease in household discount rates increases saving which reduces the real interest rate. This leads the real user cost of capital to fall. The change in gross national income with respect to the real interest rate change is:

\begin{equation}
\frac{\partial Y_t}{\partial r_t} = p^K_t K_t > 0
\end{equation}

The change in real gross national income is $\partial Y_t = p^K_t K_t \partial r_t$. Thus, a decrease in the real interest rate reduces capital’s share of income and implies that real gross national income decreases. However, since the level of real gross national income was constant,⁶⁶ the estimated decrease must be offset by an increase in the income accruing to labor, the user cost of capital (via an increase in the price of capital, $p^K_t$), an increase in profits, or some combination of the three.

In one case, the increase in the desired capital stock may lead the expected marginal product of labor to increase. Consequently, current real wages may increase (keeping in mind that the labor supply was assumed to be perfectly inelastic) in the

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⁶⁶This was because the quantity of inputs employed was unchanged in the short-run.
present. A second potential avenue is that real price of capital increases (i.e., capital gains). Third, it may be that the profits of firms increase.

Overall, for this chapter’s purpose, the change in income distribution is not important since all the proceeds accrue to households. Therefore it is of residual interest to determine how the distribution of income may be affected by a change in interest rates.
CHAPTER 3 : THERE AIN’T NO SUCH THING AS A SOFT LANDING

Introduction

The Austrian business cycle theory postulates that a money supply increase will generate a cycle of boom and bust. Proponents assume a lack of rational expectations and an Austrian theory of capital are necessary to produce these cycles. This paper inquires: Are the Austrian business cycle theory results observed if agents have rational expectations and a neoclassical theory of capital is applied?

Using the Austrian-neoclassical model developed in Schibuola (2014b), with some modifications, I find that even when agents adhere to rational expectations and live in a world described by a neoclassical capital theory, such as the one developed by Jorgensen (1963) and Hall and Jorgensen (1967), cycles of boom and bust occur as predicted by the Austrians following unexpected money supply increases.

The implications are that (1) a period of loose monetary policy will not only create inflation, but will generate an economic boom followed by a bust. (2) As the boom ebbs, it may appear that a soft-landing is possible; however, market participants will discover that inflation and unemployment appear to be rising simultaneously. (3) Under these circumstances, a monetary policymaker faces a dilemma: (a) either fight rising unemployment by adopting a loose monetary policy, which may lead to stagflation, (b)
fight rising inflation by adopting a tight monetary policy, which may lead to depression, or (c) remain passive and accept that “there ain’t no such thing as a soft landing.”

In what follows, Section I places some context with respect to the current problem. Section II introduces some modifications to the Austrian-neoclassical model developed in Schibuola (2014b). Section III analyzes the consequences of an unexpected money supply increase in the Austrian-neoclassical model. Lastly, Section IV contains a discussion and conclusion.

Section I. Background

It is useful to put the Austrian ideas into context with competing business cycle theories. The points labeled 1 through 6 in Figure 3-1 below show realized real output values, $Y$, over time, $t$. There is a trend rate of growth represented by the dashed line. This is typically analyzed using long-run models. Then there are the deviations around the trend rate of growth (business cycles), which are analyzed with short-run models. The latter are the subject of various competing theoretical constructs.

A Keynesian or New Classical model exhibits “exogenous trend reversion” as graphed in panel (a). In this case, a positive shock to aggregate demand at $t = 0$ produces a boom. Eventually the expected price level adjusts to the actual price level and the economy returns to the dotted trend line. At $t = 4$, a negative aggregate demand shock, which is unrelated to the $t = 0$ positive aggregate demand shock, occurs and produces a bust. Once again, price expectations eventually adjust and real output returns to its trend.

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67 Or policy actions restore the economy to its trend rate of growth.
rate of growth. “Exogenous trend reversion” reflects the observation that the positive and negative shocks are independent events.

Panel (b) in Figure 3-1 describes the real business cycle story. Deviations from the trend arise from supply shocks. Real output follows a random walk. Panel (c) in Figure 3-1 is the basic monetarist model often known as the “Plucking Model.”\(^{68}\) It shows that all is well up until around \(t = 3\) and \(t = 4\), when the money supply decreases and produces a bust. Eventually the situation is corrected by central bank intervention or price and nominal wage adjustments and real output returns to its normal growth path. In this story there are no booms, only busts.

Lastly, panel (d) shows an Austrian interpretation of business cycles. At \(t = 0\) money supply increase occurs. It produces a boom which moderates at \(t = 3\). The nuances of Austrian capital theory appear to produce a result in which the economy collapses into recession after \(t = 3\). An economy may recover however, most accounts of the Austrian theory stop around \(t = 4\).

“Endogenous trend reversion” reflects the Austrian notion that the initial money supply increase generates the boom and the bust. I.e., it is “endogenous” because both the boom and bust are explained by the initial shock. In contrast to exogenous trend reversion stories, such as the one told in panel (a) of Figure 3-1, patterns of boom and bust are attributable to independently occurring shocks.

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\(^{68}\) See Friedman (1966), Friedman (1993), and Garrison (1996).
Generally the Austrian theory is subject to criticism regarding (1) agents’ lack of rational expectations, (2) Austrian capital theory, and (3) the notion that the Austrian theory cannot explain positive comovement. Because the latter deviates from the present topic it is relegated to Appendix 3-A below.\footnote{This appendix is recommended if you believe that the Austrian business cycle theory argues unequivocally for negative comovement between consumption and investment during the boom phase.} Regarding the first two critiques, this paper demonstrates that the Austrian notion of endogenous trend reversion occurs even when agents adhere to rational expectations and live in a world described by a neoclassical theory of capital.
Section II. The Austrian-neoclassical model

The underlying mathematics of the Austrian-neoclassical model can be found in Schibuola (2014b). Some modifications are made here, and some important aspects reiterated in the following ten assumptions.

The following three assumptions are adopted for simplicity:

Assumption #1: The state of technological knowledge is constant.

Assumption #2: Taxation and government spending are assumed to be zero.

Assumption #3: There are no exports or imports.

The last two assumptions imply there is a two-sector (households and firms), closed economy.

Assumption #4: In the short-run only labor is variable; in the medium-run capital is adjusting toward a new steady-state level; and, the long-run is attained when the capital stock reaches its new steady-state level.\(^\text{70}\)

The Austrian-neoclassical model departs from standard macroeconomic long and short-run distinction. In the latter, the long-run occurs when money becomes neutral. In the former, the short-long run distinction is consistent with the traditional microeconomic distinction, i.e., the long-run is attained when all inputs become variable.

Assumption #5: Movements to higher (lower) steady-state levels of capital following a decrease (increase) in household discount rates lead to

\(^{70}\) This assumption was also applied in Schibuola (2014b).
the supply and demand for loanable funds shifting rightward (leftward) in equal proportions until the new steady-state level of capital is attained.

From Schibuola (2014b), an increase in the supply of loanable funds, such as one attributable to a decrease in household discount rates, causes the natural rate of interest to fall. This signals that a new higher steady-state level of capital is desired. As the actual level of capital adjusts to the new, higher steady-state level, the supply and demand for loanable funds shifts rightward over time until the new steady-state level of capital is reached, as Figure 3-2 shows below.

The bottom-right graph of Figure 3-2 depicts the loanable funds market. The real interest rate is \( r \) and the quantity of real loanable funds is \( S \). The top-right graph shows a production possibilities frontier depicting the trade-off between real consumption, \( C \), and real investment, \( I \), for given quantities of labor and capital. The top-left graph shows real output, \( Y \), as a function of the capital stock, \( K \). The output curve, \( Y | L = L_0 \), is drawn assuming the quantity supply of labor is held constant. The curve labeled \( D \) represents the portion of the capital stock that depreciates in a given period, i.e., \( D_t = \delta K_t \), where \( \delta \) represents the rate of depreciation. The curves labeled \( I | s_t \) represents gross investment as a function of the capital stock, such that \( I_t = s_t A_t K_t^a L_t^{1-a} \), where \( s_t \) is the implied saving rate and is implicitly derived from the proportion of the quantity supplied of loanable funds plus any excess real money balances to the level of output. The terms \( A_t \), \( K_t \), and \( L_t \) represent the state of technological knowledge, physical capital, and labor at time, \( t \). The
share of income accruing to capital is designated by $\alpha$. The production function is Cobb-Douglas and assumes constant returns-to-scale, where $0 < \alpha < 1$.

As Figure 3-2 shows, a decrease in household discount rates causes the supply of loanable funds to shift right from $SLF_0$ to $SLF_1$, thus reducing the real natural rate of interest from $r_0$ to $r_1$ and increasing the quantity demanded for loanable funds. As a result saving and investment increase from $S_0$ and $I_0$ to $S_1$ and $I_1$. The increase in saving also means there is a short-run decrease in consumption from $C_0$ to $C_1$, as depicted by the rightward movement along the PPF.

