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The Inverted Yield Curve and the Economic Downturn

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Abstract: This paper presents an answer to why the yield curve tends to invert one year before a recession. The capital-based macroeconomic model used in this paper traces out the effects of an injection of short-term working capital into the model. There are two consequences of this injection: the Wicksell effect and the Fisher effect. The Wicksell effect entails the downward pressure on interest rates, while the Fisher effect entails the upward pressure on interest rates. The short-term credit can create both short- and long-term malinvestments in the social structure of production. These malinvestments are unsustainable and must be liquidated. The process of liquidation phase may take the form of a credit crunch, a real resource crunch, or a combination of the two. Each scenario culminates in an inverted yield curve approximately one year before the upper-turning point of a recession.

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1 Overview

This paper addresses the question of why the yield curve tends to invert before a recession. It does not create a model to demonstrate that such a phenomenon exists, as this relationship has already been well established. This paper uses the capital-based macroeconomic approach set forth by Garrison (2001) to explain that a correlation exists between the yield curve's spread and real output. Accordingly, the topic is examined by disaggregating investment and capital-formation decisions. The capital-based approach of macroeconomic theory is well-suited for the examination of this question, since it is a theory of the upper-turning point of a business cycle.[1]

Macroeconomic theories attribute economic downturns to either monetary or real factors. The capital-based approach allows for both. A disaggregated approach allows for analysis and insights that other theories cannot provide. Unlike the capital-based approach, most macroeconomic theories that examine the upper-turning point focus on the immediate causes of the downturn. They do not include the underlying capital structure as a part of the theory, because this structure is viewed as an unnecessary complication to the theory. By ruling out capital (and the malinvestments that could be built up during the expansionary phase), the leading macroeconomic theories focus on more aggregated causes–such as monetary or real shocks to the economy.

These models are too aggregated to properly answer the question of why the yield curve tends to invert before a recession. Prior to the 1990-91 recession, several economists called attention to the past performance of the spread as a predictor of a business cycle's upper-turning point. However many dismissed the signal, declaring it may be a false positive.[2] Another had argued that there would not be a recession in 1989 or 1990 because there was "an absence of the kind of gross imbalances in the economy that have typically preceded past recessions."[3] It is possible in retrospect to see that the imbalances were in the economy and were liquidated in the 1990-91 recession.[4] The current approach, how-

[1] See Hayek (1969) where he states,"This theory [the Austrian Business Cycle Theory or ABCT] never claimed to do more than account for the upper turning point of the typical nineteenth-century business cycle." p. 282.
[2] See Brown and Goodman (1991) and Estrella and Mishkin (1998).
[3] See Keen (1989) p. 40.
[4] See, for example, Hughes (1997) for an empirical analysis supporting this claim.

ever, lacks the ability to see the imbalances (malinvestments) created during the "boom" phase. It is here that Austrian theory can provide insight. This approach allows one to analyze and draw conclusions about the problem in a manner that is superior to more aggregated methods.

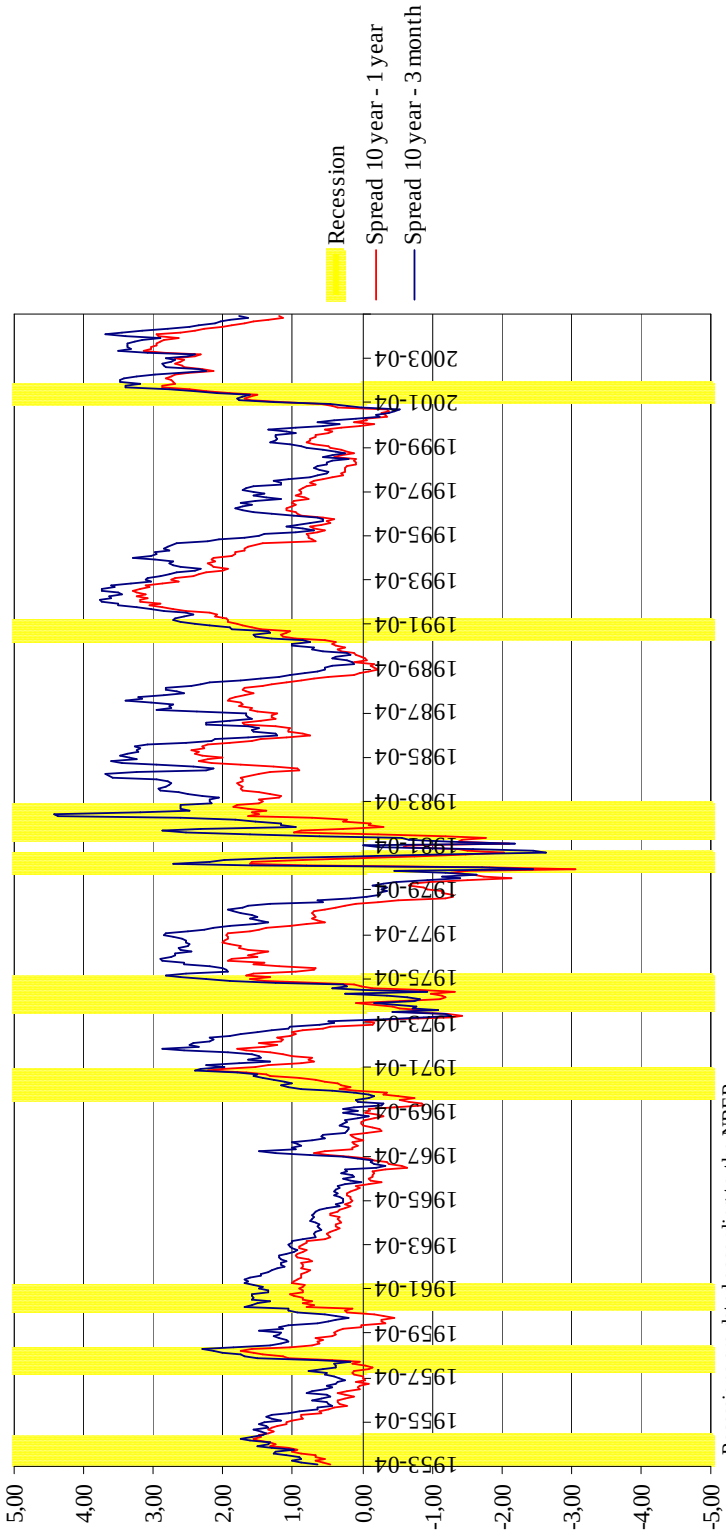
The remainder of this paper is divided into six sections. The next section reviews the empirical relationship and surveys the current models that attempt to explain the relationship. Section 3 presents the implication of monetary expansion. Section 4 continues the analysis by showing that monetary injections lead to a malinvestment boom. Section 5 establishes how such malinvestments are not sustainable and inevitably lead to the "crunch phase" of the business cycle and then demonstrates why the yield curve inverts during the crunch phase (prior to the upper-turning point). Section 6 summarizes and concludes.

2 Presentation of the Relationship and Current Research

Economists, government officials, and businessmen have long searched for accurate business cycle indicators. One strong predictor of the upper-turning point of a business cycle is the inverted yield curve. Chart 1 illustrates the 10-year Treasury Bond and the 1-year T-Bill spread and the 10-year T-Bond and the 3-month T-Bill spread between April 1953 and October 2003.[5] (Please see Chart 1 below.)

[5] The NBER dating of the recessions is used. All data for this paper were obtained from the Federal Reserve Bank of St. Louis' FRED II.

Chart 1: Yield Curve Spreads Between 1953-2005



Recessions are dated according to the NBER.
The data for interest rates were obtained from FRED II.

An inverted or humped yield curve has occurred no more than 5 quarters before every recession since the mid-1950s. Except for the Q3:1990-Q1:1991 recession, the yield curve has inverted in every recession since the mid-1960s. Prior to the Q3:1957-Q2:1958, Q2:1960-Q1:1961 and Q3:1990-Q1:1991 recessions, the 10-year/3-month spread did not become negative. The lowest points for this spread were 0.24% in February 1957, 0.20% in December 1959 and 0.13% in August 1989. Preceding these recessions, the yield curve was technically humped and not inverted. The 10-year/1-year spread was negative in December 1956 and from February through April 1957 and, according to McCulloch (1990), the 15-year/6-month spread (not shown in the chart) was negative from November 1956 through March 1957. The 10-year/1-year spread was also negative in the period of September 1959 through February 1960 and February through September 1989.

