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The Term Structure of Savings, the Yield Curve, and Maturity Mismatching

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ABSTRACT: Recognizing different types of savings allows for a more fruitful analysis of the business cycle. Sustainable investment activities must be financed by an equivalent amount of savings, both in length of availability and quantity. Upward-sloping yield curves are a feature of the unhampered loanable funds market. Interest rates differ along this curve depending on the investment community's demand for funds. While free market maturity mismatching can be successful and advance intermediation, the existence of either a central bank or a fractional reserve banking system skew the yield curve, resulting in malinvestment-fueled boom-bust cycles. Credit expansion alone fails to explain the full extent of these cycles. Additional causes of the business cycle are found via excessive maturity mismatched borrowing driven by three banking sector interventions: credit expansion, the provision of a lender of last resort, and government bailout guarantees.

KEYWORDS: business cycles, recession, term structure of interest rates, monetary policy

JEL CLASSIFICATION: E02, E3, E43, E52

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INTRODUCTION

Are all savings alike? Or must we distinguish different acts or types of savings? Recognizing the diversity of savings allows for new aspects of investment sustainability to be assessed.

Many Austrian economists treat the act of saving as homogenous (i.e., Roger Garrison, 2001; Steven Horwitz, 2000; Murray Rothbard, 2004).[1] Some economists regard monetary savings as a homogenous fund in a similar way as some treat capital as a homogenous fund.[2] Treating capital as a homogenous fund that automatically reproduces itself and abstracting from its time dimension has led to erroneous conclusions. We contend that regarding savings as a homogenous fund without a time dimension similarly obstructs and confuses the view of important theoretical and practical issues.[3] There is a term structure of savings and a subsequent term structure of investing that align, optimally, with consumers' plans.

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[1] One recent exception is Philipp Bagus (2010). In distinction, much "mainstream" literature has focused on the specific heterogeneity of savings—both in type and longevity. J. M. Culbertson (1957) provided the foundation for the segmented markets theory of interest rates, arguing that bond issuances of different maturities are not perfectly substitutable and cannot be arbitraged. Guillermo Calvo's (1998) "sudden stop syndrome" and subsequent literature focuses on the dangers of short-term funding in light of a possible liquidity crunch. Hyun Song Shin (2009) treats the September 2007 bank run on British bank Northern Rock as an unconventional run of short-term financing not being rolled over to support its longer-term lending operations. John Maynard Keynes (1936) distinguished between not only the more well-developed time preference as a source of savings, but also liquidity preference as a categorizer of this savings destination—both in kind and time to maturity. While Austrian economists have delved into the question of *what* savings are, many others have filled a theoretical gap by assessing whether all savings are created equally.

[2] John Bates Clark (1893, 1895, 1907), Irving Fisher (1906), and Frank Knight (1936) famously argued that capital is a homogenous and self-reproducing fund. Alternative viewpoints can be found in Eugen von Böhm-Bawerk (1959), Friedrich Hayek (1936) and Fritz Machlup (1935), who argue that capital is heterogeneous and depreciating.

[3] To save means to abstain from consumption. Monetary savings give buying disposition to goods and services, having their counterpart in unconsumed goods and services. These savings can be either saved on demand, or invested in corresponding capital goods. The process of savings allows the creation of roundabout, or lengthier, investment process—transforming savings into a subsistence fund to sustain investment projects to completion.

Many works neglect the time dimension of savings completely, following from the implicit assumption that any monetary savings are the same. Garrison's (2001) graphical representations of Austrian business cycle theory (ABCT) deal with one aggregate market of loanable funds, while neglecting the specific maturities of those funds. Rothbard (2004, p. 388) depicts a single market on which the interest rate is determined. These representations imply a homogenous supply of future goods, lacking a time dimension.[4]

While these considerations are important first-order approximations of the problem of time market coordination, reality is more complex. There exist loanable funds markets of different maturities which yield different interest rates. Distinct interest rates for different maturities give rise to the yield curve.