The increased saving rate leads the investment curve to shift upward from $I \mid s_0$ to $I \mid s_1$. The point at which the new investment curve, $I \mid s_1$, intercepts the depreciation line, $D$, determines the new desired steady-state level of capital, $K_T$, which will be attained at some future date, $T$.

Assumption #5 indicates that as the capital stock rises from $t = 1$ until time $t = T$, the supply and demand for loanable funds curves will shift rightward over time, e.g., $SLF_t$ shifts toward $SLF_r$ and $DLF_t$ shifts out toward $DLF_r$. This assumption is explicitly described because it is important in the next section’s business cycle analysis.
Assumption #6: There exists a unique function that relates different levels of the real rate of interest to the quantities supplied of loanable funds, which is consistent with a given set of household time preferences, or rather, which prevails as if money were neutral.

This will be very important for interpreting the course of events over the business cycle in the next section. Figure 3-3 below, for a given panel, depicts the loanable funds market in the lower graph showing the real interest rate, $r$, on the vertical axis and the real quantity of loanable funds, $S$, on the horizontal axis. The upper graph, in a given panel,
shows aggregate real consumption, $C$, on vertical axis and aggregate real gross investment on the horizontal axis, $I$. The production possibility frontier shows the trade-off between consumption and investment in a given time period, for a given capital stock, $K$ and quantity of labor, $L$. A given PPF is drawn under the assumption that the perceived real wage is equated with the actual real wage. I.e., it means that

$$\frac{W}{P^r} = \frac{W}{P},$$

where $W/P^r$ is the perceived real wage and $W/P$ is the actual real wage. The PPF is an analogue to the long-run aggregate supply curve.

In panel (a), initially at $t = 0$, saving and investment are equal, i.e., $S_0 = I_0$. Saving and investment at $t = 0$ are shaded a light gray to indicate they are past realizations of variables. Saving is graphed on the lower panel while the corresponding level of investment is graphed on the horizontal axis of the upper panel. This is approach is adopted because the figures become more complicated later on. Therefore, it is convenient to keep the two magnitudes on separate axes.

At $t = 1$, let there be an unexpected money supply increase (or money demand decrease) as shown in panel (a). This is observed as a rightward shift in the supply of loanable funds from $SLF_0$ to $SLF_1$. This depresses the real market rate of interest to $r_1$, which lies below the real natural rate of interest. The curve labeled $SLF_1$ is dashed to represent that it is attributable to a change in monetary conditions, not time preferences, as was the case in Figure 3-2 above. Therefore, let any dashed supply of loanable funds curve be designated as a “monetary-augmented supply of loanable funds curve.”
Assumption #6 indicates that the original supply of loanable funds curve, \( SLF_0 \), still retains useful information for our purposes.

In panel (a) of Figure 3-3, at interest rate, \( r_1 \), households, as consistent with their preferences, save \( S_1 \), which is less than original savings, \( S_0 \). Firms invest more than before, such that \( I_1 > I_0 \). If the prevailing market real interest rate is below the natural rate of interest, i.e., \( r_1 < r_0 \), the quantity demanded of loanable funds exceeds the quantity
supplied of loanable funds, which would prevail if money were neutral. In other words, investment exceeds saving, i.e., $I > S$. This gap is financed by an excess supply of real money balances.

The upper graph in panel (a) shows the impact on consumption and investment. The decrease in the quantity supplied of loanable funds consistent with time preferences, i.e., as depicted by the $SLF_0$ curve, implies consumption increases. As noted above, investment is increasing. Rising consumption and investment mean output increases. As assumption #4 above stipulates, only labor can be varied in the short-run, therefore the increase in real output must arise from an increase in the quantity supplied of labor. This implies that the perceived real wage ($W/P^e$) exceeds the actual real wage ($W/P$).

While panel (a) of Figure 3-3 shows the effects of a money supply increase (or money demand decrease), panel (b) shows the effects of a money supply decrease (or money demand increase). In this case, the supply of loanable funds curve shifts left from $SLF_0$ to $SLF_1$. As per assumption #6, $SLF_0$, reflects the time preferences of households as if money were neutral. The shock raises the market real rate of interest, $r$, above the real natural rate of interest, $r_0$. This leads the real quantity supplied of loanable funds to increase while quantity demanded of loanable funds decreases. A gap is created such that $S > I$. The gap is maintained by an excess demand for real money balances.

In the upper graph of panel (b) the real output mix, determined by the prevailing combination of consumption, $C$, and investment, $I$, collapses inside of the PPF. As per

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71 The PPF is only binding when the labor supply and capital stock are held constant; therefore, it is possible to move above the PPF if the labor supply can be varied.
assumption #4, capital is fixed in the short-run, therefore the decrease in real output must arise from a decrease in the quantity supplied of labor. This implies that the perceived real wage is less than the actual real wage, i.e., \( W/P^e < W/P \).

In both scenarios, i.e., a money supply increase (or money demand decrease) and a money supply decrease (or money demand increase), a gap is created between ex ante saving and ex ante investment to use Wicksell (1936 [1898])’s terms. Myrdal (1965 [1939]) demonstrated that while ex ante saving and investment may not be equal, ex post saving and ex ante investment must be equated. Consequently, when the term disequilibrium is used in this paper, it implies that ex ante saving and ex ante investment are not equated with one another. The implication is that the expectations about the future time profile of consumption are not consistent between households and firms.

**Assumption #7:** Agents have rational expectations. Agents’ subjective probability distributions over the price level match the objective distribution of the price level. Therefore any monetary shocks are interpreted as being unanticipated. The biggest departure from the Lucas supply curve (or the New Classical story) as developed by Lucas (1972) and Lucas (1975) comes from the fact that errors can compound themselves. I.e., an unexpected price change today, affects today’s investment decisions, which in turn affects next period’s prices and so forth. The errors may eventually die off; however, as will be demonstrated, the effects are far less benign than in the Lucas supply curve story. “Compounding errors” implies that economic calculation becomes more challenging over the course of a business cycle than the Lucas model can admit.
Assumption #8: (a) “Equilibrium” exists if the plans of households and firms are compatible; (b) a “stationary state” is said to exist when there is no tendency for any variables to change.

There are two senses in which the term equilibrium can be used: One, in which there exists no tendency for change, such as in the most rudimentary supply and demand framework. The second comes from Hayek (2007 [1941], p. 18), who describes it as “…the case where [agents’] plans are fully adjusted to one another, so that it is possible for all of them to be carried out because the plans of anyone member are based on the expectation of such actions on the part of the other members as are contained in the plans which those others are making at the same time.” In this chapter, the term “equilibrium” is used in the Hayekian sense; while the term “stationary state” is used to describe the case in which variables have no tendency for change.

The situation in which household discount rates fall and lead to capital accumulation as seen in Figure 3-2, above, helps illustrate the difference between uses of the terms “stationary state” and “equilibrium.” At $t = 0$, an equilibrium and a stationary state prevail. The former holds because the consumption, saving, investment, and labor supply decisions between firms and households are compatible: i.e., no agent’s expectations will be left unsatisfied if this situation replicates itself indefinitely. At $t = 1$, there is an equilibrium, but not at a stationary state. In this instance, the decrease in household discount rates leads to capital accumulation. The system is in equilibrium because prices reflect the increased desired for future consumption relative to present consumption by households; likewise the consequent adjustment of investment by firms

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fully reflects this change. While an equilibrium, it is not a stationary state because between \( t = 1 \) and \( t = T \), variables, such as the capital stock, are changing.

Once the new steady-state level of capital is attained at \( t = T \), a new stationary-state prevails. In this instance the system was always in equilibrium because the plans of households and firms remained compatible with one another throughout the transition from one stationary state to another.

By contrast, “disequilibrium” exists when the plans of households and firms are not compatible with one another. Therefore, households and firms will discover that their earlier choices were not optimal. Consequently, some agents’ expectations will be frustrated. All of this implies that ex ante everything is in equilibrium however, ex post, this may not be the case. In other words, at each stage of the analysis, given the information available to agents, they anticipate that their current choices will be utility or profit-maximizing in the present period and lead to the utility or profit-maximizing outcomes in subsequent periods.

Another way of stating that there is equilibrium is if ex ante saving and ex ante investment are equated with one another as discussed above. If they are not, once again, households and firms will find that their plans are not aligned with one another and as a consequence some agents’ expectations will be left unsatisfied.

Horwitz (2000, pp. 8-9, p. 89) notes that it is this feature which provides a radical departure from the standard macroeconomics modeling procedure in which ex ante saving and investment are always equated with one another. I.e., the latter assumption
permits the formulation of the IS-curve in the IS-LM model. However, in this present model the IS-curve conception disintegrates.