There is one instance where an inverted yield curve was not followed by a recession. From September 1966 through January 1967 the yield curve inverted, but no recession took place. Some refer to this occurrence as a false positive, but the second quarter of 1967 did experience a negative growth rate of -0.06% (real GDP). While this decline in real output did not constitute an official recession, it does confirm the relationship under study.[6]

The historical record does not show this connection to be only a post-WWII phenomenon. The yield curve inverted between June 1920 and March 1921 and again between January 1928 and November 1929.[7] Data from the 19th century are incomplete and do not easily lend themselves to analysis.[8] Nevertheless, support for the thesis of the yield curve as a predictor of business cycles can be traced as far back as the mid-1800s.[9]

The current research can be separated into two basic models: the consumption-based capital asset pricing model (CCAPM) and the Estrella models. The essential idea of the CCAPM is that investor's smooth income across business cycles. Criticism of the CCAPM has led to the development of an alternative theoretical model.

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[6] The true exception to this relationship is the Q2:1953-Q2:1954 recession, where the yield curve flattened but did not invert.

[7] Cecchetti (1987) demonstrates that the observed bond market data from the 1930s and 1940s is distortedbut didini(e)-234(an)-he

The second type of model builds on variations of the following economic tools: the Expectations Hypothesis, the Phillips curve, the IS curve, a monetary reaction function, and the Fisher Equation. This category of models is motivated by a monetary shock. The origin of these models is Estrella (1998). The Estrella model is also inadequate for understanding *why* the yield curve tends to invert before a recession.[10] The Estrella models derive the relation between interest rates and real output from the Phillips curve and the IS curve. The Phillips curve (an empirical and not a theoretical relationship) fails to explain the connection between interest rates and real output. It only shows that a connection exists between nominal rates and output. However, the theoretical underpinnings needed to understand the relationship are not explained. Furthermore, the use of the Keynesian IS curve is insufficient to create a credible model.[11]

Over the past 15 years, the debate on theory remains unresolved. No article during this period examines the effects of non-neutral monetary injections through a heterogeneous capital structure. The use of Austrian insights can provide an alternate (and fruitful) perspective to this debate.

3 Monetary Expansion

The capital-based approach posits that the initial disequilibrium of the business cycle is caused by monetary injections.[12] Credit is injected at the short-end of the yield curve and spreads through the economy causing non-neutral effects. The effect of the new credit is separated into the Wicksell effect and Fisher effect. These opposing effects distort the ability of price signals to transmit relative scarcities to entrepreneurs. As a result, monetary expansion lowers and alters interest rates that falsely signal entrepreneurs to embark upon malinvestments.

The effects of monetary expansion are traced through the yield curve, which was developed in Cwik (2004), Chapter 3. The modified Preferred-Habitat Theory of the yield curve is a combination of time-preference (in the Böhm-Bawerkian sense), expectations,

[10] See Cwik (2004) Chapter 2.
[11] Ibid.
[12] Many factors can cause an economic downturn–war, sweeping changes in institutions, radical changes in monetary policy, etc., but these are outside of the scope of this topic. This paper specifically focuses on downturns caused by monetary injections.

liquidity-preference, and risk aversion (the preference for matching debt and equity).

Böhm-Bawerk's analysis is the basis for the formation of interest rates, since it satisfies both the essentialist and functionalist questions regarding interest. After an initial interest rate is established, a yield curve can be derived by adding expectations, liquidity-preference, and risk aversion to the analysis. As shown in Cwik (2004), the modified Preferred-Habitat Theory is consistent with the empirical observations of the yield curve.

When the monetary authority engages in a policy of monetary expansion, the new money is injected into the monetary system at specific points.[13] The effect of additional liquidity is sometimes called the Wicksell effect.[14] The Fisher effect is the change in interest rates caused by changes in the expectations of future inflation.[15] The Wicksell effect and the Fisher effect are opposing forces. The Wicksell effect tends to lower interest rates while the Fisher effect tends to raise them.

With a policy of monetary expansion, the Wicksell effect first dominates interest rate movements. As money is injected into the short end of the yield curve (through the monetary base and thus the Fed funds rate) an initial lowering of short rates and a steepening of the slope of the yield curve results. Keeler (2002) states,

> The liquidity effect of a monetary shock will lower interest rates in general and lower short-term rates relative to long-term rates. The yield curve will shift down and become steeper in slope. . . . [16]

Although Keeler is correct about the steepening of the yield curve, empirical observation does not support the tendency of the yield curve to shift, as long rates tend to remain stable relative to short rates. Bernanke and Blinder (1992) argue that the short rates move

[13] The Federal Open Market Committee typically adjusts monetary policy through the use of open market operations and the use of the discount rate which change the aggregate level of depository institutions' reserves. Changes in these reserves induce changes to the Fed funds rate. The Fed funds rate is the interbank interest rate for short-term loans, usually overnight. See Miller and VanHoose (2001).

[14] The phrase "Wicksell Effect" was first used in the Cambridge Capital Controversy of the 1960s. The phrase was divided into a "Real Wicksell Effect" and a "Price Wicksell Effect," describing the change in the relationship between the rate of profit and capital intensity in real or value terms. The phrase "Wicksell Effect" used in this paper refers to an "Interest Wicksell Effect" (or a liquidity effect) where money added to an economic system, by expanding the supply of investable funds, initially reduces the market rate of interest.

[15] See Mishkin (2001) pp. 107-108.

[16] Keeler (2002) p. 5. See also Keeler (2001) pp. 333 and 335.

while the long rates remain stable. The Fisher effect increases the forward short rates, thus applying upward pressure to long rates. However, the new money is arbitraged across the term structure. The Wicksell effect prevents the long rates from rising. Thus the yield curve rotates instead of shifting, as shown in Figure 1. The new yield curve is presented as the dashed curve.

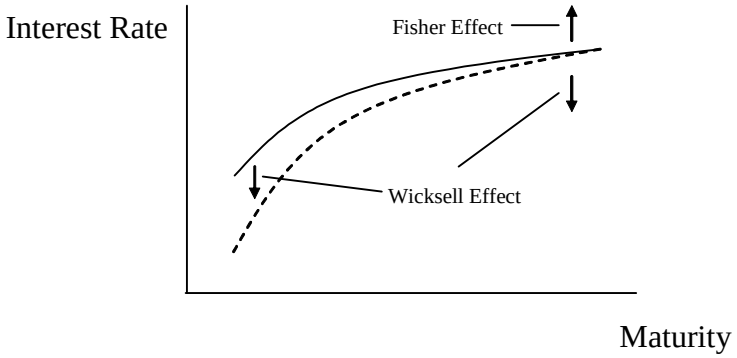

Figure 1: The Wicksell and Fisher Effects Combined

According to Keeler (2002), the steepening of the yield curve begins during the expansion phase of the business cycle. However, the yield curve is steepest at the lower turning point of the business cycle.[17] These observations are not inconsistent with Keeler's observations if the recovery phase of the business cycle is also included as part of the expansionary phase of the next cycle.

In sum, the analysis begins with the Böhm-Bawerkian framework to establish an initial interest rate. Expectations, liquidity-preference and risk aversion are added to create a modified Preferred Habitat theory of the yield curve. With monetary expansion, the Wicksell effect shows the lowering of short rates due to an increase in the supply of investable funds. The long rates tend to remain stable relative to the short rates due to the interaction of the Wicksell and Fisher effects.

Since new money does not enter an economic system uniformly or at a steady rate, the already difficult job of entrepreneurs, to correctly read market signals, becomes even

[17] This empirical observation was made as early as Kessel (1965) and has since been seen as a consistent pattern of the yield curve.

more difficult.[18] Entrepreneurs need to correctly read these market signals to make profits, and as a consequence, coordinate the economy.[19] Since the price changes resulting from an increase in the money supply are not uniform, entrepreneurs have difficulty determining whether the price change is a result of a change in relative scarcity or whether the price change is the result of inflationary pressures. In other words, they are not able to distinguish between relative price changes and inflationary price changes. As a result, the economy becomes more wasteful and less efficient.

This paper posits that the monetary authority injects money into the economy through short-term credit markets. The addition of credit lowers short rates, while the Fisher effect should increase long rates. However, the yield curve steepens and does not shift. The Wicksell effect is transmitted across the term structure of interest through the process of arbitrage and reduces the Fisher effect on long rates. Thus, monetary injections artificially lower interest rates across the entire yield curve. These false rates signal to entrepreneurs that consumers have shortened their time-preferences, leading to a malinvestment boom.

