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The Yield Curve as a Leading Indicator of Recession: Austrian Economics Insights

Summary: This is a heterodox review on macroeconomics according to the Austrian Economics. The Austrian business cycle theory explains the origin of boom-bust cycles based on the difference between natural interest rates and banking rates, which comes from the artificial processes of monetary and credit expansion. This difference is the yield curve, an instrument to detect the deviation of monetary policies, and a forward indicator of business cycles. This article studies the impact of yield curve slope on the requirements for access to bank credit, and the distorting effect of expansionary monetary policies on the capital structure. In an environment of artificially low interest rates, these distortions become an accumulation of long-term failed investments that markets cannot assume, with the consequent readjustment or recession. To detect these distortions and to control the bust, it could be useful the yield curve illustrates here.

Keywords: Yield curve, Austrian business cycle theory, Monetary policy, Macroeconomics, Political economy.

JEL: B5, E3, E5, F4.

The impact of the monetary and credit expansion processes on the production structure of national economies in the years preceding the 2008 crisis, and the monetary laxity policies implemented in the following years, have brought back the interest of economists in monetary cycle models. Among them, the Austrian Business Cycle Theory (ABCT from now on) is a great attraction for new generations of researchers who are recovering with great interest the original contributions of thinkers such as Ludwig von Mises (1912, 1949), Friedrich Hayek (1931, 1941) or Murray Rothbard (1963).

ABCT explains how monetary expansions channeled through the loanable funds market with the intention of lowering interest rates induce artificial credit growth in a fractional reserve banking system. Credit expansion (without prior savings backing) leads to significant distortions in the production (or capital) structure of the economy that obey neither the real resource availabilities nor the consumption-savings preferences of households, so that it must eventually adjust to these through a deep recession (Roger W. Garrison 2001; Randall G. Holcombe 2017).

In an initial environment of abundant and cheap credit, induced by the central banks' own monetary laxity, the lack of savings to complete the new production structure and the growing indebtedness to pay for the acquisition of immediate consumption goods will exert upward pressure on interest rates and, through the so-called "Ricardo effect" or readjustment (Esther González Arnedo, Jesús Alberto Valero-Matas, and Antonio Sánchez-Bayón 2021; Martin García, Sánchez-Bayón, and José Lominchar 2021; Sánchez-Bayón 2021), the economy will move from a scenario of artificial boom to one of adjustment and crisis (Paul F. Cwik 2005; Robert C. B. Miller 2009).

The purpose of this paper is to analyze the role of interest rates, especially the yield curve, as leading indicators of the business cycle in the light of the contributions of Austrian capital theory. To this end, it is divided into four sections. Section 1 reviews the fundamentals of the theories of capital and interest on which ABCT is based. Section 2 distinguishes between sustainable growth scenarios, based on the accumulation of savings, and unsustainable growth (or business cycle) environments, induced by monetary and credit expansion processes. The third section reviews the behavior of the slope of the United States of America (USA) yield curve in the expansionary and recessionary phases of the cycle, as well as the impact of the Federal Reserve's monetary policy (with the federal funds effective rate) on the structure of production in this country. Finally, the article closes with the conclusions of the research.

1. Theoretical Foundations of the Macroeconomics of Capital and the Cycle

ABCT has its roots in a long tradition. Starting from the theory of capital originally proposed by the Austrian economists Carl Menger and Eugen Böhm-Bawerk at the end of the 19th century and the monetary theory of Knut Wicksell (1898), it was initially elaborated by Mises (1912, 1949) and later extended by Hayek (1929, 1931, 1941, 1952, 1988) and Rothbard (1963). More recently, it has been improved and updated by Jesús Huerta de Soto (1998, 2009), Jörg Guido Hülsmann (1998), Garrison (2001) or Arkadiusz Sieron (2019a).

1.1 The Theory of Capital and Interest of Carl Menger and Eugen Böhm-Bawerk

The economists of the Austrian School define capital in a physical form, as a technical requirement to achieve more complex methods of production (Eduard Braun 2020). In his *Principles of Political Economy* of 1871, Carl Menger developed the "theory of goods of different order", which allows to characterize production as a temporal sequence in stages. The Austrian professor argued that economic goods could be classified according to the immediacy with which they fulfill their purpose of satisfying human needs. In particular, he distinguished between "first-order economic goods" (or consumer goods) and "higher-order economic goods" (capital goods), emphasizing the complementarity and substitutability between them. First-order goods" directly and immediately satisfy the needs of the individual, and therefore constitute the ultimate goal of human action (Huerta de Soto 1998, p. 215). However, to reach the condition of consumer goods, they must first pass through a series of intermediate stages comprising the so-called "higher order economic goods", the order of each stage being greater the further it is from the consumer good on the time axis. By introducing the theory of goods of different orders and stressing the importance of the time required by the production process, Menger not only laid the foundations of the so-called capital theory, but also characterized the key factor driving growth: the accumulation of capital goods, reflected in a lengthening and widening of the intermediate stages that make up an increasingly complex (that is, more time- and capital-intensive) and efficient production structure.

It would be Eugen Böhm-Bawerk (1884), Menger's disciple at the University of Vienna, who two decades later would delve deeper into the theories of capital and interest. Böhm-Bawerk's theory of capital emphasizes the temporal nature of production, arguing that it adds value to the "original factors of production" (labor and land) because it integrates the capital factor. For the Austro-Hungarian economist, capital is nothing more than the set of "higher order goods" that lengthen the intermediate stages of the production structure and increase its complexity and productivity.

However, to obtain "capital goods" it is necessary to save, that is, to postpone the consumption of present goods with the intention of achieving, after their investment in longer and more efficient production strategies, a future end that the actor considers more valuable. It is this relationship between economic goods of different orders, or between consumption and production goods, that is the fundamental root of the Böhm-Bawerkian theory of interest (Antony P. Mueller 2001, p. 4).

In *Capital and Interest*, Böhm-Bawerk (1884) introduces the theory of time preference, according to which the rate of interest results from the fact that, "in general", individuals value more the availability of consumer goods in the present than at some future time. He emphasizes, however, that time preference is one of the two determinants of the so-called "original rate of interest", the other being the greater physical productivity of methods of production that require more time for completion.

Some decades later, Mises (1949, p. 578) would deepen the study of time preference as the basis of the original rate of interest, defining it as an a priori category of human action, and not as a psychological disposition of the individual in the sense proposed by Böhm-Bawerk (Hülsmann 2002, p. 79). Based on this characterization, he would claim that time preference is universally positive (hence also the original rate of interest) since all agents are endowed with a certain impatience in their consumption preferences. On the other hand, Mises would be very critical of the Böhm-Bawerkian approach that the original interest also depends on the higher productivity of the most time-intensive production strategies, claiming that the causal relationship would go in just the opposite direction (Mises 1949, p. 626).