In this article we disaggregate the loanable funds market and take into account the time dimension of savings of different maturities. This step allows us to more adequately deal with the problem of maturity mismatching that remains hidden when savings are assumed homogenous.

THE TIME DURATION OF SAVINGS AND INVESTMENTS

ABCT provides a connection between real savings, the production process and credit expansion.[5] Credit expansion of a fractional reserve banking system artificially lowers the interest rate below the level it would have been otherwise. This lower interest rate

[4] Tyler Cowen (1997, pp. 92-105) attempts to reconcile the "traditional" ABCT with a loanable funds market incorporating both a "quantity or value dimension and a time dimension." Short rates signal how much individuals are saving in the present, while long rates represent the length that entrepreneurs expect these savings to prevail before being converted to consumption. While positing that declines in short rates unaccompanied by comparable declines in long rates should signal the impermanence of the increases in savings availability, Cowen misses an important point raised by Mises (1943, pp. 251-52): interest rates need not be visibly depressed compared to other periods to fool investors of their sustainability. They need only be lower than they would have been in the absence of an inflationary monetary environment.

[5] For classical contributions to Austrian Business Cycle Theory see Hayek (1929, 1931), Ludwig von Mises (1971, 1998), and Rothbard (2000, 2004). Substantial recent additions to ABCT include Jörg Guido Hülsmann (1998), Garrison (2001), Philipp Bagus (2007, 2010), Jesús Huerta de Soto (2009) and David Howden (2010).

no longer reflects the real amount of available savings (i.e., the subsistence fund). Entrepreneurs are deceived into thinking that a greater supply of savings is available.[6] They engage in more and lengthier investment projects than can be undertaken profitably with the available supply of real resources. A bust ensues when it becomes obvious that not all investment projects can be completed successfully. A healthy recession sets in, as malinvestments are liquidated and the economy returns to sustainability.

The time dimension of savings, and its relation to the duration of investments, may have been neglected in the existing Austrian analysis of business cycles because it is implicitly contained in the subsistence fund, which lasts for a certain time. To use the standard Böhm-Bawerkian example, Robinson Crusoe accumulates fruit savings to sustain him until his investment project (producing a capital good) is complete (Eugen Böhm-Bawerk, 1959, book 2, ch. 4).[7] During the time of the investment project, there will always be the temptation for Crusoe to alter the planned consumption of the accumulated fruits—either by depleting them faster, or by lengthening their sustainability. By abstaining from or curtailing the consumption of the fruits, Crusoe is effectively continually renewing his savings.

Alternatively, he might decide to consume the rest of his savings before he has completed the project, due to hunger or celebration, as examples. By consuming his savings prior to the completion of his investment, Crusoe has failed to "roll over" his savings and keep them available for another day. He must start saving berries again or he will not be able to continue his investment project. Matching savings and investment maturities is relatively unproblematic for Crusoe, as he operates autonomously as both the consumer that saves, and the capitalist who invests. He can assure himself that

[6] Huerta de Soto (2009, p. 422) asserts that money's homogeneity complicates the process as entrepreneurs cannot distinguish between real and artificial "savings." Howden (2010) elaborates on this point, by demonstrating that the fractional reserve banking system masks the inflationary process, creating difficulties for later receivers of money to understand its source—both in kind (real savings versus fiduciary media) and magnitude (that portion which is represented by real savings versus the amount created by the fractional reserve system).

[7] It should be pointed out that it is not necessary to save a subsistence fund before the start of the investment project. The savings can occur *during* the investment project.

he will roll over his savings until his investment matures. Crusoe controls directly both the portion of income that he saves, as well as the portion of accumulated savings that he consumes. He can adjust these portions to enable him to further his investment project.

Situational complexity increases when Crusoe's companion Friday enters the picture. To match the duration of savings to investment Crusoe and Friday could set up a company with an initial equity capital of 100 berries. The advantage of this situation is that they can now control the subsistence fund, as it is locked into the company. This alleviates the temptation to consume the stock of berries (i.e., savings) prior to the completion of their project.