4 Malinvestment "Boom"

In the previous section, the idea of malinvestments was introduced. This section examines the nature of these malinvestments in the context of a capital-based macroeconomic approach. The crisis stems from the need to liquidate the malinvestments that are built during the boom. During this crisis, which is the upper-turning point of a business cycle, the yield curve inverts as a consequence of the liquidation process.

To clarify terminology, a distinction must be made between an individual project's period of production and the social period of production. Schmitz (2003) distinguishes between the individual and social periods of production. The individual period of production corresponds to the length of time that an entrepreneur's project will take until it yields output for the next stage of production. These projects are distributed throughout the structure of production. The social period of production corresponds to the degree of

[18] Prices are packets of information that signal to entrepreneurs the relative scarcities of the various goods and services throughout the economy. See Hayek (1945).

[19] See Mises (1980).

complexity of an economy. In other words, the overall degree of economy-wide roundaboutness is the social period of production. Individual projects' are divided into long and short terms and correspond to the long and short rates of the yield curve.[20] Both long and short-term projects are found at every stage in the structure of production.

Furthermore, capital is divided into two forms: working capital and fixed capital. Working capital, also known as circulating capital, refers to the funds that flow through the structure of production. Fixed capital is the capital equipment, buildings, machines, etc. that do not flow through the structure of production. Instead, fixed capital is embedded at the different stages within the structure of production. Through the investment process, working capital is used to purchase inputs such as labor and goods-in-process; additionally working capital is also transformed into fixed capital.

Expansion of Short-Term Working Capital

This paper seeks to demonstrate that monetary injections (in the form of working capital) into an economic system necessarily lead to an inverted yield curve prior to an economic downturn. As a result, this paper assumes the extreme case where monetary expansion initially takes the form of working capital in the short-term credit markets.[21] As this assumption is relaxed, the argument is strengthened.

As previously demonstrated, the monetary injections during an economic boom (and also during a recovery) cause the yield curve to steepen.[22] Short rates fall, while long rates tend to remain relatively stable. With a monetary injection at the short end of the yield curve, the modified Preferred-Habitat theory suggests that the yield curve should shift down instead of rotate. However, the empirical evidence shows that yield curve rotates and steepens, but shifts very little. This seeming inconsistency with the theory is due to the Wicksell effect explored in the previous section. The impact of the Wicksell effect on long-term and early stage malinvestments is discussed below.

[20] A long-term project may be financed through a series of short-term loans. A simplifying assumption of a hard link between the length of the project and the duration of the loan will not change the analysis.

[21] This paper is additionally assuming that the traditional role of thrift institutions of "transforming maturities," by borrowing short and lending long, does not take place.

[22] Cwik (2004), Chapter 3, section 3.6 provides empirical evidence that expansion ary monetary policy is the typical case during the boom and the recovery phases of the business cycle.

The monetary injections, which rotate the yield curve, send opposite signals to entrepreneurs and consumers. As new short-term working capital is injected into the economy, the economy embarks upon a malinvestment "boom." As the cost of borrowing decreases, the marginal borrowers (those previously excluded from the market) will now be able to obtain the wherewithal to fund their individual projects. Real resources are transferred to these borrowers and the working capital is converted into fixed capital as distinct production processes are added to the economy. Machlup (1932) illustrates this process,

> The fresh borrowers employ the fresh capital–either for a new enterprise or for the expansion of an already existing one–by demanding means of production, partly original factors of production, partly intermediate goods. This increased demand will raise the price of production goods. Therefore the borrowers who are in the best position to compete are those who are less affected by the increased cost of intermediate goods than by the lowering of the rate of interest. This is *not* the case with investment in raw materials and goods in process, but it *is* the case with investments in *fixed* capital since in calculating the prospects of such investments the interest rate is of much greater importance than the price of the goods used.[23] (italics in the original)

After debating with Haberler, Machlup demonstrates "that the investment of fresh capital for an increase of production and output which might be technically possible without expanding fixed capital, is economically impossible."[24] Machlup's point is that in order to achieve an expansion of output, working capital must be transformed into fixed capital. In a later work, Machlup (1935) reinforces his conclusion that a decrease in interest rates leads to the formation of new investment in fixed capital.[25] While Machlup argues that the short-term funds will eventually be transformed into longer-term fixed capital, at this part of the analysis, the point to be emphasized is that working capital is transformed

[23] Machlup (1932) pp. 276-277. With expansionary monetary policy and an increase in output, Machlup concludes that, even with additional short-term funds, "the short-term use of capital is theoretically impossible." p. 277.

[24] Machlup (1932) pp. 277.

[25] Machlup (1935) states, "As a cost factor, the interest rate has real significance only as it applies to *new investment in fixed equipment*." p. 462. (italics in the original) "A decrease in the interest rate changes the comparative cost-calculation in favor of those methods of production which make the heavier demands on capital." p. 462.

into fixed capital. These short-term projects are malinvestments and must be liquidated at a future date unless additional real savings are supplied.

In the meantime, the short-term projects in the late-stages of production (those stages closest to the consumers) are justified through increased profitability due to the increase in the demand for consumer goods. With a decline in short rates, the cost of financing short-term consumer purchases (through the use of credit instruments such as credit cards) falls. Thus, an immediate result of the monetary injection is an increase in the demand for consumer goods. The effect is seen in Figure 2.

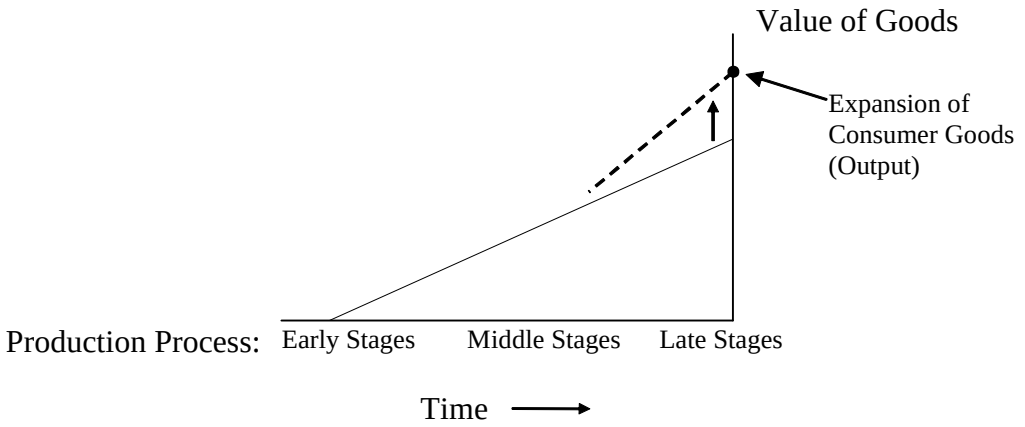

Figure 2: The First Effect from Additional Working Capital

The dashed line in Figure 2 represents the additional projects accumulating toward the late stages of production.

By restricting monetary injections to the addition of working capital in the short-term credit markets, the analysis leads to the conclusion that short-term projects at the late stages of production are built up. Machlup demonstrates that, over time, the working capital will be transformed into fixed capital. The fixed capital is combined with additional inputs to create consumer goods. These consumer goods are purchased with the new credit extended to consumers.

Long-Term Malinvestment

In this analysis, monetary injections have been restricted to the form of additions of working capital to the short end of the yield curve. As this working capital is transformed into distinct production processes to supply consumer goods, a portion of the working capital is applied to the purchase of inputs while the remainder is transformed into fixed capital. While the analysis has focused on an expansion of the late-stages of production, empirical observation of a boom is that early-stage markets experience larger swings relative to intermediate and consumer goods markets.[26] Such empirical evidence begs two particular questions: "If short-term rates fall relative to long rates thus increasing the amount of short-term projects, where is the long-term malinvestment?" and "Where is the early-stage malinvestment?"[27] To find answers the analysis will use Bastiat's "unseen."

When the monetary authority engages in monetary expansion, entrepreneurs increase their expectation of future inflation. Within the model of the modified Preferred-Habitat theory, the middle and long rates should rise in accordance with the Fisher effect, but empirically they do not. As previously observed, short rates fall relative to the long rates and the long rates tend to remain stable.

Nevertheless, long-term malinvestments emerge from the injection of short-term working capital. The arbitrage process from the shorter rates prevents the long rates from rising. In other words, credit is flooding into the long bond markets, keeping their yield from rising. The Wicksell effect counters the Fisher effect. The "unseen fact" is that many long-term projects would have been curtailed with an increase in long-term rates, but the Wicksell effect discourages their liquidation. These non-liquidated projects are now in a state of disequilibrium. They, too, are malinvestments. The degree to which the Wicksell effect inhibits long-term rates from rising corresponds with the extent to which of long-term malinvestment.