**Assumption #9:** Let there be a central bank (also referred to as a “monetary authority” or “monetary policymaker”) with an undefined objective function and which has complete control over the nominal money supply.

The central bank has the ability to use discretion to change the money supply; therefore, agents may not be aware of policy-induced money supply changes. If they are unaware, the money supply shock shall be designated as “unexpected” or “unanticipated.” The central bank’s objective function is not defined for simplicity. This allows us to avoid having to figure out how a central bank will react to developments over the course of a business cycle.

**Assumption #10:** Agents exhibit habit persistence\(^\text{72}\) in their desire to hold real money balances.

An unexpected decrease in real money balances will cause households to believe their wealth has decreased; consequently, they will reduce their consumption expenditures in order re-acquire the level of real money balances they had been accustomed to holding. This feature\(^\text{73}\) is critical for producing endogenous trend reversion as Section III will show.

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\(^{72}\) My gratitude goes to Professor Garett Jones for supplying an existing theory for this feature of my model.

\(^{73}\) See Sundaresan (1989) and Constantinides (1990) for baseline versions of the habit persistence models. Generally it is applied to consumption over time rather than real money balance holdings.
Section III. Analysis of a business cycle

The following analysis looks at the effects of an unanticipated increase in the money supply using the Austrian-neoclassical model developed in Schibuola (2014b) and as elaborated upon above. This section contains seven subsections. The first four deal with a particular phase of the business cycle while the remaining three discuss broader issues.

A figure of the Austrian-neoclassical model depicting the loanable funds market and real consumption-real investment space is provided in each of the first four subsections. The panel (a)’s of these figures show the prior positions of the real interest rate, saving, investment, and consumption, while the panel (b)’s represent the current positions of the same variables. For example, in the first phase, when $t = 1$, panel (a) of the applicable figure, shows the situation at $t = 0$, while panel (b) shows the current situation at $t = 1$.

To place some context to this analysis, it is worthwhile to note as, O’Driscoll and Rasmussen (2014) observe that Hayek did not have a monetary theory business cycles per se. Indeed as Schumpeter (1954) points out, the starting point for Hayek’s business cycle theory generally begins with some real shock for which the banking system or monetary authority responds to. If the response ends up creating an excess supply of real money balances then a cycle of boom and bust may occur.

As per assumption #9, there is a central bank which has complete control over the money supply. At period $t = 0$, the economic system is in equilibrium as consistent with assumption #8 in Section II. Between period $t = 0$ and $t = 1$, the monetary authority
exogenously increases the money supply and does not publicly announce this change. The consequences of this shock are now examined. The following analysis leads up to the bust, but does not show the path toward re-attaining an equilibrium.

III.A. Phase one of the business cycle (t = 1)

At $t = 0$, the economy is in an equilibrium and a stationary-state. This situation is captured in panel (a) of Figure 4. At $t = 1$ the central bank unexpectedly increases the nominal supply of money. In the Austrian-neoclassical model, this is manifest as a rightward shift in the supply of loanable funds from $SLF_0$ to $SLF_1$. This causes the real market interest rate to decrease from the real natural rate, $r_0$, to $r_1$ as observed in panel (b) of Figure 3-4 below.

In the language of Schibuola (2014a), the real interest rate decrease signals to firms that the future supply of consumption goods is marginally more valuable than the present supply of consumption goods. Consequently, the quantity demanded for loanable funds increases as depicted by the movement along the $DLF_0$ curve. This indicates that real investment increases from $I_0$ to $I_1$. At $t = 0$, since the economy was in a stationary state, it was implied that gross investment was equal to capital consumption, i.e., $I_0 = D_0$. Now however $I_1 > D_1$, which implies capital accumulation is occurring, which in turn will allow the supply of future consumption goods to increase.\(^74\)

\(^74\) Note it is implied that any initial steady-state level of capital is less than the golden-rule level of the capital stock. See Schibuola (2014b) as to the universal plausibility of this proposition.
For households, via assumption #6, looking at the original $SLF_0$ curve, the fall in the real interest rate indicates the quantity supplied of loanable funds decreases saving from $S_0$ to $S_1$. This corresponds to an increase in consumption from $C_0$ to $C_1$. The gap between the quantity demanded of loanable funds and the quantity supplied of loanable funds (i.e., $S_1 > I_1$) is maintained by an excess supply of real money balances.

As per assumptions #2 and #3, which indicate a closed-two sector economy, real output is the sum of real consumption and real investment, i.e., $Y_0 = C_0 + I_0$. Since $C_1 > C_0$ and $I_1 > I_0$, it must be that $Y_1 > Y_0$. As this is the short-run, the capital stock is
fixed, $K_1 = K_0$, as per assumption #4. Therefore, the real output increase must be attributed to an increase in the quantity supplied of labor. Thus, $L_1 > L_0$. Since the real output mix is above the PPF, it implies that the perceived real wage exceeds the actual real wage, $(W/P_e) > (W/P)$.

The failure of expectations to adjust to this shock is implicit. Had the money supply shock been anticipated, the price level and the expected price level would have adjusted proportionally, and the quantity of real money balances would be unaffected. However, the presence of a liquidity effect suggests this adjustment did not occur.

In the standard aggregate demand-aggregate supply model there is a similar story as panel (a) of Figure 3-5 below shows. In this case, the money supply increase shifts aggregate demand from $AD$ to $AD'$. As a result, real output increases from $Y_0$ to $Y_1$, which is seen as a movement along a given short-run aggregate supply curve. The latter is drawn under the assumption that the expected price level at $t = 1$ is equal to the price level observed at $t = 0$, i.e., $P_1^e = P_0$. 

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III.B. Phase two of the business cycle \( (t = 2) \)

In the aggregate demand-aggregate supply framework price expectations eventually adjust to the price level that would have arisen had the monetary change been neutral in the first place. This is observed in panel (b) of Figure 3-5 above as an upward shift in the short-run aggregate supply curve from \( SRAS \) to \( SRAS' \). Real output returns to its full-employment level, i.e., the boom is followed by a soft-landing. This implies that employment and the capital stock return to their initial values.

![Figure 3-5: Unexpected money supply increase in AD-AS framework](image-url)
In the Austrian-neoclassical model, things are more complicated: For one, as the quantity demanded for loanable funds increased at $t = 1$, net investment was positive. This implies that capital is being accumulated. Panel (a) of Figure 3-6 below shows the situation at $t = 1$ while panel (b) shows the new situation at $t = 2$.

![Figure 3-6: Panel (a) situation at $t = 1$; Panel (b) situation at $t = 2$](image)

In this instance, assumption #5 is critical. It stipulated that over the medium-run, in which the capital stock is moving toward a new, higher desired steady-state level, the supply and demand for loanable funds curves will shift rightward over time to maintain
the new, lower natural real rate of interest. However, in this case, the real rate of interest was altered by a change in monetary conditions, not time preferences. Thus, the effects differ. In this case, firms, having interpreted the lower real interest rate as a signal to accumulate capital, increase their demand for loanable funds, as depicted by the shift from $DLF_0$ to $DLF_2$ in panel (b) in order to attain the new, higher steady-state level. Again this is consistent with assumption #5. However, there is no corresponding increase in the supply of loanable funds. This difference arises because the initial deviation in the supply of loanable funds was due to a change in monetary conditions, not time preferences.

Garrison (2001) refers to the shift in the demand for loanable funds from $DLF_0$ to $DLF_2$ as “distress borrowing.” This is a misnomer. This change represents firms adjusting to the recently decreased real interest rate, which indicated that a new, higher-steady-state level of capital was desired.

The increased demand for loanable funds bids the real interest rate up from $r_1$ to $r_2$. As per assumption #6, the original supply of loanable funds curve, $SLF_0$, shows the quantity supplied of loanable funds which would have prevailed if money were neutral. Thus, the quantity supplied of loanable funds increases from $S_1$ to $S_2$ which in turn implies a decrease in real consumption from $C_1$ to $C_2$. The shift in the demand for loanable funds increases the overall quantity demanded for loanable funds from $I_1$ to $I_2$. Notice a gap between saving and investment such that $I_2 > S_2$, remains, signifying that an excess supply of real money balances persists. Moreover, the observed changes are not consistent with the notion of equilibrium as defined in assumption #8: The plans of
households and firms are not compatible with one another as ex ante saving and investment are not equated.

The figure shows that \( C_2 < C_1 \) and that \( C_2 = C_0 \), while \( I_2 > I_1 > I_0 \). If the decrease in consumption were equal in magnitude to the increase in real investment, it can be surmised that \( Y_2 = Y_1 > Y_0 \). Consequently, real output, \( Y_2 \), remains above the equilibrium real output level that existed at \( t = 0 \), \( Y_0 \). Graphically, the consumption-investment mix remains above the PPF, as depicted by the black circle labeled ‘2’ in the upper graph of panel (b) in Figure 3-6 above.