1.2 Wicksellian Monetary Theory

The study of ABCT must also dwell on the enormous influence exerted by the monetary theory of Wicksell (1898). In his theory of the natural rate of interest, Wicksell relies on the Böhm-Bawerk conception of interest. The Swedish economist was able to prove that there were cyclical variations in the general level of prices that did not respond to alterations in the quantity of money in circulation and that omitted the role of credit in economic activity. To explain the impact of bank credit and interest rates on the general price level (P), he distinguished between the natural rate of interest and the money (or bank) rate of interest.

Wicksell (1898, p. 102) argues that there would be a rate of interest on loans that would guarantee the stability of P. This variable, which he designates the natural rate of interest on capital, would depend on the supply and demand for loanable funds if there were no money and loans were made in the form of real capital goods. Thus, the natural (*in*) or original rate of interest would be defined as a real variable which: (1) it would not depend on monetary factors; (2) it would be consistent with the profitability (marginal productivity) of capital and the supply of real savings (which would depend on the agents' rate of time preference); (3) it would equalize the levels of savings (*S*) and investment (*I*) ensuring the emptying of the goods market; (4) it would place the economy at its level of potential production or full employment; (5) it would guarantee the stability of *P*.

Alternatively, the money interest rate (*im*) would depend on the supply and demand for money and credit in the loanable funds market. Therefore, it would not faithfully reflect the supply of real resources in the economy.

Based on these variables, Wicksell defines monetary equilibrium as that in which the bank interest rate coincides with the natural rate ($im = in$), so that the demand for funds for investment is restricted by the supply of available savings ($S = I$), and the general price level remains stable ($P = 0$).

Having established a frame of reference, this author admits that situations of decoupling between the two interest rates can occur, leading to a scenario of economic disequilibrium. The discrepancy between the two variables would have its origin in monetary shocks. In fact, in a monetary economy, the bank rate would not coincide with the natural rate of interest because the supply and demand for capital would not occur in real terms but in the form of money.

Thus, if because of a credit expansion process (creation of bank money not backed by savings) the money rate would fall below its natural level ($im < in$), firms would demand more financing to invest while households would have less incentive to save (hence $S < I$). The economy would enter a disequilibrium scenario in which investment demand would grow behind the supply of available savings, while inflationary pressures would arise ($P > 0$).

The rise in the general price level would demand an increase in money in circulation, which in turn would cause a drain on reserves that would force commercial banks to raise the money interest rate. Thus, the increase in *P* would act as a link connecting the money rate to the natural rate of interest. The effect of the divergence between the two variables the rise in the price level would become the cause of their subsequent convergence to a new equilibrium state in which $im = in$. In this new scenario, the increase in the monetary rate would reduce excess demand and the pressures on *P* would disappear.

Since monetary equilibrium is reached when $im = in$, Wicksell argues that a neutral monetary policy should ensure that the bank rate coincides with the natural rate of interest. That is, the only interest rate that would ensure a full employment equilibrium with price stability would be the natural rate of interest, characterized as a real phenomenon that would not depend on changes in the quantity of money (Ansgar Belke and Thorsten Polleit 2009, p. 172).

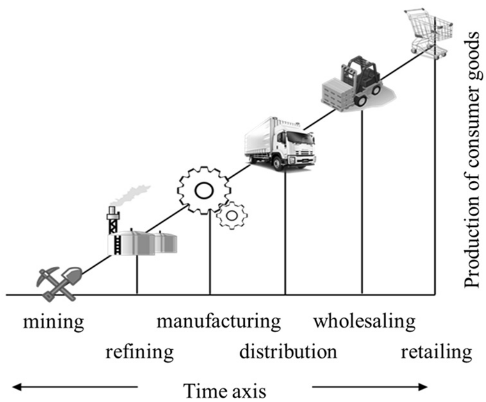
Undoubtedly, Wicksell's theory represents an invitation to analyze what happens when the monetary rate diverges from the Wicksellian natural rate of interest, and the adjustment process followed by the economy until equilibrium is restored.

However, Mises (1912) and Hayek (1931) would abandon the Wicksellian analysis of the impact of credit expansion processes on the general price level, to focus on their effect on relative prices and on the resulting microeconomic distortions in the capital/production structure. Thus, although Hayek (1931, p. 39) based his theory of the business cycle on the concept of the natural rate of interest, he was very critical of the attempt to create a rigid connection between the interest rate and changes in the general price level, the only point in the Wicksellian exposition that he considered clearly wrong.

1.3 Mises and Hayek Cycle Theory

Mises (1912) would be the first to combine Böhm-Bawerk's theory of capital and Wicksell's monetary dynamics to generate a first version of ABCT. Later, Hayek (1931) would formalize and reinforce Misesian theory by incorporating the "Ricardo effect" and John Stuart Mill's fourth proposition (Garrison 1986, p. 441). In this sense, Hans-Michael Trautwein (1996, p. 38) argues that the Hayekian explanation of the cycle would integrate as distinctive elements: (a) the Wicksellian theory of interest; (b) a Böhm-Bawerkian stage structure of production; (c) a "Cantillon effect" that would explain the impact of changes in the quantity of money on relative prices; and d) a "Ricardo effect" that would connect consumption goods and capital (or production) goods of different orders.

To these four elements, both Mises (1912) and Hayek (1931) would add the idea that physical capital is not a "homogeneous fund" easily divisible and transferable between different sectors of activity, but is composed of a heterogeneous set of highly specialized capital goods, which show varying degrees of complementarity and substitutability. In ABCT, the specificity of the means of production becomes a fundamental factor that hinders the process of reallocation of resources between the different stages of production and accentuates the persistence of adjustment in recessions.



Source: Own elaboration (based on Garrison 2001).

Figure 1 Intertemporal Structure of Production: Hayek's Triangle

In Hayekian theory, production is defined as a staged intertemporal process. This characteristic, which defines the dynamic character of production and the heterogeneity and specificity of capital goods, is represented by the so-called “Hayek triangle” (Figure 1), a construction that allows us to explain the changes that occur in the capital structure because of changes in interest rates and credit expansion (Figure 1 is based on Hayek 1931, pp. 49-71, reviewed by Garrison 2001, p. 84).

Along the so-called “time axis”, Hayek’s triangle shows the time structure of production, from the stages furthest away from consumption (called “higher order” stages: mining, refining, etc.), more time and capital intensive and therefore more vulnerable to changes in the interest rate, to the stages closer to consumption (“lower order” stages: wholesaling, retailing, etc.), less sensitive to changes in this variable because they are more dependent on the labor factor.

Linked to changes in the time structure of production are the “Cantillon effect”, the “Ricardo effect” and John Stuart Mill’s so-called fourth proposition.

Starting from the initial approach developed by the economist Richard Cantillon in 1755, economists of the Austrian school emphasize that the magnitude of changes in the quantity of money and the channel through which new monetary injections enter the economy differentially affect relative prices and, therefore, the capital structure and market outcomes. In this sense, it should be borne in mind that changes in relative prices alter decision-making processes, whether in production or consumption.