Machlup (1935) presents the rate of interest as a cost and capitalization factor in the production process. As interest rates (the short-term rates in particular) decline, the capi-

[26] See Skousen (1990) pp. 303-305.

[27] Long-term malinvestment and early-stage malinvestment are not the same. Long-term malinvestment refers to individual projects with a long-term planning horizon. Such projects may be found at any stage in the structure of production. Early-stage malinvestment refers to the projects at the higher-order stages of production. They may employ both long and short-term individual projects.

tal values of all fixed capital increases. The capitalization effect yields a greater return for the longer-lived capital equipment.[28] Such a change in the relative value of long-lived fixed capital encourages the expansion of long-term investments despite the increase in only short-term working capital. Thus, not only are some projects that should be liquidated not discontinued, but new long-term projects are started. As the newly expanded short-term malinvestments are added to the long-term malinvestments, the economy moves beyond the production possibility frontier curve–it has an unsustainable capital structure.

The argument so far is that the monetary authority has injected working capital into short-term credit markets. The addition of credit lowers the short rates, the yield curve steepens, and the arbitrage process prevents increases in the long-term rates; the Wicksell effect counters the Fisher effect. Short-term projects (malinvestments) are commenced due to the lowering of the short rates. These short-term projects embed various degrees of fixed capital into the structure of production. Up to this point of the analysis, the short-term projects have been located toward the late-stages of production, but the addition of short-term projects is not necessarily an addition of projects to a particular stage. Short-term projects may be added throughout the structure of production.

Simultaneously, the rotation and steepening of the yield curve is evidence that long rates are artificially held down. The prevention of increasing long rates delays the liquidation of some long-term projects, and new long-term projects are started because of the relative change in the return of long-lived fixed capital. These long-term projects are not supported by a foundation of real savings and will need to be liquidated at some future date. These long-term projects are malinvestments. Thus malinvestments (in both long and short-terms) emerge throughout the structure of production.

Despite demonstrating that long- and short-term malinvestments arise from monetary injections, one may be led to ask the second question posed above, "Where is the early-stage malinvestment?" While a hard link between long-term investments and the early-stages in the social structure of production cannot be technically proven, it is reasonable to assume that such an association exists. The case can be argued that individual long-term investment projects necessarily affect the social period of production to the

[28] See Machlup (1935) p. 465.

extent these long-term projects prompt capital lengthening. Nevertheless, to avoid using a conjecture that cannot be proven, this paper adopts the extreme case that long- and short-term projects may occur at any stage in the production process. To the extent that long-term investments lengthen the social period of production, the overall argument of this paper is bolstered.

Early-Stage Malinvestment

Despite all of the stringent assumptions about the monetary authority injecting working capital into the short end of the yield curve and that long and short-term projects may occur at any stage in the structure of production, a malinvestment boom in the early stages can be demonstrated.

In his seminal paper, Hayek (1945) demonstrates that entrepreneurs have only price signals to guide them to meet consumers' demands and make profits. Prices are information packets that not only signal to entrepreneurs the quantity and quality of the goods they are to produce, but also allow entrepreneurs to calculate which types of inputs and production processes are the most efficient. It is in this manner that the economy is coordinated. A network of prices ties the structure of production together. For a single interest rate model in equilibrium, the rate of interest equals the rate of profit. When the model is expanded to include a term structure of interest rates, the same principle applies, but the rate of profit for each individual project corresponds to the matching instrument in the yield curve. For example, a two-year project's rate of return should correspond to the yield of a two-year bond.[29, 30] Thus when the rates across the yield curve fall (or are held down by the Wicksell effect), the cumulative effect is a change in the social period of production. The decrease in the short-term interest rates and the artificially low long rates signal to the entrepreneurs that the normal rate of economic profit has been

[29] The modified Preferred-Habitat Theory is able to accommodate the segmentation of the yield curve.

[30] While long-term projects may be financed through a series of short-term loans, the entrepreneur will use the maturity that matches the individual project as the relevant yield. With a positively sloped yield curve, the yield of rolling over short-term instruments is below that of the longer maturity instrument. However, the entrepreneur will not view the short-term instruments as a relevant substitute for the project. Instead, if he is looking to engage in a long-term project, he will look to the yield of the longer-term instrument as the opportunity cost of such an investment. For example, if the yield of a one-year bond is 4% and the yield of a two-year bond is 5%, the entrepreneur will regard the 5% yield as the opportunity cost of embarking upon a two-year project.

lowered.

To illustrate this process, the analysis begins with a single interest rate model. Suppose that all individual projects have a length of 3 months and there is a corresponding single interest rate for 3-month instruments. The monetary injections falsify the price signals to the entrepreneurs.[31] The effect of the additional credit lowers the interest rate and also lowers the normal rate of return for these projects. In other words, the opportunity cost of each project is lowered.

As the rate of interest changes, so does the rate of return necessary to obtain normal economic profits.[32] As the monetary injections lower the interest rate, two effects emerge. The first effect is that consumers, experiencing a decrease in their return on their savings, shift their wealth into consumer goods. Garrison (2001) refers to this situation as over-consumption.[33] As consumers dedicate less resources to their savings, retailers face an increase in the consumers' demand curves in their markets. As a result, retailers increase their demand of wholesaler goods in order to take advantage of the profit opportunities. The cumulative effect of the entrepreneurs' actions at the late-stages of production is to reduce the degree of roundaboutness in the economy. The effect is illustrated in Figure 2 above.

The second effect is that the injected money is lent simultaneously to entrepreneurs, thereby increasing the amount of investment throughout the structure of production. In this phase, the amount of investment is no longer equal to the amount of savings. A "tug-of-war," to use Garrison's phrase, arises between saving and investment. Garrison argues that "the conflict is resolved initially in favor of investment spending–because the investment community has more to pull with, namely, the new money that was lent into existence at an attractive rate of interest."[34] As a result of this conflict, the economy is pulled in the direction of more roundabout production processes by the investors and consumers pull the economy in the direction of less roundabout production processes.

[31] The importance of Hayek's observation is that entrepreneurs only have price signals to guide them in their conduct. Evans (1987) argues that a "mis-assessment of risk" by investors can occur when the "true" risk structure of the economy is uncertain. Since the true risk structure is never precisely known, entrepreneurial error can occur even under the best conditions. When the monetary authorities manipulate price and interest rate signal, these errors are intensified.

[32] The following analysis follows the analysis of Cwik (1998).

[33] See Garrison (2001) pp. 69-70.

[34] Ibid. p. 71.

A "dueling production structure"[35] emerges. Figure 3 illustrates this result.

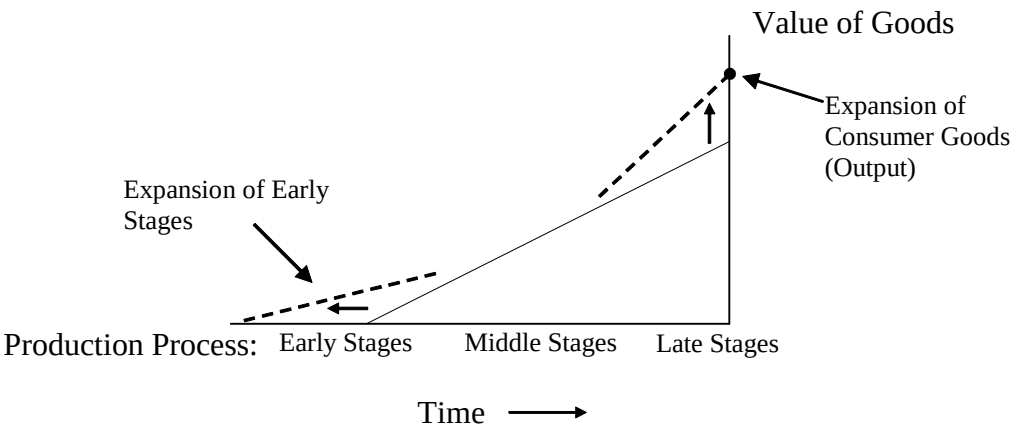

Figure 3: The Dueling Production Structure

Garrison is able to achieve this result by arguing that lower interest rates make longer-term investments more profitable. To the extent that longer-term investments are capital deepening, this result is correct. However, there is another, more fundamental reason why the economy becomes more roundabout: as the normal rate of profit falls, the effect of the decrease in the interest rate is compounded through the structure of production (via relative price changes) and yields its largest impact at the earliest stages of production.