Given the real output level, and the subsequent accumulation of capital, the employment of the factors of production is altered. During the initial monetary shock at \( t = 1 \), the capital stock was fixed, as per assumption #4, such that \( K_1 = K_0 \). However, in that time, positive net investment occurred such that at \( t = 2 \), \( K_2 > K_1 = K_0 \). Since \( Y_2 = Y_1 \), and \( K_2 > K_1 \), thus for labor, it must be that \( L_2 < L_1 \). Still, current employment exceeds its initial equilibrium quantity, i.e., \( L_2 > L_0 \). The proof of this proposition is in Appendix 3-C below. This in turn implies that the perceived real wage continues to exceed the actual real wage, \((W_2 / P_2^e) > (W_2 / P_2)\).

In contrast to the basic aggregate supply and demand model framework, the initial monetary shock is causing on-going changes to the relative supplies of the factors of production, which in turn means the relative prices of these factors are being altered. In the discussion of assumption #7, regarding rational expectations, the notion of “compounding errors” was mentioned. It suggests that not only do expectations regarding
the nominal price level need to adjust, but also the optimal mix of capital-to-labor. Deviations in the latter imply that wages relative the rental rate of capital are not at equilibrium levels. Thus the nominal price errors end up “compounding” themselves into relative price errors.

With respect to real interest rates, the real market rate of interest \( r_t \) now equals the real normal rate of interest, which prevailed at \( t = 0 \), i.e., \( r_0 \). Although the two rates are equal, given the monetary conditions (neutral at \( t = 0 \), non-neutral at \( t = 2 \)) the prevailing real market interest rate does not create consistency between the plans of households and firms.\(^{75}\) As it stands, ex ante investment continues to exceed ex ante saving, implying that the future supply of consumption goods will exceed the future demand for consumption goods.\(^{76}\)

**III.C. Phase three of the business cycle \((t = 3)\)**

As the price level begins to increase, the excess supply of real money balances decreases. This causes the supply of loanable funds to shift leftward from \( SLF_1 \) to \( SLF_3 \), as seen in panel (b) of Figure 3-7, below.\(^{77}\) At \( t = 3 \), the reduced supply of loanable funds increases the real rate of interest from \( r_3 \) to \( r_3 \). The higher real rate of interest encourages households to increase the quantity supplied of loanable funds, i.e., ex ante saving

\(^{75}\) Mises (1966, p. 558) seems to make an analogous point.

\(^{76}\) This has an important implication for empirical analyses of Austrian business cycle theories: Just because an observed market interest rate is equal to the estimated natural rate, it cannot be inferred that the natural rate truly prevails, i.e., we cannot definitively claim that there is equality between ex ante saving and investment. Consequently to infer whether a prevailing market rate is functioning, as Wicksell’s theory of the natural rate of interest predicts, it must be determined whether money is actually neutral.

\(^{77}\) As usual, panel (a) of Figure 3-7 shows the situation that prevailed at \( t = 2 \); while panel (b) shows the current situation.
increases from $S_2$ to $S_1$, which means consumption decreases such that $C_3 < C_2$. “Forced saving” is observed. It indicates that households are forced to reduce their consumption because their purchasing power was reduced via inflation.  

With respect to investment, the higher real interest rate decreases the quantity demanded for loanable funds. In other words, gross investment decreases, such that $I_3 < I_2$. The consumption and investment decrease suggest that $Y_3 < Y_2$. The way the figures are drawn suggests that $Y_3 = Y_0$, where $Y_0$ was the real output level that prevailed when the economy was in equilibrium as consistent with assumption #8.

It appears the mainstream aggregate demand-aggregate supply framework correctly concludes the effect of a money supply increase: a boom followed by a soft-landing to the full-employment level of output. This is misleading however. In the prior periods capital accumulation was occurring; thus it must that $K_3 > K_0$. Since $Y_3 = Y_0$, then $L_3 < L_0$. Thus in contrast to the basic aggregate demand-aggregate supply story, the relative supplies of the factors of production have been altered. The condition of the factors of production is proved in Appendix 3-D, below.

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78 See also Hayek (1967 [1931], p. 57).
Also at $t = 3$, $C_3 < C_0$ and $I_3 > I_0$ thus consumption and investment have not returned to the levels which prevailed in equilibrium. This imbalance arises because the prevailing real market interest rate exceeds the natural rate of interest, i.e., $r_3 > r_0$. This acts a signal for firms to de-accumulate capital and move toward a lower steady-state level of capital than the one which initially prevailed.\textsuperscript{79}

\textsuperscript{79} In general the natural real rate of interest is not directly observable. Therefore, what matters is the direction of change with respect to the real interest rate, which is observable, and the initial conditions which are observable. In this case, we were first moving toward a higher steady-state, only to discover that an even lower steady-state than what was initially found in equilibrium appears to be desired.
Now, the quantity demanded of loanable funds is equal to the quantity supplied of loanable funds, i.e., ex ante saving is equal to ex ante investment. This implies that the excess supply of real money balances was absorbed and that real output returned to its initial equilibrium level. It would appear that a stable equilibrium results, or more colloquially, that a soft-landing occurred.

Before proceeding, it is worthwhile to briefly compare the events occurring from $t = 0$ to $t = 3$ to the nomenclature typically used by the Austrians. It is held that Austrian capital theory is necessary for observing Austrian business cycles; however, even the most basic neoclassical capital theory appears adequate. As Schibuola (2014b) demonstrates, “more roundaboutness” is just a cognate for great capital intensity (i.e., an increased capital per labor, $K / L$, ratio). In the Austrian model, the liquidity effect, induced by the initial money supply increase, causes investment to increase into more roundabout production processes\textsuperscript{80} which allows the supply of future consumption goods to increase.\textsuperscript{81} In the present account, the Austrian-neoclassical model tells a similar story except that “greater roundaboutness” was replaced with “greater capital intensity” as evidenced by the increasing capital stock.

This amounts to the following proposition: Austrian capital theory may be a sufficient condition to generate an Austrian-variety business cycle (exhibiting endogenous trend reversion), but it is not a necessary condition.

\textsuperscript{80} See Hicks’s (1973) Fundamental Theorem for a proof of this assertion.\textsuperscript{81} From Schibuola (2014b), this is tantamount to saying that the initial steady-state level of capital is less than the golden-rule level of capital. From the lens of the Ramsey-Cass-Koopmans model, it implies that so long as household discount rates are greater than zero, an economy’s steady-state level of capital will always be less than its golden-rule level of capital. Thus any increase in capital accumulation in that range will produce an increase in the level of future consumption.
Turning to the more conventional side: a policymaker thinking in terms of a basic aggregate demand-aggregate supply framework may believe all is well. However, the relative changes in the supplies of the factors of production have yet to be resolved. The changed values are still being altered as net investment changes with the ongoing fluctuations in the supply and demand for loanable funds. Likewise, as employment has fallen below its initial starting point at $t = 0$ it implies that the supply and demand for labor are not fully reflective of labor-leisure preferences and the existing state of technological knowledge.

It is notable that both output and employment are declining while the price level is rising. The conflicting signals the policymaker faces are striking: inflation and unemployment appear to be rising. At this juncture the monetary policymaker has three potential strategies: (1) dove, (2) hawk, and (3) passive.\(^{82}\)

Choosing the dove strategy to combat the decreasing level of employment may prolong the boom, but requires accelerating the rate of money supply increases, and eventually begets stagflation. Choosing the hawk strategy, to combat the rising price level, may exacerbate a bust and cause a depression.

Lastly, if the passive strategy is selected, i.e., no hawkish or dovish moves, a bust still occurs. Briefly, I discuss this in the context of the Austrian policy recommendations in the 1930s. There is a difference between hawkishness and passiveness although the two are often conflated together.\(^{83}\) Hayek (1966 [1933]) recommended stabilizing

\(^{82}\) A passive policy seems to amount to a strategy of “wait-and-see.”

\(^{83}\) If a depression like deflation gives way, then a passive strategy or anyone who advocated it, would be categorized ex post as a hawk (such as Hayek).
nominal spending in the 1930s. Depending on one’s frame of reference this might be interpreted as a “hawkish” strategy. As Friedman and Schwartz (1963) demonstrate, the Federal Reserve was hawkish, not passive, during the Great Depression as decreasing the money supply in a recession is not a passive policy, and runs contrary to Hayek’s recommendation to stabilize nominal spending.

Returning the mainstream-Austrian theoretical debate, in contrast to the standard aggregate demand-aggregate supply story, as depicted in Figure 3-5 above, one can see in the context of Figure 3-1 above the difference between exogenous trend reversion and endogenous trend reversion. With the former the economy operates at its natural levels of output and employment until some negative aggregate demand shock comes along and throws the economy below the trend rate of growth. In contrast, endogenous trend reversion stories indicate that adjustments are still needed to restore equilibrium. The potential effects monetary policy interventions will be discussed further below. At this juncture, the next phase of the business cycle is analyzed. It is assumed that the monetary policymaker remains passive; therefore, no changes to the supply of money are made.