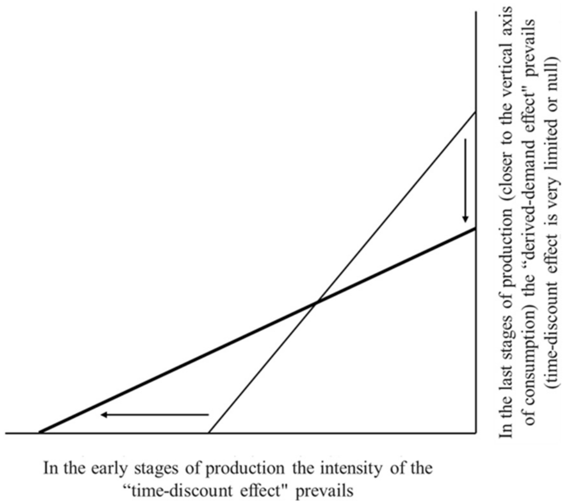
The “Cantillon effect” trace the path followed by money injections and show that monetary expansion processes are not neutral (Hayek 1931, p. 30). In other words, ABCT explains that monetary and credit expansions, through changes in relative prices and interest rates, have an impact on real economic activity by lengthening the time structure of output. In contrast, monetary tightening scenarios are characterized by the liquidation of a good number of investment projects further away (on the time axis) from final consumption. Similarly, the non-neutrality of money is also studied in terms of its redistributive effects on income and wealth (Sieron 2019b, pp. 104-113).

Another element that integrates the Hayekian theory of the cycle is the so-called “Ricardo effect” (Garrison 1986, p. 441). Hayek (1948, p. 220) argues that although the Ricardo effect is central to the interest rate analysis of Böhm-Bawerk, Wicksell and Mises, none of them develops it in detail.

In its original conception, the “Ricardo effect” (David Ricardo 1817) refers to the substitution of labor for machinery in response to changes in the rate of interest. Thus, a reduction in the market interest rate would cause a relative cheapening of capital, favoring its hiring to the detriment of labor. In the Austrian capital theory, in addition to this effect, changes in the interest rate also stimulate a substitution of lower-order capital goods (located in the stages of production closer to final consumption) for higher-order capital goods (located in the more distant stages). Thus, in the initial stages of a monetarily induced boom and bust cycle, an artificial lowering of interest rates to below their natural level would trigger investment in higher-order capital goods, leading to a lengthening of the production structure. Even more recent studies postulate as corollaries, when the aforementioned readjustment takes place, that a relocation of the labor factor to stages further away from consumption would also take place, generating greater personal wellbeing for workers (with more creative jobs, better working conditions, etc. Sánchez-Bayón and Lominchar 2020; Sánchez-Bayón and Aznar Estrella Trincado 2020, 2021; Arnedo, Valero-Matas, and Sánchez-Bayón 2021).

Finally, John Stuart Mill's fourth proposition, contained in the fifth chapter of his *Principles of Political Economy* (1848), argues that the demand for labor is not a demand derived from the demand for goods. Several decades earlier, the British economist proposed a view contrary to the Keynesian principle of effective demand (John Maynard Keynes 1936), according to which aggregate demand would determine the levels of production and employment in the economy. In this regard, Hayek (1941) analyses a reduction in consumption in the goods market does not necessarily involve a decline in production and labor demand. Instead, the resulting increase in savings, via interest rates, will promote a shift of productive resources from the generation of immediate (or present) consumption goods to the production of capital goods (Hayek 1941, p. 322 and pp. 487-496) and future consumption. Thus, the net impact on the demand for capital and labor could be positive.

Garrison (2001, 2005) shows that, following an increase in savings, the interrelation between the derived demand (typically Keynesian) and time discount effects explains the change experienced by the production structure. Thus, in the first case "derived-demand effect", the decline in demand in the goods market causes a fall in output, this impact being consistent with the Keynesian principle of effective demand. However, in the second case "time-discount effect", the reduction in the interest rate resulting from the accumulation of savings stimulates investment in the early stages of production (Figure 2). These, being more time and capital intensive (the further away from consumption), are more sensitive to changes in interest rates.



Source: Own elaboration (based on Garrison 2001).

Figure 2 Effect of a Decrease in the Interest Rate on the Production Structure

Therefore, in a context of increasing savings, the "Ricardo effect" and the "time-discount effect" cause a lengthening of Hayek's triangle. As a result, a more complex and productive capital structure is achieved. However, not every decline in interest rates comes from an increase in voluntary savings, but may be the outcome of an exogenous monetary expansion implemented by the central bank (Garrison 2001) or, in line with the original arguments of Mises and Hayek (Holcombe 2017), of a credit expansion under a fractional reserve banking system (Huerta de Soto 1998).

2. Sustainable versus Unsustainable Growth

In a free market economy, relative prices act as a vehicle for the transmission of information that guides and coordinates production and consumption decisions. They reflect changes in agents' preferences as well as the relative scarcities of alternative resources (Hayek 1948). However, agents do not easily recognize that price changes may have a monetary or real origin. Therefore, monetary manipulations of prices can distort their signaling function, lead to an accumulation of decision errors and generate a scenario of unsustainable economic un-coordination.

Likewise, natural or originating interest rates guide and coordinate the production strategies of entrepreneurs and the intertemporal consumption preferences of households, making them mutually compatible. The interest rates resulting from the free play of supply and demand in the loanable funds markets provide a precise and reliable signal of where production resources should be directed given the consumption-saving decisions of households. Thus, in an economy in which saving increases, the increase in the supply of loanable funds leads to a reduction in equilibrium interest rates. In this case, the new interest rates will reveal that agents are reducing their present consumption to increase their future consumption possibilities, and entrepreneurs, guided by this information, will direct their investments towards the first stages of the production structure. Thus, in the absence of monetary and credit manipulation processes, the accumulation of savings and the coordinating role of market interest rates will facilitate the consolidation of "sustainable growth" scenarios with a more productive capital structure (Stefan Erik Oppers 2002).

However, monetary authorities play an essential role in determining interest rates. In this regard, ABCT explains that business cycle scenarios arise because of their artificial manipulation. It is the processes of bank credit expansion orchestrated by central banks in a fractional reserve system that cause monetary rates to differ from natural rates. In this case, market interest rates cease to coordinate producers and consumers and promote the accumulation of investment errors in the early production stages, further away from final consumption (Holcombe 2017).

Building on Renaud Fillieule (2013), the phases that define an Austrian boom-bust cycle since its first formulation by Ludwig von Mises in the early 20th century are:

(a) The crisis begins with an expansion of bank credit and a correlative decline in interest rates, in an environment of great monetary laxity driven by central banks. Through this process, the monetary authorities disturb the balance between savings and investment by pushing monetary interest rates below their natural level (lower interest rates stimulate long-term investment while discouraging savings, creating a scenario of competition for limited financial resources, Garrison 2001, pp. 117-118).