With an increase in investable funds, the normal rate of profit for all businesses decreases. As firms react to compete for the new profits in the late-stages of production, they bid up input prices until they establish this new rate of profit. The cumulative effect of bidding up input prices creates windfall returns for the firms in the early stages. These economic profits attract new investment into the early stages creating the dueling production structure.

To illustrate this idea, suppose that there is a simple production process through which there are four stages. Each stage is 3-months long and the initial rate of interest is 10%. As a starting point, assume that the initial price of inputs is $100. Under equilibrium, each stage meets the normal rate of profit of 10%. Using the discounted

[35] This phrase was coined by John Cochran (2001) p. 19.

present value formula, the price of the final output (one year later) is $146.10. Figure 4 demonstrates this relationship.

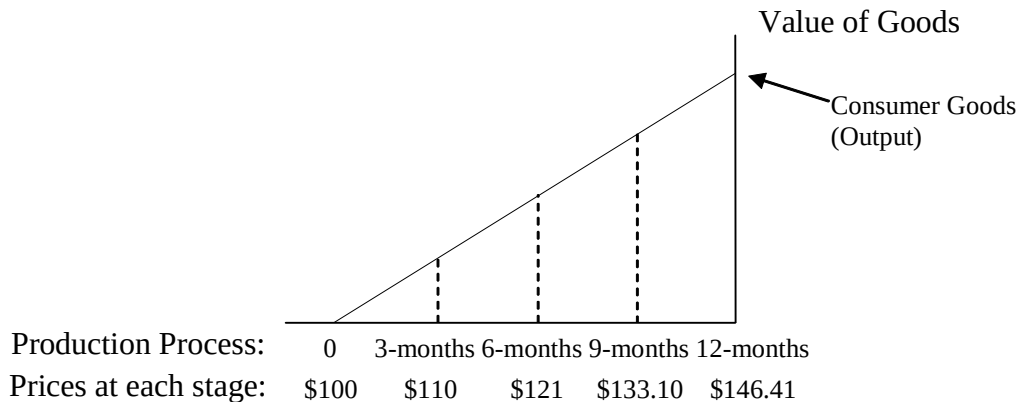

Figure 4: Prices for Each Stage Production

Holding, for the moment, the price of the final output constant, when the rate of interest falls to 8%, the price of 9-month goods will be bid up to $135.56, thus yielding an economic profit of 1.85% to those firms operating at the wholesale stage of the production process. Table 1 shows the economic profit is highest for the owners of natural resources.

Table 1: The Effects of Relative Price Changes on Economic Profit

Stage:	0-months (Natural Resource Owner)	3-months	6-months	9-months	12-months (Final Output)
Prices with 10% interest rate.	$100	$110	$121	$133.10	$146.41
Prices with 8% interest rate.	$107.61	$116.22	$125.52	$135.56	$146.41
Rate of Economic Profit	7.61%	5.66%	3.74%	1.85%	0%

The rate of economic profit is expressed in Equation 1.

$$\text{Rate of Economic Profit} = \left(\frac{(1 + r_1)^{t_n - t_x}}{(1 + r_2)^{t_n - t_x}} - 1 \right) * 100. \qquad \text{Equation 1}$$

where r_1 is the initial interest rate,
r_2 is the interest rate after the monetary injection,
tn is the maximum number of stages in the production process, and
tx is the stage under examination.

Equation 1 shows that rate of economic profit is larger for the earlier-stages of production. This process demonstrates how the early-stage markets are able to expand while consumer market's demand curves are rising. While it may look as though the expansion of the early-stages depends upon longer-term investment (through the use of the discounted present value formula), the assumption early-stages having long-term investments is not necessary. The large swings in early-stage production processes result from changes in relative input/output prices.

The example provided above makes the unrealistic assumption of a specific number of stages that follow a precise order. In the real world, there is no method by which to determine where a firm is located in the structure of production. Additionally, there are many recursive loops in the structure of production, where a portion of a firm's output may be sold in both the consumer and early-stage markets. An example of such a product is the desktop computer. They are sold to research and development institutions and to consumers. Nevertheless, the principle illustrated above holds true when the economy is examined from the perspective of the social period of production.

When the assumption of holding the output price constant is relaxed and the output price is allowed to rise in accordance with the increased demand for consumer goods, the effect upon the level of economic profit is magnified. Furthermore, when the assumption of a single rate of interest is relaxed, the same formula and analysis can be applied and extended across the entire term structure of interest rates. The early-stage firms are able to derive economic profits from engaging in both long and short-term projects. The major difference for the long-term interest rates is that r1 becomes the rate of interest

that would have materialized on the market if the Wicksell effect did not affect it.[36]

Responding to the compounding effects of relative price and interest rates changes, entrepreneurs act as if the social period of production has changed and build more roundabout processes. Keeler (2002) empirically demonstrates that relative prices are the key component of the propagation mechanism during the malinvestment boom phase of the business cycle. Furthermore, he establishes that investment reallocation and capacity utilization are expanded toward the early stages of production.[37]

Additionally, Machlup (1932) points out that even short-term investment in working capital requires an array of higher-order capital (a superstructure) to support its production. Thus even if a short-term project is transformed into fully integrated fixed capital, it requires an additional array of higher-order capital to maintain its output. Machlup further argues that the effect on capital is compounded the "more distant" an individual production project is from consumers. Thus, a malinvestment boom in the early production stages occurs even when only short-term working capital is expanded.

A conclusion from this analysis is that the extent of the Wicksell effect corresponds to the degree of malinvestments. In other words, to the degree that the new credit is able to prevent an upward shift (or even cause a downward shift) in yields across maturities, one will see maintenance (and expansion) of disequilibrated capital projects. It is important to note that only a disaggregated approach can examine the capital structure in this manner. The more aggregated theories are unable to draw these conclusions. Thus the disaggregated, capital-based approach explains the malinvestment boom that Keen (1989), Brown and Goodman (1991) and Estrella and Mishkin (1998) missed prior to the 1990-1 recession.

A key aspect of the malinvestment boom is not the boom, but the malinvestment. The malinvestments maintained and created during the boom phase are *mal*investments because real savings does not support them.[38] As a result, they must be liquidated at a future date. These malinvestments are revealed during the crunch phase of the business

[36] The rate, r_2, is still the observed rate of interest after the monetary injection has had its effect.

[37] See Keeler (2002) p. 15.

[38] Additional savings (entering the economy from abroad or through a tax cut on savings) will transform some (or maybe even all) malinvestments back into stable investments. However, additions to the money supply changes the international price of the currency and reduces the incentive of foreigners to invest in economy under examination.

cycle.

5 The Crunch Phase and an Inverted Yield Curve

As noted above, the theories of the upper-turning point of the business cycle center on either monetary or real factors as the primary cause of the downturn.[39] While the capital-based macroeconomic theory of the upper-turning point is not unique in describing the upper-turning point, the significance of this approach is that it is able to account for multiple factors. Robertson (1959) presents a classic observation on the phenomenon:

> How is this cumulative upward process [of the economy] stopped and reversed? It seems to me unlikely that there is a single answer applicable to all occasions; there is a great variety of reasons why, in Haberler's language, the system may become more and more sensitive to "deflationary shocks" as expansion proceeds. Some interpreters have laid stress on purely monetary factors–the fact that the banks, finding their reserves slipping away through withdrawals of legal tender money to pay the enhanced wage-bills, etc., ultimately draw in their horns with a jerk. Others lay stress on the emergence of what they call a "shortage of saving," which no liberality on the part of the banks could remedy. According to this picture, windfall profits are eaten into by rising wages and interest rates, which at this stage no longer lag appreciably behind the rise in prices, and with the disappearance of windfall profits the main source of demand for instrumental goods is dried up. There turns out to be an overproduction of such goods in the sense, as Cassel puts it, of "an overestimate of the. . . amount of savings available for taking over the real capital produced."[40]

Within the above passage, Robertson identifies two causes of the onset of a recession as either a "deflationary shock" or a shortage of savings. The capital-based approach identifies each of these factors as a potential and immediate cause of a recession, but the underlying factor in each case is the malinvestment built up during the boom phase. Monetary injections create disequilibria that cannot be maintained forever. The crunch phase of the business cycle, where the scramble to prevent the liquidation of malinvestments takes place, can come about in two ways–the credit crunch or the real resource

[39] See fn. 12 above.