III.D. Phase four of the business cycle ($t = 4$)

What occurs now is important to endogenous trend reversion theories. Bogged down in Austrian capital theory, attempts to describe this turning point are difficult to follow. Mises (1966, p. 566), Hayek (1967 [1931], p. 60), and Strigl (2000 [1934], p. 84)

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84 Rothbard (1963 [2000]), p. 17), from an Austrian standpoint, argues that further money supply decreases can be desirable in order to break the back of sticky wages and prices; however, this seems extraordinarily inadvisable as Friedman and Schwartz (1963).

85 Hayek’s (1931) comment that, “Mr. Keynes’s aggregates conceal the fundamental mechanisms of change,” seems relevant here.
126) imply that the monetary authority/banking system was creating new money until 
$t = 3$, at which point the central bank stops issuing additional credit, or even reduces it 
altogether, or that private banks suddenly become averse to issuing any additional credit, 
or even start to increase their reserves. In this chapter however, there was a *one-time 
increase* in the money supply, at which point the monetary authority or banking system 
ceased to issue any new money, or to remove any from circulation. Thus, it is not the 
actions of the banking system, but the gradual rise in the price level which sops up the 
excess liquidity.\footnote{The differences between the older Austrian business cycle story and the one give here, vis-à-vis the Austrian-neoclassical model, are discussed in greater detail in subsection III.G below.} This factor caused the leftward shift of the supply of loanable funds 
curve from $SLF_1$ to $SLF_3$ in the prior period.

At $t = 4$ an additional leftward shift of the supply of loanable funds curve from 
$SLF_3$ to $SLF_4$, as depicted in panel (b) of Figure 3-8 below, occurs.\footnote{Once again panel (a) in Figure 3-8 below depicts the situation as it was in the prior phase, at $t = 3$; while panel (b) shows the present situation at $t = 4$.} This arises from the 
habit persistence of households in their demand for real money balances (see Section II, 
assumption #10). The nominal price level increase at $t = 3$ caused the value of households 
real money balances to decrease. Given the assumed habit persistence, households, 
wishing to re-attain the prior level of real money balance holdings, increase their demand 
for real money balances, which shifts the loanable funds curve leftward. This raises the 
real market rate of interest from $r_3$ to $r_4$. Once again, as per assumption #6, the curve now 
labeled $SLF_0 = SLF_3$ continues to preserve information about the underlying time 
preferences of households *as if* money were neutral. It indicates that at $r_4$ the quantity
supplied of loanable funds, $S_4$, exceeds the quantity demanded for loanable funds, $I_4$, i.e., ex ante saving exceeds ex ante investment. This gap is maintained by an excess demand for real money balances.

As a result, investment and consumption decrease, such that $C_4 < C_3$ and $I_4 < I_3$. Since $C_4 + I_4 < C_3 + I_3$, it means that $Y_4 < Y_3$. Thus, economic activity collapses to the interior of the production possibilities frontier. The bust has occurred.

\[ \begin{align*}
\text{(a) } t &= 3 \\
\text{(b) } t &= 4
\end{align*} \]

Figure 3-8: Panel (a) situation at $t = 3$; Panel (b) situation at $t = 4$

\[ ^{88} \text{Appendix 3-E below sketches out the proof for what happens to labor and capital at this phase of the business cycle.} \]
The dynamics of real money balance supplies and demands are discussed in greater detail now. During the $t = 1$ and $t = 2$ phases of the business cycle, agents had an excess supply of real money balances. Since the money supply shock was unanticipated, agents perceive this as an increase in their wealth. This led to the initial consumption and investment boom. As the excess money real balances dissipated at $t = 3$, households suddenly observe that their perceived wealth has decreased. As a result, they attempt to reacquire the level of real money balances they had become accustomed to by decreasing their consumption expenditures and transferring some of their savings into money holdings. In other words, households increase their demand for money.

Figure 3-9 depicts the evolution of the excess supply of real money balances and then the excess demand for real money balances. With the initial liquidity effect, the real rate of interest fell from the natural rate, $r_0$, to $r_1$. At $r_1$, the observed gap between the saving and investment was financed by an excess supply of real money balances. This gap is represented as the distance between the two points labeled ‘1s’ and ‘1d.’

Next, at $t = 2$, the real rate of interest increased to $r_2$. Ex ante investment continued to exceed ex ante saving. Again, this gap was maintained by an excess supply of real money balances. The distance between the points labeled ‘2s’ and ‘2d’ represents this.

At $t = 3$, as the nominal price level is rises, households discover that their nominal money balances can acquire fewer goods than was perceived. Although there is no excess demand or excess supply of real money balances (consequently the point labeled ‘3s’ and ‘3d’ are the same), since as per assumption #10, households exhibit habit persistence,
they have become accustomed to holding real money balances equal to the distances represented by ‘1s’-‘1d’ and ‘2s’-‘2d.’ Consequently, households attempt to re-attain those holdings. This translates into an increase in money demand which shifts the supply of loanable fund curve leftward and causes the quantity supplied of loanable funds to now exceed the quantity demanded for loanable funds by a distance of ‘4d’ to ‘4s.’

Figure 3-9: Evolution of real money balances over the cycle\(^{39}\)

\(^{39}\) \(r_0\) is real natural rate of interest, which prevailed at \(t = 0.\)
III.E. A summing up

Figure 3-10 below shows the time paths of output, investment, saving, labor, capital, consumption, and the interest rate following an unexpected money supply shock. Panel (a), depicting output, exhibits endogenous trend reversion: the boom becomes a bust; a phenomenon explained by the initial money supply increase. Panel (b), depicting investment and saving, shows the Wicksellian disequilibrium between ex ante saving and ex ante investment. In the initial phases of the business cycle, the gap was maintained by an excess supply of real money balances (denoted as “XMS”). In the bust phase, ex ante saving exceeds ex ante investment. The excess demand for real money balances (denoted as “XMD”) maintains this gap. Panel (c) shows the paths of capital and labor. Initially the quantity supplied of labor increases. As capital accumulation occurs, the quantity supplied of labor gradually declines. At $t = 3$, when a soft-landing seems possible, the quantity supplied of labor is less than what it initially was at $t = 0$, when equilibrium prevailed. Lastly, panel (d) shows the path of real consumption and the real interest rate. At first, real consumption increases, but reverses direction over the cycle. The real interest rate initially decreases, but as the supply and demand for loanable funds evolves, it rises.
III.F. Impact of a central bank intervention

Suppose the central bankers believe that the world functions according to the basic aggregate demand-aggregate supply framework. At $t = 3$, they would observe that real output had returned to its full-employment equivalent. At $t = 4$ they would be surprised by the sudden decrease in economic activity. Would it be advisable for the central bank to intervene at $t = 4$?

Suppose that the central bank announced a money supply increase, therefore households and firms anticipate it. If agents take into account the inflationary effect of
this money supply increase, the increase in nominal money balances will be offset by a proportional increase in the price level. This in turn implies that the desired quantity of real money balances remains unaffected. Households would still want to reacquire the quantity of real money balances that prevailed during the boom. Thus the increase in money demand at $t = 4$ persists.

Suppose instead that the central bank discretely increases the money supply. I.e., agents are unaware of the money supply increase. This creates a similar chain of events as occurred from $t = 1$ to $t = 4$. There would be a liquidity effect, and the economy would begin to accumulate even more additional capital. Eventually, if this strategy is played one-too-many times, the marginal product of additional capital would start to diminish so much that any increases to output would be small and nominal prices would rise at an accelerating rate. I.e., there would be stagflation.

Lastly, if the central bank opts to do nothing, i.e., adopts a “passive” strategy, it is not clear if equilibrium will be re-attained. However, it is clear that neither of the dovish intervention strategies will improve outcomes. This leads to the conclusion that “there ain’t no such thing as a soft-landing.”