(b) The decline in interest rates causes the capital structure of the economy to shift towards the early stages of the production process, which are more time and capital intensive, to the detriment of the later stages, which are oriented towards final consumption. However, unlike in sustainable growth scenarios, the increase in investment is no longer supported by an accumulation of voluntary savings.

(c) Thus, the artificial expansion of credit distorts the production structure: it causes a mismatch between the intertemporal decision plans of producers and consumers resulting in the accumulation of long-term "bad investments" that the market will not be able to absorb. On the other hand, the increase in the inflation rate caused by the abundance of cheap money will force the monetary authorities to raise official intervention rates and limit credit.

(d) Since the capital structure of the economy does not respond to the availability of real resources (savings) or to the consumption-savings preferences of agents, it will eventually have to adjust to them through a severe and painful recession. Also, it is paid attention to the effect of the slowdown in credit and the increase in interest rates on the sustainability of investment projects.

This sequence of stages implies that changes in short-term official interest rates in general, and in the slope of the yield curve in particular, can play a relevant role as leading indicators of business cycles encouraged by monetary and credit expansion processes.

3. Yield Curve Slope as "Leading Indicator": Austrian Insights

The yield curve is defined as a representation of the relationship between the interest rates of government debt securities (bills, notes, and bonds) and their respective maturities. This construction is also commonly referred to in the financial literature as the term structure of interest rates (TSIR).

Generally, the slope of the yield curve is positive (long-term rates are higher than short-term rates) for two reasons: the preference for liquidity and inflation risk. However, there are many studies (i.e., David C. Wheelock and Mark E. Wohar 2009) that consider the flattening or the inversion of the TSIR (short-term interest rates are temporarily above long-term rates) as a "leading indicator" of the recessionary economic cycles lived in recent decades (Arturo Estrella 2005; Mezie D. Chinn and Kavan Kucko 2015; Ryan Griggs and Robert P. Murphy 2021; Rashad Ahmed and Chinn 2022; Jean-Baptiste Hasse and Quentin Lajaunie 2022; David Sabes and Jean-Guillaume Sahuc 2023; Xiaojin Sun and Kwok Ping Tsang 2023). Since the mid-1950s, each flattening or inversion of the slope of the yield curve has anticipated the onset of a recession in the United States with a lead time of between four and six quarters. What could be the reason for its predictive capacity?

The best known explanation is provided by the so-called "expectations theory", according to which long-term interest rates are determined by market expectations about future rates. It follows from this theory that, in expansionary scenarios, expectations of future interest rate rises would cause the slope of the TSIR to have a positive sign. On the contrary, in recessionary stages, the opposite result should be expected. Authors such as Paul Krugman (2008) argue that expectations are the driving force behind the TSIR and its predictive power. Thus, he asserts that if investors anticipate an economic downturn, they will also expect the Federal Reserve to lower interest rates in the medium and long term, causing the yield curve to invert. Therefore, the 2008 Nobel Prize winner argues that the yield curve inverts when investors anticipate that the economy will enter a recession.

The main problem under this approach, it is that Krugman's explanation would make sense if yield curve inversions occurred when the long-term bond yields plummeted and fell below the short-term Treasury bill yields. However, as we will see in Section 3.1 of this paper, since the 1960s the US yield curve inverts in the quarters preceding a recession because short-term Treasury interest rates soar and rise above long-term bond yields (Griggs and Murphy 2021). The long-term interest rate does not decline until the recession is underway. This raises certain doubts about the soundness of the "expectations theory" to justify yield curve inversions prior the onset of a recessionary period.

A second explanation comes from the "liquidity preference theory". According to the theory, the slope of the yield curve reflects investors' preferences for liquidity and the risk associated with holding longer-term bonds. Thus, a positive sloped yield curve comes from the fact that investors demand higher risk to get more profits for longer maturities. Nevertheless, this approach fails in its attempt to explain why the TSIR could be reversed.

Cwik (2005) proposes a third version that integrates the two previous theories. He analyzes the effects of a short-term monetary injection on the yield curve. The first one, concerning the so-called "liquidity effect" (also known as the "Wicksell effect"), creates downward pressure on the entire TSIR. The second one, concerning the "Fisher effect", reflects the impact of monetary expansion on investors' inflation expectations, the longer the maturities, the greater its intensity. As a result of the combination of these effects of opposite sign, a process of monetary inflation will imply a decrease in interest rates at the same time as the slope of the yield curve increases.

In the same vein, Mises (1949, p. 637) argues that in an "evenly rotating economy" (idem, pp. 300-301), therefore, in the absence of uncertainty, there would be not positively sloping TSIR. Rate differentials would drive arbitrage trades where agents would tend to borrow short and lend long. This strategy would lead to a flattening of the yield curve. Only in a setting of increasing monetary laxity could central banks continue to maintain a positive TSIR (ibidem p. 654). This implies that processes of monetary and credit expansion interrupt the tendency of the economy to equalize interest rates along the TSIR. This interruption causes short-term rates to deviate from long-term rates and, with rare exceptions, the slope of the yield curve to be positive.

How to link the slope of the yield curve to ABCT? In a very interesting article, Griggs and Murphy (2021) show that the movements of the Austrian money supply, also known as "true money supply (TMS)" (Rothbard 1978; Joseph T. Salerno 1987), align remarkably well with changes in the slope of the yield curve. Specifically, they show that rapid growth in the TMS coincides with a positively sloped (or normal) yield curve, while decelerations or sudden declines in the TMS coincide with an inversion of the slope of the yield curve. Building upon the study by Griggs and Murphy we illustrate that, through the estimation of a vector autoregressive (VAR) model and an impulse-response function, an expansion in the TMS has a statistically significant positive impact on the TSIR. However, this effect tends to erode over time.

Additionally, James P. Keeler (2001), Robert F. Mulligan (2006) and Francis Bismans and Christelle Maugeot (2009), among others, show that changes in short-term interest rates (three-month Treasury bills) are temporary and volatile, being mainly dominated by the pace and intensity of monetary policy. Therefore, they can be used as a proxy for "Wicksellian" money rates. In contrast, changes in long-term rates (ten-year government bonds) are slow, of long duration and low volatility, so that their conduct could resemble that of capital productivity. Moreover, given the long life span of capital goods, their financing would take place in the long-term credit markets at rates compatible with the Wicksellian natural rate of interest. Thus, the historical illustrations of the ABCT assume the ten-year government bond rates to be a correct approximation to the natural rate, since it is a long-term variable that responds to factors of a real nature, being less sensitive to monetary policy measures.