[40] Robertson (1959) pp. 96-97. Robertson does not provide the specific cite for the Cassel quotation.

crunch. While each scenario may cause the economy to turn from boom to bust, they often occur together. However, the capital-based approach, by not over-aggregating the effects of monetary injections, shows that each of these "causes" have the same root–malinvestments.

Since the mid-1960s, there have been six official recessions.[41] Except for the 1990-1 recession, monetary policy was tightened in each instance. However, when tightening occurred after the recession started, it cannot be concluded that the recession was caused by a credit crunch.[42] In five instances, 1966, 1969-70, 1973-5, 1981-2, and 2001, a credit crunch preceded an economic downturn. The recessions that are not preceded by a policy of credit tightening are: 1980, and 1990-1. These recessions were caused by a real resource crunch where economic pressure increased input prices which led to an economic downturn.

Credit Crunch

The credit crunch occurs when the monetary authority determines inflation (or expected inflation) is too high and "slams on the monetary brake." The monetary authority's actions force short-term rates to rise. The yield curve rotates instead of shifts because the rate of future inflation is expected to fall. The Wicksell effect dominates the Fisher effect at the short-end of the yield curve and they negate each other at the long-end. Thus the yield curve tends to invert prior to a recession, as seen in Figure 5.

[41] In addition to the six recessions, the second quarter of 1967 experienced a negative growth rate. It was preceded by an inverted yield curve and a credit crunch in 1966.

[42] Owens and Schreft (1995) argue that there was tight credit in 1966, 1969-70, 1973-74, first half of 1980, 1981-2, and early 1990-2. However, they state that the 1990 crunch was market induced, while the others stem from actual policies of monetary tightening or threats of increased regulatory oversight.

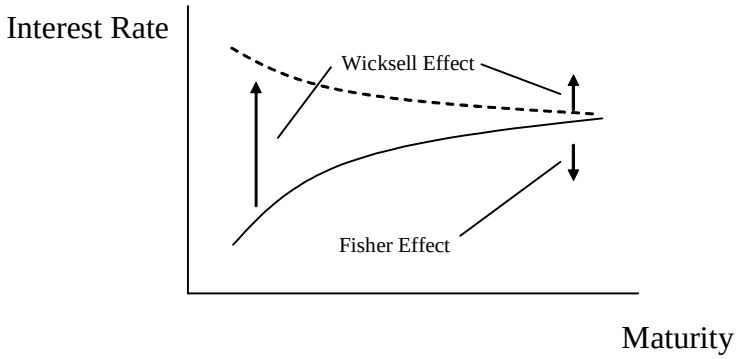

Figure 5: Inverting the Yield Curve with the Wicksell Effect and the Fisher Effect

Hayek (1969) states that in order to maintain the level of malinvestment, the rate of money supply increases must be accelerated even when expectations of future prices remain constant. If there is an expectation of future inflation, the rate of monetary expansion must also outpace expectations of inflation. During periods of increasing price levels, expectations of future inflation are not constant. In the neo-classical model of the Long-Run/Short-Run Phillips curves, the economy is on a point to the left of the Long-Run curve. Such a point is inherently unstable and the only manner in which the economy can maintain its level of output is through accelerating rates of inflation.

With monetary expansion, price levels increase for two reasons: the previous expansions of the money supply drive prices higher in an uneven manner and the instability of the malinvestments induces entrepreneurs to bid up input prices. Malinvestments are projects for which there is not enough savings to support them. During the monetary expansion phase of the boom, new investments are encouraged and consumers increase their levels of consumption and decrease their level of savings.[43] As a result, there is a shortage of real resources at existing prices. Assuming that prices are not sticky upwards, the consequence is an increasing input-price level at an accelerating rate. The

[43] Again the significance of using the modified Preferred-Habitat theory becomes important. The fact that there is a divergence between entrepreneur's plans and that of consumers is based upon the inclusion of Böhm-Bawerk's formulation of time-preference. Since consumers have not changed their time-preferences, when new money is injected into the economy, they decrease their rate of savings. A Preferred-Habitat theory using Fisher as its foundation could not support such a claim.

inflationary effects of the earlier monetary expansion are compounded due to the need of entrepreneurs to finance their malinvestments. Only with a disaggregated approach, such as with the capital-based approach, can it be shown that inflation must not only accelerate to account for expectations, but that it must expand at a higher multiple to accommodate increasing input prices in order to maintain output levels.[44]

Kashyap, Stein and Wilcox (1993) demonstrate that when the monetary authorities engage in a policy of monetary contraction, there is an immediate effect on the money stock. The first consequence is a reduction of new loans made to entrepreneurs. As input prices increase, there is a need for new financial capital to complete or maintain the malinvestments. The firms with investment-grade bonds have access to credit markets, but firms without this rating scramble for financial capital. They drive up short-term rates in order to finance their projects. Cantor and Wenninger (1993) illustrate how, in a time of credit tightness, funds flow away from low-grade investment instruments (in their analysis, away from the junk bond market) and into bonds with at least a grade of Baa. Long-term rates do not change due to two factors: expectations for future inflation have not changed and firms with investment-grade bonds are able to borrow long-term by tapping the funds flowing out of the low-grade investment instruments. Romer and Romer (1993) show that "[S]mall firms are particularly dependent on banks for finance. . . ."[45] They also conclude that during the periods of monetary contraction where the Federal Reserve is able to increase short-term interest rates, banks are able to maintain the levels of loans. However, banks do not increase their loan levels that would be required to maintain the malinvestments.

When the monetary authorities believe that the current rate or future rate of inflation is too high, they engage in a policy of monetary tightening. Christiano, Eichenbaum and Evans (1996) show that a contractionary monetary policy increases the federal funds rate. The short-term rates increase relative to the long-term rates. Kashyap, Stein and Wilcox (1993) show that the issuance of commercial paper and bonds jumps relative to bank loans after monetary tightening. Bernanke and Blinder (1992) argue that a tight monetary policy leads to a short-run sell-off of the banks' security holdings (with little effect on

[44] If the monetary authorities adopt a policy of accelerating inflation, the consequence is hyperinflation. However, a real resource crunch will usually come about before that point is reached, e.g., the 1980 recession.

[45] See Romer and Romer (1993) p. 39.

loans), therefore reducing the capital value of these assets and making it more difficult for firms to borrow against their assets. They demonstrate that, over time, banks terminate old loans and refuse to make new ones. In other words, the monetary shock hits securities first. After the securities are sold off, banks rebuild their portfolios and loans start to fall off. After an average period of 2 years, securities return to their previous levels and loans reflect the entire decline. When there is a monetary contraction, according to the results of Kashyap, Stein and Wilcox (1993), a reduction of the supply of loans and the effects on production will not begin to materialize until 6-9 months later. Furthermore, they find evidence that output corresponds with loans. Christiano, Eichenbaum and Evans (1996) argue that households do not adjust their financial assets and liabilities for several quarters after a contractionary monetary shock. The authors also support the findings that the net funds raised by businesses are able to increase for up to one year after the policy shock, after that period, these funds decline. This delay explains the timing issue–the fact that the yield curve tends to invert approximately one year before a recession.

Bernanke and Gertler (1995) argue that interest rates initially spike after monetary contraction and return to their trends after 9 months. This evidence corresponds to the data that show that the yield curve tends to return to its normally positive slope just prior to a recession. This phenomenon was observed in 1957, 1960, 1967, 1989-90 and 2001. Furthermore, Bernanke and Gertler (1995) argue that with a monetary contraction, final demand falls off before production does, implying that inventories rise in the short-run.[46] According to their results, durable spending displays the largest response to monetary policy shocks, which corresponds to the arguments presented in section 4.

Owens and Schreft (1995) argue that the recessions of 1953-4, 1957-8 and 1960-1 were caused by credit crunches. They report that a credit crunch occurred in the spring of 1953 and the recession began in Q2:1953. While the yield curve did not become invert or humped, it flattened throughout the preceding period.

The next US recession began in Q3:1957. Based on the Minutes of the FOMC Meetings, Romer and Romer (1993) identify a contractionary monetary shock in September 1955. The yield curve displayed the effects of a credit crunch when it became humped in

[46] Dimelis (2001) demonstrates that business inventories are procyclical and are more volatile than sales. She also points out that EU swings are larger than US swings. She attributes this characteristic to better inventory practices in the US.

December 1956, but it did not invert over the course of the recession.[47]

Owens and Schreft (1995) find evidence of a credit crunch in last third of 1959. The recession began in Q2:1960, and while the yield curve became humped in September 1959, it did not invert.