**III.G The Austrian-neoclassical story vs. the old Austrian business cycle story**

The initial effects of a money supply increase are consistent with the accounts of Strigl, Mises, and Garrison: There is a period of overconsumption and overinvestment,\(^90\) which implies that total output increases. This runs contrary to the Hayek’s story (1967

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\(^90\) Evidence of for the Austrian argument of overconsumption in the initial stages of the business cycle can be found in Strigl (2000 [1934], pp. 128-9), Mises (1966, pp. 553, 559), and Garrison (2001, p. 70). In contrast, Hayek (1967 [1931], p. 57) seems to argue that forced saving (i.e., less consumption) occurs in the initial stages of a money-induced business cycle.
[1931], p. 55). However, for this chapter’s purposes, the Strigl-Mises-Garrison is given most attention.\textsuperscript{91}

In this chapter’s account the boom consists of a period of growing capital intensity. In Austrian nomenclature: more roundabout production processes are adopted.\textsuperscript{92} Hayek (1967 [1931], p. 60), Mises (1966, pp. 551, 555-6, 559, 568), and Strigl (2000 [1934], pp. 140-1) suggest that the central bank or banking system continuously injects new money into the system. In this chapter, ‘continuous injections of additional money’ is represented by a persistently higher level of real money balances. The difference of accounts is minor.\textsuperscript{93}

Both approaches are similar leading up to time index, $t = 3$, when the boom ebbs. In the old story, this occurs when the banking system ceases to extend credit. In this story, it is when the price level adjusts. The similarity is that the excess real money balances, which were available during the boom, now dry up. Ultimately however this is not what creates the bust. As Mises (1966, p. 562) notes: “The change in banks’ conduct [i.e., the cessation of credit expansion] does not create the crisis. It merely makes visible the havoc spread by the faults which business has committed in the boom period.” Equivalently, in this chapter, the drying up of credit shows that the capital accumulated during the boom phase, which is in excess of the equilibrium steady-state level of capital, is ill-fated. Therefore, there should be a tendency to return to the initial steady-state. However, there will not be a smooth process of capital depletion. This is attributable to

\textsuperscript{91} Again some of these differences are discussed in Appendix 3-A.
\textsuperscript{92} Again from Schibuola (2014b) it is implied that “capital intensity,” in the capital-to-labor ratio sense, is a cognate for greater “roundaboutness.”
\textsuperscript{93} Ultimately, their accounts imply that the rate at which money increases outpaces the inflation rate.
the habit-persistence\textsuperscript{94} exhibited by households with respect to their real money balances holdings.

This factor transforms the fizzling boom into a bust. This establishes the assertion that there ain’t no such thing as a soft landing. The elevated supply of real money balances during the boom was a money illusion. It made agents think they were wealthier than they really were. When the illusory wealth disappears, agents, who want to re-attain their former portfolio of wealth, attempt to acquire more real money balances. Mises (1966, p. 562) writes: “…firms badly need money in order to avoid bankruptcy (p. 562),” and that, “Every firm is intent upon increasing its cash holdings, and these endeavors affect the ratio between the supply of money (in the broader sense) and the demand for money (in the broader sense) for cash holding (p. 568).” Likewise Strigl (2000 [1934]) notes:

“A first reason for the non-neutral behavior of money is already clear from the conditions that lead to a halt in the expansion of credit. The ‘overstraining of the credit system’ will not only cause banks to discontinue the further expansion of credit but to restrict the amount of credit they grant. In addition to this, the symptoms of the crisis—collapses and connected losses, “freezing” of credit—make it likely that the banks will make the relationship between their cash reserves and their granted credit more favorable. Hence, the volume of credit will be restricted and banks will recall cash. Something very similar can also be expected

\textsuperscript{94} See assumption #10 in Section II above.
outside the area of banks: Considering the insecurity of conditions and the
danger of not maintaining liquid assets—the lack of expected payments,
the impossibility of withdrawing from deposits, the difficulty of obtaining
credit—many firms will increase their cash reserves. As compared to the
adjustment process that we have studied, all of this means a disruption in
the course of an economy by withdrawing money from the circulatory
system of payments. 95

The key difference between the Mises-Strigl rendition and this chapter’s rendition is that firms and banks constitute the increase in money demand in the former, whereas in the latter, it arises from households. Nevertheless, this is not a deal breaker. All of these are channels through which a crisis of liquidity might be observed.

What of the importance of capital? In the Austrian-neoclassical account given in this chapter, the capital accumulated during the boom is realized to be ill-founded once the excess real money balances dry up. This is tantamount to realizing that ‘too roundabout production processes were being adopted.’ The situation deteriorates even further when the money demand increase arises because the increasing real market rate of interest suggests that a lower steady-state level of capital is desired (even lower than the $t = 0$ steady-state level of capital). So the disinvestment that first occurs now spills over, not only from those firms which were accumulating capital in the boom, to those firms which were not. This is in essence the realization of a “cluster of errors,” to use

95 Note that Strigl’s story seems comparable to the “Agency Costs and Net Worth” story of Bernanke and Gertler (1989).
Rothbard’s (1963 [2000], p. 9) term, in which entrepreneurs appear to “all make errors at the same time.”

Note that the bust arises from the evolution of monetary factors, not from the heterogeneity of firms or capital.\textsuperscript{96} In this chapter, firms were implicitly all identical. This suggests that the heterogeneity of capital may serve to amplify booms and busts, but not to generate cycles of boom and bust. Therefore, Austrian capital theory is not necessary to generate cycles of boom and bust, and indeed it may not even be sufficient.

This creates a key question: If we eliminate the increase in money demand in the Mises (1966) and Strigl (2000 [1934]) accounts, will the remaining, unique element of Austrian capital theory be sufficient to generate a bust? It seems that Mises and Strigl could not definitively do so without the money demand increase. As this question is too big to answer here, I leave it for future research.

Lastly, I want to discuss the implication for the broader Austrian story. If we accept Hayek’s (1937) interpretation of markets as coordinating the actions of agents with dispersed knowledge, admit that macroeconomic systems are continuously buffeted by non-monetary shocks, that capital varies in magnitude over business cycles, and that the possibility of compounding errors exists (as was shown in this chapter), then the scope for signal extraction errors, to use Cowen’s (1997) term, rises tremendously. This undermines ability of rational expectations to hold. It even suggests that a transparent monetary policy would not yield monetary neutrality. It appears that monetary policy is

\textsuperscript{96} It can certainly be admitted that some industries are more susceptible to boom and bust than others, but overall the differences driving an industry’s “susceptibility” are insufficient to create a boom \textit{and} bust for the economy as a whole.
more of an art than a science, and that the task of monetary theory is to discover which arrangement of monetary institutions would minimize money’s role in propagating signal extraction errors, or rather in minimizing the costs of economic calculation.

Section IV. Discussion and conclusion

This chapter demonstrates that the essence of the Austrian business cycle theory, endogenous trend reversion, in which some initial shock, such as a money supply increase, sets off a cycle of boom and bust, is plausible, even when mainstream analytical devices, such as rational expectations and a basic neoclassical capital theory, are applied.

One may liken the money supply increase to a temporary subsidy on a durable good: The presence of the subsidy causes some people who would have waited to buy the good later to buy it today. When the subsidy ends, those who would have bought the good in the now present moment, already have it and do not buy it. As a consequence there is a sudden dearth in demand. Likewise for money supply increases, it creates a greater demand for durable goods (e.g., fixed capital, residential investment, and consumer durables) today. When the “subsidy” ends (i.e., excess real money balances dissipate), suddenly the demand for those durable goods collapses. Leamer (2007) shows evidence of this story and concludes that:

“Management of sales of homes and consumer durables by either businesses or monetary authorities is a difficult intertemporal control problem, with decisions made today affecting the range of options in the

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97 See Bernanke and Gertler (1995, p. 33) for evidence of this.
future. If we choose to stimulate today, tomorrow our ability to stimulate will be less.”

Furthermore, one might say that Classical macroeconomics is a special case of Keynesian macroeconomics, and that the latter is a special case of Austrian macroeconomics. If we adopt the standard conceptual framework of aggregate demand-aggregate supply, as the boom ebbs one might think all is well. The sudden increase in money demand and decrease in investment as occurred at \( t = 4 \), might be interpreted as abrupt change in animal spirits. Beaudry, Galizia, and Portier (2014) make the connection that Hayek’s and Keynes’s views of recessions may not be all that incompatible. The main difference being that in the Austrian view of things the sudden demand deficiency was the consequence of a loose monetary policy to begin with, whereas for Keynesians the demand deficiency was an exogenous event.

The analysis contains the following policy implications:

(1) Maintaining monetary neutrality is essential for maintaining price and output stability. As Hayek (1966 [1933]) shows, a nominal GDP target is required to maintain monetary equilibrium.

(2) Following a period of loose monetary policy, a central bank will eventually confront rising inflation and unemployment, as seen at \( t = 3 \). If a central bank adopts a dovish strategy to fight unemployment, it eventually creates stagflation. If it adopts a hawkish strategy to fight inflation, it creates a depression.
(3) If the central bank remains passive at \( t = 4 \) as households attempt to re-acquire the quantity of real money balances they had become accustomed to having, there is a sudden increase in money demand, which ultimately produces the bust.

(4) If at \( t = 4 \), the central bank announces a money supply increase (i.e., one that is anticipated), it has no effect on real output.\(^98\) If the central bank increased the money supply unexpectedly instead, it would set off another period of additional capital accumulation, which would ultimately give way to stagflation.