3.1 US Yield Curve Case: Monetary Policy or Just Investors' Expectations?

Although it is true that changes in investors' expectations regarding the course of future monetary policy and interest rates can affect the "long end" of the slope of the yield curve, it is also true that the way central banks adjust short-term policy interest rates has a more direct and intense impact on the "short end" of this curve.

Cwik (2005), Estrella and Mary R. Trubin (2006), Tobias Adrian and Estrella (2008), and Adrian, Estrella, and Hyung Song Shin (2010), among others, argue that the current course and intensity of monetary policy impact the slope of the yield curve. Specifically, a policy of monetary tightening involves a rise in short-term interest rates, usually to limit inflationary pressures. Moreover, if the contractionary policy applied by the central bank is credible, investors will anticipate an upcoming moderation of the inflation rate, so that monetary authorities will return to an accommodative monetary policy with lower policy rates. Additionally, private investors may expect an economic slowdown because of monetary policy tightening, which would exert downward pressure on expected future policy interest rates. Therefore, it should be expected that in a context of monetary tightening, short-term interest rates will increase more than long-term rates, which would be coherent with a flattening or an inversion of the slope of the yield curve.

Griggs and Murphy (2021, p. 534) show a positive relationship between the annual growth rate of the Austrian TMS and the yield curve slope (SPREAD), defined as the difference between 10-year and 3-month Treasury rates. They also use econometric tools to confirm this relationship. Using this paper as a starting point, the Appendix analyses the relationship between the annual growth rate of the TMS and the yield curve slope for the period January-1987 (coinciding with the beginning of Alan Greenspan's tenure as Chairman of the Federal Reserve)-February 2020 (just before the pandemic declaration by the World Health Organization). Once we confirm that both series are stationary (I(0)) at the 0.05 level of significance by performing the Augmented Dickey-Fuller (ADF) unit-root test, Granger causality tests indicate that TMS Granger-causes the slope of the yield curve, but not the opposite (Table A1).

The estimation of a Vector Autoregressive (VAR) model of order 2 (or VAR(2)) – where the optimal lag order is determined by the Schwarz information criterion (SIC) – with a constant term (see table A2) corroborates these findings. Finally, the estimation of the dynamic relationship between both variables in terms of an impulse-response function shows how the slope of the yield curve reacts succeeding a disturbance in TMS. In other words, it provides insights into the magnitude, length, and direction of the response of the yield curve to Cholesky one S.D. innovations in Austrian TMS. In this regard, Figure A1 shows that a positive shock in TMS has a growing significant positive impact on the slope of the yield curve until the 15th month and then it begins to dissipate. These results reveal that movements in the slope of the yield curve are mostly driven by changes in short-term interest rates caused by monetary policy decisions, and not just by investors' expectations of future recessions.

Figure 3 below shows that, through the management of the federal funds effective rate (FFER), the Federal Reserve (Fed) has exercised timely control over three-month interest rates since the mid-1950s. In contrast, this control is much weaker and imprecise on ten-year rates, given the existence of risk premiums (default, credit risk, liquidity risk, inflation risk or other uncertainties that may affect the repayment of investments) that are not under the control of the Fed. Since monetary policy primarily affects short-term rates, a positive yield curve signals a loose monetary policy. Conversely, when the Fed reverses its strategy and raises the FFER, the yield curve tends to flatten or invert.

In the period 1955-2019 (figures do not include 2020 due to the considerable distortion caused by the Covid-19 crisis in the Federal Reserve's Monetary Policy), the Fed systematically faced recessionary cycles (gray areas in the figure) by reducing the FFER. This strategy was particularly visible since the 1990s (1990, 2001 and 2008 crises). The cuts in the FFER led to almost identical changes in the three-month rate, while their impact on the ten-year rate was much more limited (Cwik 2005). As a result, the slope of the yield curve (10-year − 3-month) increased in the recessionary phases of the cycle and in subsequent quarters (Figure 4), revealing the countercyclical use of monetary policy.

The Fed's artificial lowering of short-term interest rates, and the resulting upward-sloping yield curve, creates profit opportunities that induce agents to "arbitrage" the yield curve, i.e., to borrow short at low rates and lend/invest long at higher rates. This strategy tends to flatten the interest rate structure. To keep it on a positive slope, so that bank credit expansion remains profitable, the Fed will have to maintain, or even accentuate, the tone and direction of its monetary policy (Frank Shostak 2000). If the central bank were to abandon its loose monetary policy, the slope of the yield curve would tend to level off again and the benefits of arbitrage would cease.

If loose monetary policies persist, interest rate differentials will continue to spur long-term bank credit to pay for an increasing accumulation of investments in the early stages of the intertemporal production structure. At the same time, low interest rates will discourage savings and boost household indebtedness. The divorce between savings and investment plans caused by the arbitrary manipulation of interest rates will multiply long-term investment errors. These errors will have to be detected and corrected by the market in the recessionary phase of the business cycle.

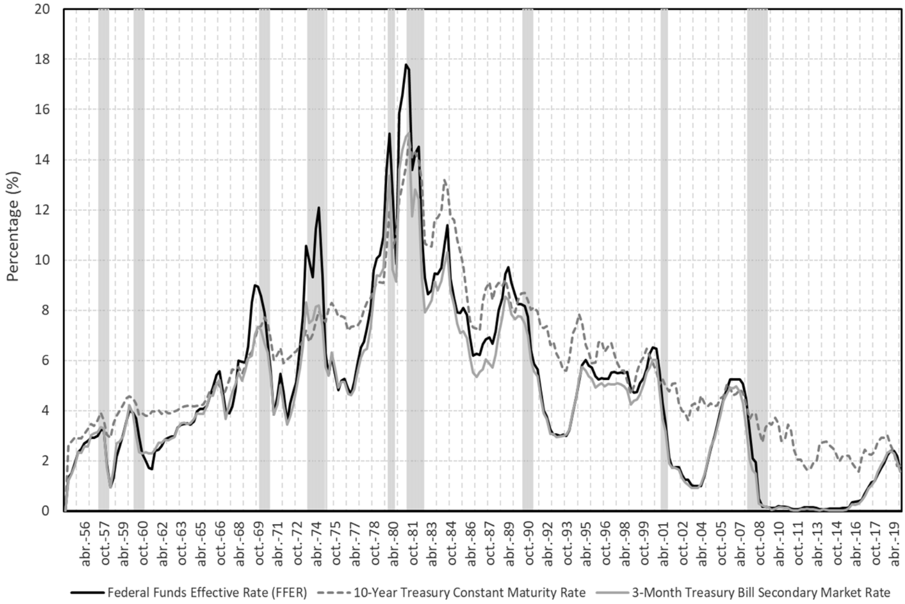
Recessions are the consequence of the misalignments between the intertemporal decision plans of producers and consumers provoked by expansionary monetary policies. On the one hand, the accumulation of long-term investments (the outcomes of which will only be visible in the future) and the short-termism of household consumption decisions (encouraged by cheaper loans), generate a problem of excess demand in the markets for immediate consumption goods. In this setting, the threat of inflation will force the central bank to modify the direction of its monetary policy and raise short-term interest rates. On the other hand, the scramble for limited resources between producers who demand funds to complete their long-term investments, and households who want to borrow to finance their current consumption expenditures, will put upward pressure on short-term rates. The sum of these two effects will lead to a flattening or reversal of the TSIR.