As noted above, the economic downturns of 1966, 1969-70, 1973-5, 1981-2 and 2001 were also caused by a credit crunch. In February 1966, President Johnson publicly stated that he feared an approaching inflation and said that he was counting on the Federal Reserve to prevent it. Owens and Schreft (1995) report that the Federal Reserve met with bankers and imposed quantitative limits on certain types of lending. The yield curve inverted in September 1966 and the economy experienced negative growth for Q2:1967.

In late 1968, the fear of inflation arose again. Romer and Romer (1993), using the Minutes of the FOMC Meetings, identify the contractionary monetary shock in December 1968. Owens and Schreft (1995) identify the January 14, 1969 meeting of the FOMC where a shift toward tighter monetary policy took place. The recession began in Q4:1969 and lasted through Q4:1970. In any case, the yield curve became humped in November 1968 and inverted in briefly in January 1969 and then again inverted between July 1969 and August 1969. It inverted once more between November 1969 and January 1970.[48]

For the 1973-5 recession (which began in Q4:1973), the fear of inflation led the Federal Reserve to raise discount rate 4.5% to 5% on January 15th, 1973. The yield curve became humped in February 1973, inverted in June of the same year, and remained inverted until September 1974. However Romer and Romer (1993), again using the Minutes of the FOMC Meetings, identify the contractionary monetary shock in April 1974.

Preceding the recession of 1981-2, which began in Q3:1981, Owens and Schreft (1995) argue that the Fed maintained tight credit policy throughout 1981. The yield curve became humped in September 1980 and inverted in November 1980.

On December 5th, 1996, Chairman Greenspan used the phrase "irrational exuberance," sending the first warning that inflationary pressures were on the horizon. How-

[47] However, Owens and Schreft (1995) do not find evidence of a credit crunch until the fall of 1957.

[48] It is interesting to note that the yield curve became humped before the contractionary monetary policy was put into place. A possible reason for this is that there was a real resource crunch just staring to take effect at this time as well. The real resource crunch is explained below.

ever, after a series of rate cuts (cutting the discount rate by 50 basis points to 4.50% by December 1998) the Federal Reserve did not increase the discount rate until August 1999. Beginning in that month, the Federal Reserve began a series of discount rate increases, which culminated in a discount rate of 6.00% in June 2000. The stated reason for the change in policy is found in the FOMC Press Release August 24th, 1999: "Today's increase in the federal funds rate, together with the policy action in June and the firming of conditions more generally in U.S. financial markets over recent months, should markedly diminish the risk of rising inflation going forward." The November 16th, 1999 FOMC Press Release stated that the Federal Reserve was increasing the fed funds rate and the discount rate to check "inflationary imbalances." However the annualized rate of inflation, according to the Consumer Price Index (CPI), for August and November 1999 were merely 1.48% and 1.47% respectively.

As a consequence of the policy of monetary tightening, the yield curve became humped in April 2000 and inverted in August 2000. It and remained inverted through December 2000. The NBER dates the beginning of the recession in March 2001.

While the cause of the 2001 recession may be claimed to be the monetary policy, the Federal Reserve was actually reacting to significant inflationary pressures in the producers markets.[49] Between April 2000 and January 2001, the Producer Price Index (PPI) for industrial commodities increased over 8.09% and the PPI for all commodities increased over 7.11%. Also during this period, the CPI increased at an approximate rate of only 2.21%. These inflationary pressures are accounted for by a real resource crunch where malinvestments that have built up in the economy can no longer be supported without an accelerating rate of inflation. In other words, if the Federal Reserve had not intervened with a contractionary monetary policy, the economy would have experienced an inverted yield curve and recession because of the impending real resource crunch. The action of the Federal Reserve only hastened the outcome, but did not substantively change the result.

In the surveyed downturns, the monetary authority actively followed a policy of monetary contraction. However, not all recessions are caused by such policies. The recessions of 1980 and 1990-1 were caused by a real resource crunch. The existence of

[49] This case is the opposite scenario of the 1980 recession, which was a recession caused by a real resource crunch and enhanced by a credit crunch.

malinvestments can be analytically identified only with a capital-based approach. The subsequent need to liquidate these malinvestments is significant because this need causes the yield curve to invert and sets the economy down a path toward recession even without a policy of monetary contraction.

Real Resource Crunch

Unlike more aggregated models, the capital-based approach can also account for the upper-turning point of a business cycle even when the monetary authorities do not engage in monetary tightening. During the malinvestment boom, entrepreneurs are given false signals to undertake malinvestments. Also during the boom phase, consumers rebalance their portfolios so that they increase their spending on consumer goods and reduce their level of savings. These malinvestments are unstable because there are not enough resources to complete and maintain each of these projects. As Robertson described above, windfall profits disappear, wages and input prices rise and "no longer lag appreciably behind the rise in prices. . . ."[50] Consequently, there is a scramble for financial capital by entrepreneurs to prevent the liquidation of their projects. They bid up short-term rates and the yield curve inverts due to a real resource crunch.

As described above, the price level is driven upward during the malinvestment boom because of two factors: the expectation of future inflation and the bidding up of input prices by entrepreneurs to prevent the liquidation of their projects. Even when the monetary authorities engage in a policy of monetary expansion to meet the increasing expectations of inflation, the total amount of stable investments is limited at any one point in time by the level of savings in the economy. Savings provide the wherewithal for entrepreneurs to build, complete and maintain their projects.

Monetary injections falsify the price signals to the entrepreneurs, causing them to begin more projects than are actually tenable at that point in time. Additionally, the steepening of the yield curve signals to consumers that short-term credit for consumer purchases are less expensive. As described in section 4, a decrease in short-term rates indicates that the cost of financing short-term purchases falls. Furthermore, with ever increasing rates of inflation, consumers will rebalance their portfolios away from savings

[50] See Robertson (1959) pp. 97 and fn. 41 above.

and checking accounts (and cash holdings) and into tangible assets. In the aggregate, the demand for consumer goods increases and consumers save less. With fewer savings in the economy, the total amount of possible stable investment projects diminishes.

The initial effect of the monetary expansion is that entrepreneurs are able to bid resources to their projects because they are able to cheaply borrow and use the new credit. However, the act of embarking on these investment projects bids up these resource prices. At first the effects of the misalignment of the social structure of production is not apparent and the dueling structure of production emerges (as seen in Figure 2 above).

To better illustrate this process, the following example is provided.[51] Suppose that a builder exists who has enough bricks to finish four houses, yet he starts to build five. With a decrease in the normal rate of profit, he sees the additional house as a potential windfall (economic) profit. He figures that he will be able to purchase the bricks necessary for the completion of the project in the future when he needs them. Suppose further that he borrows $100,000 to finance the project. Competing entrepreneurs also follow this pattern due to the false market signals. As the entrepreneur runs out of bricks, he starts to purchase more to complete the project. However, other entrepreneurs are also bidding for more bricks. The price of the bricks increases with the increasing demand. The $100,000 initially borrowed to complete the project is no longer enough. The entrepreneur must find additional financial capital to complete all five houses.

To state the situation more generally, the amount of funds previously borrowed to complete projects (across all lengths) is now insufficient. There is an immediate need for funds to complete and maintain the malinvestments. The scramble for additional funds may be more intense with short-term projects. All entrepreneurs are faced with the alternative of liquidation or of finding supplementary funds to complete their project, but the intensity in demand for funds may be much higher for projects that are almost complete. In other words, an entrepreneur may be more highly motivated to secure funds to finish a project that will produce output next month than he would be to secure funds for a project that will not yield a return until next year.

As a result of these actions, short-term rates are bid up quickly, inverting the yield

[51] This example is similar to one presented in Mises (1966) pp. 559-560.

curve.[52] Tribó (2001) argues that smaller firms must look for short-term credit when faced with output problems.[53] He further finds that larger firms are able to tap into the long-term credit markets. However, as noted above, those firms without investment-grade ratings scramble for financial capital.

Over the course of a business cycle, long rates tend to remain relatively stable. The larger firms with investment-grade ratings are able to attract funds for long-term investments from the low-grade investment sectors. The effect from the increases in the short rates is diminished across the yield curve, because long-term lenders take on less risk since they tend to be the mortgage holders, etc. They are the first to collect if the firm enters bankruptcy. There is a liquidity premium to lending long, yet long-term instruments have an inherent hedge against business cycle risk. Thus, the yield curve inverts instead of shifting.

Three of the recessions since the mid-1950s were not caused by a credit crunch. While there is evidence that there was monetary tightening in every recession except for the 1990-1 recession, the tightening for the 1980 downturn did not take place until after the recession was under way.