(5) If the central bank opts to remain passive, neither increasing nor decreasing the money supply, it is unclear if the original \( t = 0 \) equilibrium would be restored, i.e., if there would be a “natural recovery.”\(^99\)

Future research might consider what effects a pro-active fiscal policy might have. Given the path of variables as described here, it seems that at any stage in the cycle, fiscal policy would crowd out any private consumption and investment decisions, thus rendering it totally ineffective. I.e., fiscal policy will always crowd out private spending.

Ultimately, more conventional macroeconomic tools, such as rational expectations and the most basic capital neoclassical capital theory, tell the story that Austrian macroeconomists were trying to tell all along: There ain’t no such thing as a soft-landing.

\(^98\) One might interpret this as a liquidity trap.
\(^99\) My preliminary analysis suggests that there is; but this subject will be left for a future paper.
Chapter 3 References


Appendix 3-A. Standard criticisms of Austrian business cycle theory

Austrian capital theory plus agents who do not adhere to rational expectations equals the Austrian business cycle theory.

Three major criticisms generally follow:

(1) The rational expectations critique: Austrian business cycle theory cannot explain why entrepreneurs are systematically fooled by changes in monetary policy.

(2) The sunk cost critique: Austrian capital theory cannot explain why earlier investments, which are essentially sunk costs, impinge on current economic activity.

(3) The comovement asymmetry critique: (a) The Austrian theory precludes positive comovement between consumption and investment during the boom phase; (b) while allowing it for the bust phase.\(^\text{100}\)

The first critique seems rather easy to rectify: assume that some money supply increases are unanticipated. The second critique is dealt with in the text by replacing Austrian capital theory with the Hall-Jorgenson neoclassical capital theory. The third error is important to deal with as it applies to only Hayek’s version of Austrian business cycle theory, which is not applied in the primary text of this chapter.

The third critique can be better understood by comparing and contrasting it using a portion of the Garrison (2001) capital-based macroeconomics model. Panel (a) in

\(^{100}\) Appendix 3-B below contains a list of passages from multiple authors who use this to critique the Austrian theory.
Figure 3-11 shows the basic production possibilities frontier (PPF) and the Hayekian triangle for a stationary, zero-growth economy.

The PPF represents the economy’s potential mix of consumption goods for a given capital structure and a given amount of labor. The Hayekian triangle shows the value of goods-in-process, at a given movement, as they move from raw materials into final consumption goods.

Panel (b) of Figure 3-11 depicts the consequences of a decrease in household discount rates, which creates more saving and decreases the natural rate of interest, thus stimulating more investment. Greater investment leads to capital accumulation, i.e., additional roundaboutness, visible as the extension of the structure of production, which later yields a higher level of consumption.

In the aforementioned part (a) of the “comovement asymmetry” critique, it is implied that a money supply increase leads to an increase in investment but a decrease in consumption, such as that shown from $t = 0$ to $t = 1$ in panel (b) of Figure 3-11. Eventually, investment and consumption will eventually collapse inside the PPF, i.e., the economy experiences a bust. This is part (b) of the comovement asymmetry critique. Naturally, the question becomes: If a money supply increase and a preference-induced increase in saving have the same initial effects, why do they yield different outcomes?
Figure 3-11: Effects of a change in household time preferences

Note that something is askew: If the Austrian theory is a theory of boom and bust, how can we say it fits the mold of endogenous trend reversion? After all, if during the “boom” investment increases and consumption decreases in equal magnitudes, then real output is unchanged. So the “boom,” is no boom at all. It suggests that the path of real output over the business cycle would be similar to Friedman’s plucking model, as shown in panel (c) of Figure 3-1 in Section I above, rather than the endogenous trend reversion story shown in panel (d) of the same figure.
In reality, Hayek’s idea was more complex. Panel (a) in Figure 3-12 below shows Hayek’s (1967 [1931]) implied path of events given a money supply increase. While investment increases, consumption remains unchanged. It does not decrease as was the case shown in panel (b) of Figure 3-11. However, Hayek’s (1967 [1931], p. 55) arguments seem to be in nominal terms whereas here real terms are used.\footnote{It is difficult to follow Hayek on his real-nominal distinctions. Certain passages, such as on Hayek (1967 [1931], p. 51), suggest that the figures simply represent relative money values between the stages of production, which does not necessarily negate changes in real quantities between stages of production. Also, Hayek (1967 [1931], p. 59) seems to suggest consumption will remain unchanged.}

Admitting the ambiguity of this, the difference between the initial effects of an increase in saving and an increase in the money supply is found in the figures of Hayek’s Prices and Production.\footnote{All the page number references in this paragraph are for Hayek (1967 [1931]).} Hayek’s Figure 2 (p.44) represents an original structure of production, such as the one found in panel (b) of my Figure 3-11, above, which is the triangle marked with ‘0’s. Hayek’s Figure 3 (p. 52) shows the initial effects of an increase in saving; it corresponds to panel (b) of my Figure 3-11’s triangle marked with ‘1’s. Hayek’s Figure 4 (p. 56) shows the initial effects of a money supply increase; this corresponds to the triangle of panel (a) of my Figure 3-12, below, which is labeled with the circular objects containing a ‘1’.
In any event, there are two canonical versions of the Austrian business cycle theory. Again, panel (a) depicts Hayek’s interpretation of events while panel (b) shows the events as suggested by Mises (1980 [1912], p. 559) and Strigl (2000 [1934], pp.128-9). Overall, modern Austrians accept Mises’s and Strigl’s version of the story\textsuperscript{103} whilst, as the passages in Appendix 3-B show, non-Austrians accept Hayek’s account as the canonical Austrian view. In this sense, the two-sides tend to talk past one another.

This paper will not cover the merits and demerits of each version. I believe this to be somewhat unproductive. Much of the Austrian literature seems to focus on how

\textsuperscript{103} Indeed this is the version adopted by Garrison (2001 and 2004).
entrepreneurs can be “systematically” fooled. Indeed there is a peculiar anomaly here. How can Hayek be a key proponent of the Austrian business cycle theory and still be cited by Robert E. Lucas as a key figure in the development of the theory of rational expectations?\textsuperscript{104} In any event, I consider the endeavor “unproductive” because the main, practical importance of the Austrian business cycle theory is its endogenous trend reversion property, which is present in the Misesian and Striglian renditions, but not Hayek’s. In other words, the key importance of the Austrian story is that “there ain’t no such thing as a soft-landing.”

\textsuperscript{104} See Lucas (1981) and Snowdon and Vane (2005).
Appendix 3-B. Comovement-asymmetry critiques

The following passages are evidence of the critique levied against Hayek’s rendition of the Austrian business cycle story, which implies that consumption and investment do not exhibit comovement during the boom, but only during the bust. I italicized the portions of the passages which emphasize the comovement-asymmetry critique.

Caplan (2000): “If, as in the Austrian theory, initial consumption/investment preferences ‘re-assert themselves,’ why don’t the consumption goods industries enjoy a huge boom during depressions? After all, if the prices of the capital goods factors are too high, are not the prices of the consumption goods factors too low? Wage workers in capital goods industries are unhappy when old time preferences re-assert themselves. But wage workers in consumer goods industries should be overjoyed. The Austrian theory predicts a decline in employment in some sectors, but an increase in others; thus, it does nothing to explain why unemployment is high during the ‘bust’ and low during the ‘boom.’”

Cowen (1997, p. 28) writes: “Advocates of the Austrian business cycle theory did not explicitly address the issue of comovement; furthermore, the basic Austrian cycle theory appears to contradict comovement. In Hayek’s Prices and Production, and in other early Austrian writings, long-term investments expand when short-term investments contract, and vice versa. Hayek, in his other writings on capital theory, argued explicitly that investment goods and consumer goods were substitute outputs.”
Hummel (1979, p.77) writes: “Stated another way, this assumption means that the lengthening of the structure of production that occurs as the result of credit expansion and the lengthening of the structure of production that occurs as the result of a genuine shift in time preferences are basically identical except for the fact that the lengthening due to credit expansion must in the future be reversed because it is inconsistent with underlying consumers tastes.”

Krugman (1998): “Here’s the problem: As a matter of simple arithmetic, total spending in the economy is necessarily equal to total income (every sale is also a purchase, and vice versa). So if people decide to spend less on investment goods, doesn’t that mean that they must be deciding to spend more on consumption goods—implying that an investment slump should always be accompanied by a corresponding consumption boom? And if so why should there be a rise in unemployment?”

Tullock (1988, p.77): “Looked at from the standpoint of ordinary employees in a non-producer goods industry, the Austrian cycle would mean that their living standard was artificially depressed during the boom period, because funds that they would prefer to spend on consumption were being diverted to investment. During the depression however, their living standard would benefit, first, because with more capital goods, the demand for complementary services (mainly labor) is greater than it otherwise would be and, second, because prices for consumer goods are lower. Laborers would be exploiting the capitalists.”
Appendix 3-C. Condition of factors of production at $t = 2$

As per this chapter’s assumptions, the production function is Cobb-Douglas, and exhibits constant returns to scale such that:

\[(C-1) \quad Y_t = K_t^\alpha L_t^{1-\alpha}, \quad 0 < \alpha < 1\]

Since technological knowledge, $A_t$, is assumed to be constant, it is omitted from the production function for simplicity.