Each time the Fed changes the direction of its policy and raises short-term interest rates, several production activities that emerged in the preceding phase of monetary and credit boom come under pressure. However, the effects of monetary tightening are not automatically passed on to the whole economy, but are gradually shifted from one market to another. For this reason, changes in the TSIR slope have a "lagged" effect on economic activity, making this variable a good "leading indicator" of the cycle (Shostak 2000).

Figures 3 and 4 show how the changes in the slope of the yield curve, mainly depend on changes in monetary policy, rather than on private investors' expectations, according to Ben S. Bernanke (2006) or Krugman (2008). Concerning this issue, Shostak (2000) and Murphy (2021) argue that expectations only reinforce the slope of the TSIR, which represents the Fed's monetary policy stance. Thus, the three-month interest rate, which is entirely driven by the Fed's management of the federal funds effective rate, spikes to meet or exceed the ten-year rate, resulting in a flattening or inversion of the TSIR before each recession since the 1950s. In other words, in the quarters preceding these recessions, the slope of the yield curve flattened or inverted because short-term rates spiked due to tight monetary policy, and not because investor expectations triggered a collapse in long-term rates. This regularity has been particularly important in the recessions experienced since 1980 (Griggs and Murphy 2021; Murphy and Cwik 2023). This idea is fully consistent with the ABCT, which indicates that by slamming on the brakes of monetary policy and causing a tightening of credit, central banks exacerbate recessive processes.

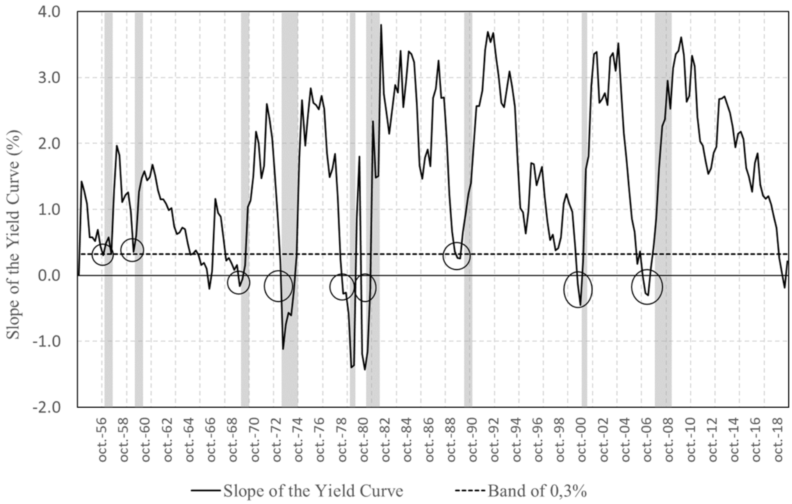
The same short-term rate declines over the course of recessions and in subsequent quarters, resulting in a rise in the slope of the yield curve. Given these results, Estrella (2005) and Adrian and Estrella (2008) claim that the slope of the TSIR is a more accurate indicator of the monetary policy stance than individual interest rates.

But is it the slope of the yield curve a leading indicator of the business cycle or a trigger for it? A flat or downward sloping TSIR tends to hurt bank profitability. With a positive yield curve, financial institutions make profits thanks to arbitrate the spreads between the yields they earn on their long-term assets (loans) and the interest rate they pay on their short-term liabilities (deposits). In this case, commercial banks may be more willing to increase lending activities and offer more credit to borrowers. However, if after a rise in the FFER the yield curve flattens or inverts, the arbitrage profits vanish (or turn negative) and the lending activities become unprofitable (Adrian, Estrella, and Shin 2010). At this point, banks will tighten credit access conditions to offset losses (Bruno De Backer, Marjolein Deroose, and Ch. Van Nieuwenhuyze 2019), eventually impacting the real economy.



Source: Own elaboration (based on FRED 2022)[1].

Figure 3 Short-Term and Long-Term Interest Rates in the Phases of the U.S. Cycle



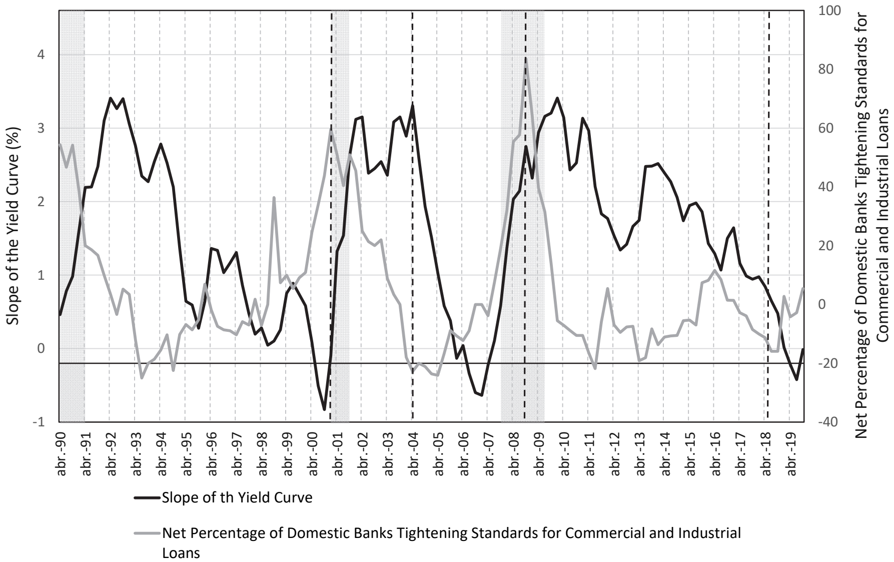
Source: Own elaboration (based on Federal Reserve Bank of St. Louis - FRED 2022).

Figure 4 Variations in the Slope of the Yield Curve in the U.S. Cycle

[1] **Federal Reserve Bank of St. Louis.** 2022. Data. https://fred.stlouisfed.org/ (accessed January 11, 2022).

Todd A. Knoop (2008, p. 124) explains three reasons why a rise in interest rates negatively affects banks' willingness to lend funds. On one hand, higher interest rates rise the debt-servicing burden on borrowers, making loan repayment more difficult. On the other hand, rising interest rates lead to an increase in the demand for loans from borrowers willing to take on riskier investment projects. Finally, borrowers who have already received a loan are encouraged to engage in riskier activities to deal with higher financing costs. For these reasons, raising banks' concerns about the risk of default during periods of sharply rising interest rates may make them reluctant to expand credit.