There is an alternative situation in which the investors do not directly save for themselves, but rather elicit savings from external sources. In this simple example, Friday could loan Crusoe the berries that are necessary for his production process. Let us consider two scenarios.

First, Crusoe secures a loan of 100 berries from Friday. The loan must be repaid within a period of 100 days plus an interest payment of 10 berries. This will sustain him until the production of the capital good is finished (90 days) and he has produced sufficient fruits or other goods to pay Friday—the principal plus the interest (10 days). The terms of the secured savings and the period until the investment project is expected to mature (to repay the loan) are matched.

Second, Crusoe secures a loan of 100 berries from Friday that he must repay in 50 days plus 5 berries of interest. Crusoe knows that in 50 days the project will not be complete, and that this possibility of paying back the loan at that point is impossible. He might speculate that Friday will renew his loan for another 50 days once the first loan becomes due, thus increasing the available duration of his savings, and allowing Crusoe to complete his project and later make the applicable loan repayments.

This is a risky undertaking, as Friday might not renew (or roll over) his loan after the 50-day period, or only do so at a very high interest rate. As people are always saving up for something (Garrison, 2001, chapter 3), it is probable that Friday has only initially loaned the berries for the shorter period as he expects a

better opportunity to present itself after 50 days.[8] Friday may have saved for 50 days and not longer because new opportunities may present themselves in the future for these savings to be directed to.[9] Lacking any better alternatives, Friday will renew the loan to Crusoe at the end of its duration.

Alternatively, Friday could have saved for 50 days because in 50 days he has already planned a consumption activity—he will adopt a pet and use the berries to feed his new favorite animal. Furthermore, with the additional interest paid to him from Crusoe for loaning the berries for 50 days, Friday will be able to eat an extra portion. After 50 days, if no better future opportunity entices Friday to renew his loan (i.e., feeding his pet is the best use of his available savings), Crusoe will not be able to complete his project unless he starts saving himself. The only way that Crusoe will be able to continue production in this example is to compensate Friday for the use of Friday´s savings and curtail his own consumption.

The availability of savings at the initiation of the investment is not the sole concern facing the entrepreneur. The duration of savings' availability must also be accurately gauged, lest either 1) projects be left unfinished or liquidated after the savings are not renewed, or 2) consumption will be curtailed to complete projects if savings are not made available for the duration previously estimated (i.e., later savings will need to be increased). In other words, there may be malinvestments caused by maturity mismatching based upon an erroneous anticipation of future savings.

MONETARY SAVINGS AND THE YIELD CURVE

Not only do entrepreneurs wish to utilize savings during specific periods, modern financial products allow a plethora of

[8] Böhm-Bawerk (1901) presages this desire to save for only a limited period—Crusoe's savings are not an absolute renunciation, but rather a decision to not consume *yet*—a waiting for better opportunities to present themselves.

[9] More correctly stated, Friday has only invested for 50 days due to the uncertainty inherent in the future investment opportunities. Not knowing what opportunities will be available in the future, Friday feels comfortable only saving for a specific time to make these future possibilities available if they arise and are discovered by him. If no better opportunity presents itself, Friday may feel comfortable rolling over his savings for another period.

options to do so. There are monetary savings granted as loans of 3 months to 30 years, invested in 10-year corporate bonds or in an equity investment of unlimited maturity. This implies that there are several loanable funds' markets operating at any given time.[10] The same nominal amount of monetary savings offers a different yield depending on its maturity. These distinct interest rates form the yield curve, which normally slopes upward.[11] There are two reasons for this.