The marginal products of labor and capital are:

\[(C-2a) \quad MPL = \frac{\partial Y_t}{\partial L_t} = (1 - \alpha) \frac{Y_t}{L_t}\]

\[(C-2b) \quad MPK = \frac{\partial Y_t}{\partial K_t} = \alpha \frac{Y_t}{K_t}\]

Real output changes are approximated by the following total differential:

\[(C-3) \quad dY_t = \frac{\partial Y}{\partial L_t} dL_t + \frac{\partial Y}{\partial K_t} dK_t,\]

For small changes in real output, employment, and capital, the differentials can be defined as:

\[(C-4a) \quad dY_t = Y_t - Y_{t-1}\]

\[(C-4b) \quad dL_t = L_t - L_{t-1}\]

\[(C-4c) \quad dK_t = K_t - K_{t-1}\]

The partial derivatives, $\partial Y / \partial L$ and $\partial Y / \partial K$ in equation (C-3), can be replaced with the terms $MPL$ and $MPK$ as these are the marginal products of labor and capital:
(C-5) \[ dY_t = MPLdL_t + MPKdK_t, \]

In the main text, the following propositions were made:

(#1a) \[ K_2 > K_1, \]  
(#1b) \[ K_1 = K_0, \]

(#2a) \[ Y_2 = Y_1, \]  
(#2b) \[ Y_1 > Y_0, \]

(#3a) \[ L_2 < L_1, \]  
(#3b) \[ L_2 > L_0 \]

The task of this appendix is to prove propositions (#3a) and (#3b).

Proposition (#3b) is proved first:

Combining equation (C-3) and proposition (#2b) yields the following inequality:

(C-6) \[ dY_t = MPLdL_t + MPKdK_t > 0 \]

From proposition (#1b), \[ K_2 = K_1 - K_0 = 0, \]

therefore:

(C-7a) \[ dY_1 = MPLdL_1 > 0 \]

(C-7b) \[ dY_2 = MPLdL_2 + MPKdK_2 = 0 \]

The total change in real output from \[ t = 0 \] to \[ t = 2 \] is \[ Y_2 - Y_0 = dY_2 + dY_1. \] Combining equations (C-7a) and (C-7b) yields:

(C-8a) \[ dY_2 + dY_1 = MPLdL_2 + MPKdK_2 + MPLdL_1 > 0 \]

By proposition (#2a), \[ Y_2 = Y_1 = 0, \]

therefore equation (C-8a) simplifies to:

(C-8b) \[ dY_1 = MPLdL_2 + MPKdK_2 + MPLdL_1 > 0 \]

Rearranging terms yields:

\[ \textit{105 This arose from assumption #4 found in Section II, which stipulates that the capital stock is fixed in the short-run.} \]
\[ (C-9) \quad \frac{dY_1 - MPKdK_2}{MPL} = dL_2 + dL_1 \]

Rearranging the right-hand side’s labor terms according to equation (C-4b) yields:

\[ (C-10a) \quad \frac{dY_1 - MPKdK_2}{MPL} = L_2 - L_0 \]

Since \( Y_i = C_i + I_i \), and by extension \( dY_i = dC_i + dI_i \), \( dY_i \) can be replaced with \( dC_i + dI_i \), such that:

\[ (C-10b) \quad \frac{dC_1 + dI_1 - MPKdK_2}{MPL} = L_2 - L_0 \]

The term \( dK_2 = K_2 - K_1 \) is net investment, and gross investment is

\[ I_i = \phi(K_i^* - K_i) + \delta K_i \]  

\( K_i^* \) represents the desired steady-state level of the capital and \( \delta K \) represents capital consumption. The first term in gross investment, \( \phi(K_i^* - K_i) \), represents net investment and is equal to \( dK_2 \). Since \( dI_1 = I_1 - I_0 \), this in turn is equal to

\[ dI_1 = \phi(K_1^* - K_1) + \delta K_1 - [\phi(K_0^* - K_0) + \delta K_0] \]

which by proposition (#1b) simplifies to

\[ dI_1 = \phi(K_1^* - K_0^*) \]  

At \( t = 0 \) the economic system was in a steady-state equilibrium, thus net investment was zero. Following the money supply shock at \( t = 1 \), since \( K_1^* > K_0^* \), there is positive net investment. By \( t = 2 \), this net investment has increased the capital stock by \( dK_2 \). Thus, in this instance, \( dK_2 = dI_1 \). Therefore equation (C-10b) can be rewritten as:

\[ (C-11) \quad \frac{dC_1 + (1 - MPK)dI_1}{MPL} = L_2 - L_0 \]
The primary text shows that $dC_1$ and $dI_1$ are greater than zero. The Cobb-Douglas production function with constant returns to scale implies that $MPL$ and $MPK$ are greater than zero. If all of the values on the left-hand side are positive and 

$$dC_1 + (1 - MPK)dI_1 > 0$$

then the left-hand side of equation (C-11) is greater than zero.

This means that $L_2 - L_0 > 0$, which implies that the proposition that $L_2 > L_0$ is proved.

This *might* be violated if $MPK > 1$. However, proposition (#2b) will hold unequivocally if $MPK < 1$. This seems plausible: Since, $MPK = \alpha Y / K$, $MPK < 1$ can be rewritten such that, $\alpha Y / K < 1$. Rearranging terms, the following inequality must hold if $MPK < 1$

(C-12) \[ \alpha Y < K \]

Inequality (C-12) states that the marginal product of capital will be less than unity so long as the share of real income accruing to the owners’ of capital is less than the real present value of the capital stock. This seems extremely plausible as dividends on stocks and coupon payments on bonds are generally a fraction of their respective present values.

Therefore the assertion that $L_2 > L_0$ is reasonable.

Proposition (#2b) which stipulates that $L_2 < L_1$ is much easier to prove: In the primary text it was found that: (1) $Y_2 = Y_1$ and (2) $K_2 > K_1$. The first proposition, by replacing the real output terms $Y_2$ and $Y_1$, with their Cobb-Douglas equivalents, can be rewritten as: $K_2^{\alpha} L_2^{1-\alpha} = K_1^{\alpha} L_1^{1-\alpha}$. Rearranging terms yields: $(K_1 / K_2)^{\alpha/(1-\alpha)} > L_2 / L_1$. Given
that $0 < \alpha < 1$ and $K_2 > K_1$, the quotient of the left-hand side of the inequality must be less than unity. Thus implying that, $L_2 / L_1 < 1$. This in turn proves the assertion that $L_2 < L_1$. 
Appendix 3-D. Condition of factors of production at $t = 3$

The task of this appendix is to prove that $L_3 < L_0$. The following two propositions were asserted in the primary body of the text: (1) $Y_3 = Y_0$ and (2) $K_3 > K_0$. The first proposition, by replacing the real output terms $Y_3$ and $Y_0$, with their Cobb-Douglas equivalents, can be rewritten as: $K_3^a L_3^{1-a} = K_0^a L_0^{1-a}$. Rearranging terms yields:

$\left(\frac{K_0}{K_3}\right)^{\alpha/(1-\alpha)} > \frac{L_3}{L_0}$. Given that $0 < \alpha < 1$ and $K_3 > K_0$, the quotient of the left-hand side of the inequality must be less than unity. Thus implying that, $L_3 / L_0 < 1$. This in turn proves the assertion that $L_3 < L_0$. 


Appendix 3-E. Condition of factors of production at $t = 4$

The task of this appendix is to prove that $L_4 < L_0$. The following two propositions were asserted in the primary body of the text: (1) $Y_4 < Y_0$ and (2) $K_4 > K_0$. The first proposition, by replacing the real output terms $Y_4$ and $Y_0$, with their Cobb-Douglas equivalents, can be rewritten as: $K_4^\alpha L_4^{1-\alpha} < K_0^\alpha L_0^{1-\alpha}$. Rearranging terms yields:

$$(K_0 / K_4)^{\alpha/(1-\alpha)} > L_4 / L_0.$$ Given that $0 < \alpha < 1$ and $K_4 > K_0$, the quotient of the left-hand side of the inequality must be less than unity. Thus implying that, $L_4 / L_0 < 1$. This in turn proves the assertion that $L_4 < L_0$. 
BIOGRAPHY

Alexander David Fernando Schibuola was born October 19th, 1985 in Miami, FL. His parents are Dino and Kathi Schibuola. He received his diploma from Miami Country Day School in 2004 and his Bachelor of Arts in economics from the University of North Florida in 2007. In 2009 he received his Master of Arts degree in economics from George Mason University, where he is currently employed as a graduate lecturer.