Figure 5 shows that in the stages of monetary laxity in the United States, identified by a rise in the long-short rate spread (April 1990-April 1993; April 2001-April 2004 and April 2007-April 2010), there is a large reduction in the net percentage of banks tightening the conditions of access to commercial and industrial loans. In contrast, in periods when monetary tightening is associated with a fall and subsequent reversal of the TSIR (April 1999-April 2001 and April 2004-April 2007), there is an upsurge in the net percentage of domestic banks raising credit access conditions. This happens in the quarters immediately preceding the onset of a recessionary cycle. Consequently, beyond signaling a recession, the reversal of the slope of the yield curve could cause it through its negative impact on the supply of available credit.



Source: Own elaboration (based on FRED 2022).

Figure 5 Changes in Yield Curve Slope and Banks Conditions for Access to Loans

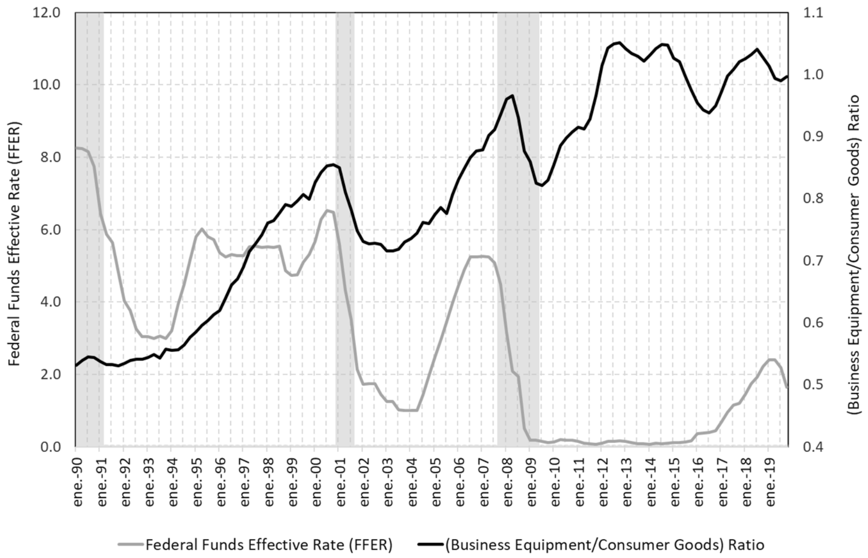
As in the previous case, where we studied the impact of shocks in the TMS on the slope of the yield curve, we now analyze the effect of changes in the TSIR on the lending policy of private banks. Due to data limitations, we cover the period 1990-2020Q1. After confirming that both time series (Figure 5) are stationary, I(0), we review the relationship between them. Granger causality tests (Table A3 in Appendix) reveal that the slope of the yield curve (SPREAD) Granger-causes the percentage of US banks (BANKS) tightening standards for commercial and industrial loans. In this case, we can observe that the causal relationship is bidirectional, meaning that the level of restriction in domestic bank credit also Granger-causes the slope of the yield curve.

Afterwards, estimating a first-order vector autoregressive model (VAR(1)) with a constant term (Table A4), where the lag order is determined by using the SIC information criterion, confirms the bidirectional relationship between these variables. The impulse-response functions of Figure A2 shows that a positive shock in SPREAD (an increase in the slope of the yield curve) has a statistically significant negative effect on the percentage of US banks tightening credit standards. However, this impact tends to dissipate after the eighth quarter.

Lastly, it can be observed that a rise in the net percentage of US banks tightening credit access has a statistically significant positive effect on the slope of the yield curve, which suggests the countercyclical nature of Fed's monetary policy. As in the previous case, this effect tends to dissipate after the eighth quarter.

3.2 The Fed's Monetary Policy and the U.S. Production Structure

Finally, Figure 6 relates the Fed's monetary policy stance – proxied by FFER – to the U.S. production structure. As discussed in previous sections, ABCT explains that in periods of monetary laxity, low interest rates promote the accumulation of longer-term, capital-intensive investment projects in the early stages of the production structure (aimed at the creation of capital goods) to the detriment of the later stages (oriented



Source: Own elaboration (based on FRED 2022).

Figure 6 FFER Variation and Production Structure of the U.S. Economy towards the production of consumer goods). These extremes of the capital structure, and their relative weight within it, are proxied by the *capital goods production/consumer goods production ratio* of the U.S. Industrial Production Index.

In line with ABCT, Figure 6 shows that a FFER downgrade through its impact on the TSIR and bank credit expansion generates a lagged increase in the production ratio. On the contrary, in the quarters following a tightening of monetary policy (with a rise in FFER) there is a large decline in the ratio while the economy enters recession. Therefore, it can be concluded that the Fed's decisions have a "lagged impact" on the U.S. production structure consistent with the movements of the Hayekian triangle (Figure 2). In this sense, as the basis for further research that goes beyond the scope of this paper, it may be relevant to deep into the study of this relationship by using econometric tools such as VAR models or Almon polynomial distributed lag models (Shirley Almon 1965).

4. Conclusions

ABCT explains that the origin of boom-bust business cycles is to be found in the spread between natural rates of interest and monetary rates caused by artificial processes of monetary and credit expansion.

A credit expansion encouraged by lax monetary policies of central banks reduces monetary interest rates and triggers a boom in long-term wrong-investments, incompatible with the availability of real resources and the intertemporal consumption preferences of households. The distortions in the production structure, the lack of coordination between consumption and investment plans, and the inflationary pressures caused by the laxity of monetary policy, force the central banks to reverse their monetary strategy, restrict credit expansion and raise short-term rates. It is then that the investment errors induced by the abundance of cheap credit come to the surface, and the artificial boom scenario leads to a severe adjustment process.

Although there is no direct measure of the Wicksellian natural rate of interest, the academic literature usually assumes that ten-year government bond rates represent a good proxy. These are defined as long-term rates that do not respond to central bank policies and therefore reflect to a greater extent the economy's rates of time preferences. Indeed, while central banks exercise precise control over short-term rates, their ability to govern long-term interest rates is much more limited and imprecise. This is the main reason why the slope of the yield curve signals the course and intensity of monetary policy.

If this result is coupled with the fact that the slope of the yield curve anticipates with great reliability the economic cycles of countries such as the United States, Germany, or the United Kingdom (Wheelock and Wohar 2009), the monetary and credit origins of the boom-bust business cycles of the last decades can be deduced.

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Appendix

Table A1 Does TMS Growth Granger Cause Ten-Year-Three-Month Yield SPREAD?