As shown above, the 1969-70 recession has elements of both a credit crunch and a real resource crunch. The yield curve became humped in November 1968, a month or two before the policy of monetary contraction was agreed upon by the Federal Reserve. These two causes are not mutually exclusive and may work simultaneously, thus this evidence is not surprising.

The recession of 1980 is an example of a recession caused by a real resource crunch and enhanced by a credit crunch.[54] The recession began in Q1:1980. The yield curve became humped in September 1978, inverted in December 1978, and remained so until

[52] Summarizing his empirical findings, Keeler (2002) states, "As the aggregate economy expands and firms progress in building capital and expanding output, shortages of resources occur which raise resource prices. Short term interest rates are increased toward long term rates and the yield curve flattens or may invert. The primary mechanism in this endogenous market process is the intertemporal disequilibrium between sources and uses of income; at low interest rates, consumers and investors increase spending, and need to finance an increase in both consumption and investment, but savers decrease the quantity supplied of funds." p. 5.

[53] See also Romer and Romer (1993).

[54] As noted above, the 1980 and 2001 recession are opposite scenarios but both contain the same components: a policy of monetary contraction and a real resource crunch.

April 1980. While Romer and Romer (1993) identify contractionary monetary shocks in August 1978 and October 1979, Owens and Schreft (1995) argue that the credit crunch did not occur until the first half of 1980. Their position is that in order to regain control over inflation and the expectation of high rates of future inflation, the Carter Administration imposed credit controls on March 14th, 1980. Furthermore, the Federal Reserve did not fully enforce these regulations until the Federal Reserve officials met on May 17th, where Chairman Volcker warned the banks that the Federal Reserve would enforce the program.

Producer prices grew at an accelerating rate between September 1978 and January 1980 (the dates where the yield curve became humped and the beginning of the recession). Over this period, the PPI for industrial commodities grew at a rate over 22.64%, and the PPI for all commodities at a rate over 17.19%. The CPI, over the same period, grew at a rate of 16.99%. This evidence corresponds with the scramble by entrepreneurs to find funding to complete their projects.

The first post-war recession that did not experience a contractionary monetary policy was the 1990-1 recession, which began in Q3:1990. Although the yield curve never inverted, it became humped in February 1989 and lasted in this state through September 1989. While Romer and Romer (1993) identify a contractionary monetary shock in December 1988, most analysts doubt that such a shock occurred. Cantor and Wenninger (1993) state that, "One of the most striking features of the recent credit cycle [of the 1990-1 recession] has been the [credit] crisis that never happened." They argue that there was a boom in the credit markets between 1986 and 1991. Bernanke (1993) interprets the 1990-1 recession as the result of a credit crunch without a contractionary monetary policy.

A real resource crunch is evidenced by increasing rates of input prices while output prices fail to keep pace. Unfortunately, the aggregated data from the Federal Reserve Bank of St. Louis is not specific enough to capture this relationship.[55] Hughes (1997) provides some evidence that corresponds to the real resource crunch scenario. He shows that a malinvestment boom took place, with long-term bank borrowing by manufacturing

[55] Nevertheless, the data from FRED II is as follows: from the date when the yield curve began to change, January 1989, through the beginning of the recession, June 1990, the PPI for industrial commodities increased at a rate greater than 3.28%, and the PPI for all commodities increased faster than 3.43%.

industries increasing from $60.5 billion in 1981 to $197.2 billion in 1991 (in unadjusted dollars). He also demonstrates that early-stage firms (such as primary metals and Iron and Steel industries) greatly expanded their capacity from 1981 to 1985, but their output prices collapsed in 1986. While his arguments tend to support the Austrian Business Cycle theory, he seems to argue that, at least for the early-stage industries, the 1990-1 recession really began in 1986. Thus to find evidence of a real resource crunch for the 1990-1 recession, one must look at the market which most analysts identify as the one which set off the recession–the commercial real estate market.

When viewed from the perspective of the commercial real estate market, one sees that the 1990-1 recession was caused by a real resource crunch. Cantor and Wenninger (1993) demonstrate that there was a large increase in the value of real estate prices prior to the late 1980s. Additionally, the authors argue that deregulation forced non-bank thrift institutions (like insurance companies) to look for ways to increase their rates of return. Thus these institutions extended credit to more risky ventures (like those in the real estate market), but the capital requirements for these thrift institutions remained low and many weak firms were exempted from tough regulatory scrutiny.

Cantor and Wenninger (1993) point out that the real estate market collapsed in the late 1980s, after which regulators increased scrutiny of these types of loans, making it very difficult to obtain funding for real estate ventures. Owens and Schreft (1995), in their paper which also observed decreasing real estate values in the late 1980s, state that there were complaints that regulators were too closely scrutinizing real estate portfolios, making real estate lending extremely difficult. Many new buildings came on the market at the same time, depressing rental and sales prices. Additionally in many cases, the tax breaks that made commercial building profitable were removed. Bernanke (1993) observes that large losses in the real estate market reduced the amount of bank capital, which he labeled a "capital crunch." However, Bernanke downplays the supply of funds as a major cause of the recession, because as bank loans fell in 1989, commercial paper increased. Cantor and Wenninger (1993) state that during the period between 1986 and 1991, "nondepository credit growth continued to exceed GDP growth by a wide margin (4.5 to 5.5 percentage points). Depository credit, on the other hand, decelerated sharply as thrift credit went into an outright decline in the 1989-1991 period."[56] There was a

[56] See Cantor and Wenninger (1993) p. 5.

shift from financing through banks, etc. to self-financing in the commercial paper and commercial bond markets. Those firms with investment-grade securities were able to obtain financing, while those without such a rating were not. Cantor and Wenninger (1993) further argue that just prior to the recession, (1989-90) money stopped flowing into "junk" bonds and instead went into investment-grade corporate bonds. Despite an easy monetary policy,[57] those borrowers without direct access to the financial markets (i.e., those without investment-grade ratings) did not benefit from this policy. Their scramble for financial capital caused the yield curve to become humped. Below investment-grade borrowers were shut out of the long and short-term money markets and eventually were forced to liquidate their projects, while those with investment-grade ratings benefited from the easy credit policy.

Bernanke and Lown (1991) support the conclusion that the decrease in bank loans was not supply-side related. Thus, they are skeptical that a credit crunch caused the recession. The lack of contractionary monetary policy explains the appearance of a humped yield curve instead of an inverted yield curve. While Bernanke and Lown argue that the demand for loans was a more important cause of the 1990-1 slowdown, the evidence they provide is that all forms of credit (including commercial paper) decreased during the 1990-1 recession–indicating a decrease in demand for credit. There seems to be a timing discrepancy in their analysis. In 1989 commercial paper increased and then, when the recession began, all forms of credit decreased. Their evidence supports the real resource crunch scenario, instead of the scenario where a fall in the demand for credit caused the recession. There was a scramble for credit in the late 1980s, which is seen in the increase in commercial paper issuances and the change in the shape of the yield curve. When businesses started to fail in 1990, the demand for all credit fell and the recession was underway.

6 Summary

The capital-based approach compares favorably with CCAPM and Estrella models because it is able to explain why the yield curve tends to invert before a recession. Unlike these other models, this approach centers its focus on the malinvestments built up during

[57] Owens and Schreft (1995) report that the Fed eased monetary policy in spring of 1990.

the malinvestment boom. These other models, by over aggregating, are unable recognize that the root cause of the inversion of the yield curve is the malinvestments.

In this paper, the assumption was made that the initial monetary injection was short-term working capital. It has been shown that this capital is transformed into fixed capital, long-term projects and early-stage malinvestments. To the extent that these projects are inconvertible, the liquidation process becomes more severe.

The modified Preferred-Habitat theory is an essential component to the model used, because it is able to illustrate how monetary injections lead to a disequilibrium between consumption/savings horizons of households and the investment projects of entrepreneurs. Monetary injections cause the yield curve to steepen which falsely signals entrepreneurs to begin new investments and encourages households to increase their demand for final goods and services.

The unstable malinvestments force input prices to rise and lead to a credit crunch, a real resource crunch, or a combination of both. In their attempts to prevent their individual projects from being liquidated, entrepreneurs will cause the yield curve to flatten, become humped or even invert as they scramble for financial capital (even when the monetary authority adopts a policy of easy credit). Thus in every recession since the mid-1950s, an inverted or humped yield curve occurred no more than 5 quarters prior to the upper-turning point of the business cycle.

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