Pairwise Granger causality tests. Sample: 1987M01 2020M01 (monthly data)

***H*₀: TMS does not Granger cause SPREAD**			***H*₀: SPREAD does not Granger cause TMS**		
Lags	F-Statistic	p-value	Lags	F-Statistic	p-value
1	20.5207	0.0000	1	6.29532	0.0125
2	12.6147	0.0000	2	0.35347	0.7025
3	8.76401	0.0000	3	0.61045	0.6086
4	5.50755	0.0003	4	0.13787	0.9682
5	4.35515	0.0007	5	0.32704	0.8966
6	3.51327	0.0021	6	0.21721	0.9712
7	3.21502	0.0025	7	0.33272	0.9388
8	2.63540	0.0081	8	0.53351	0.8312
9	2.44083	0.0105	9	0.56926	0.8223
10	2.47247	0.0071	10	0.45024	0.9206
H_0 is rejected: TMS Granger-causes SPREAD at least with a 0.05 level of significance for all the lags from 1 to 10.			H_0 is accepted: SPREAD does not Granger-cause TMS for all the lags from 1 to 10 (except for lag 1).		

Source: Authors' calculations.

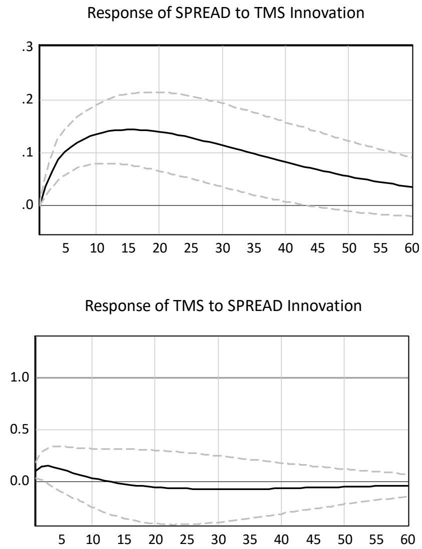
Table A2 VAR Model

Vector auto-regression estimates.
Sample (adjusted): 1987M03 2020M01
Included observations: 395 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	SPREAD	TMS
SPREAD(-1)	1.225006	-0.021043
	(0.04870)	(0.17961)
	[25.1557]	[-0.11716]
SPREAD(-2)	-0.276395	-0.018173
	(0.04787)	(0.17656)
	[-5.77392]	[-0.10293]
TMS(-1)	**0.046107**	1.396446
	(0.01280)	(0.04722)
	[3.60165]	[29.5753]
TMS(-2)	**-0.035840**	-0.413184
	(0.01296)	(0.04781)
	[-2.76486]	[-8.64193]
C	0.015878	0.168489
	(0.02000)	(0.07377)
	[0.79386]	[2.28391]
R-squared	0.966175	0.977086
Adj. R-squared	0.965828	0.976851
Sum sq. resids	17.29122	235.2290
S.E. equation	0.210562	0.776628
F-statistic	2784.971	4157.481
Log likelihood	57.43492	-458.1113
Akaike AIC	-0.265493	2.344867
Schwarz SC	-0.215128	2.395233
Mean dependent	1.708937	6.862278
S.D. dependent	1.139056	5.104389
Determinant resid covariance (dof adj.)		0.026210
Determinant resid covariance		0.025550
Log likelihood		-396.7080
Akaike information criterion		2.059281
Schwarz criterion		2.160012
Number of coefficients		10

Source: Authors' calculations.

Response to Chlesky one S.D. (d.f. adjusted) Innovations
± 2 analytic asymptotic S.E.s



Source: Authors' calculations.

Figure A1 Impulse-Response Functions

Table A3 Does the Slope of the Yield Curve (SPREAD) Granger-Cause the Net Percentage of Domestic Banks Tightening Standards for Commercial and Industrial Loans (BANKS)?

Pairwise Granger causality tests. Sample: 1990Q01 2020Q01 (quarterly data)

***H_0*: SPREAD does not Granger cause BANKS**		
Lags	F-Statistic	p-value
1	15.0446	0.0000
2	6.16840	0.0029
3	4.53790	0.0049
4	3.45278	0.0107
5	3.07384	0.0125
6	2.65997	0.0194
7	2.77798	0.0111
8	2.88999	0.0063
9	2.33109	0.0205
10	1.93472	0.0454

H_0 is rejected: SPREAD Granger-causes BANKS at least with a 0.05 level of significance for all the lags from 1 to 10.

***H_0*: BANKS does not Granger cause SPREAD**		
Lags	F-Statistic	p-value
1	30.3098	0.0000
2	8.13641	0.0005
3	4.97963	0.0028
4	4.04020	0.0043
5	3.42831	0.0066
6	3.57360	0.0030
7	2.82778	0.0099
8	1.96046	0.0597
9	1.53434	0.1474
10	1.31150	0.2365

H_0 is rejected: BANKS Granger-causes SPREAD at least with a 0.05 level of significance for all lags from 1 to 7.

Source: Authors' calculations.

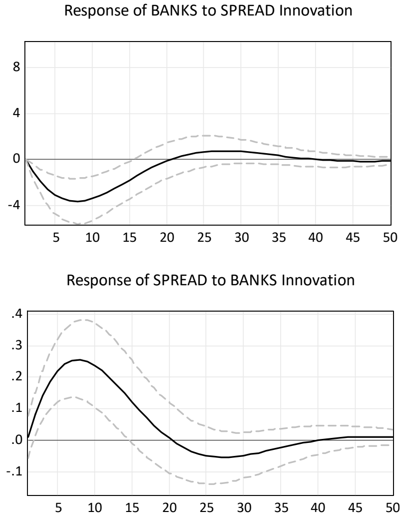
Table A4 VAR Model

Vector auto-regression estimates.
Sample (adjusted): 1990Q2 2020Q1
Included observations: 120 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	BANKS	SPREAD
BANKS(-1)	0.879303	**0.007943**
	(0.03623)	**(0.00144)**
	[24.2724]	**[5.50543]**
SPREAD(-1)	**-2.880046**	0.943464
	(0.74252)	(0.02957)
	[-3.87873]	[31.9038]
C	5.138583	0.056066
	(1.54937)	(0.06171)
	[3.31657]	[0.90860]
R-squared	0.840320	0.898228
Adj. R-squared	0.837590	0.896488
Sum sq. resids	9658.386	15.31973
S.E. equation	9.085720	0.361853
F-statistic	307.8578	516.3116
Log likelihood	-433.5580	-46.77160
Akaike AIC	7.275967	0.829527
Schwarz SC	7.345654	0.899214
Mean dependent	4.653333	1.730500
S.D. dependent	22.54517	1.124700
Determinant resid covariance (dof adj.)		10.79921
Determinant resid covariance		10.26600
Log likelihood		-480.2755
Akaike information criterion		8.104591
Schwarz criterion		8.243966
Number of coefficients		6

Source: Authors' calculations.

Response to Chlesky one S.D. (d.f. adjusted) Innovations
± 2 analytic asymptotic S.E.s



Source: Authors' calculations.

Figure A2 Impulse-Response Functions