First, *ceteris paribus*, savers are only willing to forgo the availability of their funds for a longer period in exchange for a higher interest rate than is offered for short-termed investments. Imagine that there is option A to save and invest for 10 years risk-free with an annually compounded interest rate of 10 percent and option B to save and invest for 5 years risk-free with the option to renew the investment after 5 years for an additional 5 years with an equal annually compounded interest rate of 10 percent. *Ceteris paribus*, actors prefer option B. This is due to the universal and *a priori* category of time preference. Actors prefer to achieve their ends sooner rather than later. They prefer to have higher liquidity sooner rather than later. This liquidity allows them to confront possible problems or exploit opportunities that may arise in an uncertain world. Actors will forgo liquidity longer only if a higher interest rate is offered.[12]

[10] The heterogeneity of goods based on distinct maturities raises problems for the traditional loanable funds model: "Loans for different terms are however presumably different goods; there is a family of different interest rates, not one interest rate. It is therefore only a provisional and unsatisfactory simplification if we treat loans as one good. The task of defining loans in an appropriate way remains to be performed" (Rosenstein-Rodan, 1936, p. 280).

[11] Yield curve inversion may occur due to an increasing desire for short-term funds coupled with a lack of corresponding supply as uncertainty entices savers to move from short-dated maturities into cash. Paul Cwik (2005, pp. 21-33) places the burden of inversion on the high demand for short-term funds on the eve of the bust, as entrepreneurs face the realization that the subsistence fund is insufficient to complete all projects. Those projects that can be completed in the shortest amount of time (i.e., only requiring short-term financing) are chosen to be completed, pushing up short-term yields relative to the longer end of the yield curve. This imbalance is mitigated during the recession as investors liquidate investments, thus reducing demand for short-term funding.

[12] One might respond that option B is chosen because the option to renew has value and not because of time preference. The question is, however, why someone

Moreover, there is a tendency that counterparty risk increases with maturity. Due to uncertainty, longer-term loans have a higher chance of not being paid back than shorter-termed loans. Savers prefer therefore to grant shorter loans.[13]

Second, entrepreneurs are willing to pay a higher interest rate for longer-term loans than for shorter-term loans to compensate for less uncertainty. An entrepreneur will choose, *ceteris paribus*, a loan with the same maturity as an investment project to one that he will have to renew until the investment project matures, provided they are offered at the same interest rate.[14]

This is implied by the inherent human aversion to uncertainty. Uncertainty aversion is implied in the category of human action whereby actors use means to attain uncertain ends—they want to remove felt uneasiness in the most assured manner possible (Mises, 1998, p. 14). Actors try to avoid any uncertainty that might keep them from removing felt uneasiness. Uncertainty aversion is, thus, an *a priori* concept of action.

Uncertainty is increased if an entrepreneur takes a short-term loan to finance a long-term project as there is the possibility that it will not be renewed, or renewal will come at a higher rate. He prefers, *ceteris paribus*, loans to match or even exceed the project's expected duration. The demand for longer-term loans and their interest rate tends to be higher as a result; the yield curve is sloping upward.

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would value the option to renew. Lacking time preference, an investor would not prefer to be liquid sooner to later, the value of the option would be zero and he would be indifferent between options A and B. It is because of time preference that the option to renew the loan acquires value.

[13] Astute readers may notice, as one referee did, that we allude to two existing explanations for an upward sloping yield curve—the segmented markets and liquidity preference theories. Aside from these empirical tendencies, we demonstrate on *a priori* grounds that time preference and an aversion to uncertainty are sufficient to explain why, *ceteris paribus*, longer-dated yields are higher than shorter-dated ones. Further scrutiny may find many similarities between Culbertson (1957) and our two justifications for higher long-term interest rates. Closer inspection finds Culbertson relying on the empirical tendency of expectations concerning changes in the future price level affecting long-term debt yields, as well as liquidity preference theory.

[14] Here *paribus* refers most importantly to a situation where no changes in the purchasing power of money, economic output or time preference are expected.

The upward sloping yield curve implies that marginal savers and investors agree on higher interest rates for a longer term than for a shorter term. *A priori*, future goods (less certain goods) have progressively less value than present goods (more certain goods). It is a mistake to think that this difference in yields for different maturities can be arbitraged away in the real world. Rothbard (2004, pp. 445–50) correctly argues that in the evenly rotating economy the yield curve would be flat, arguing that there is a "tendency for short-term and long-term rates to be equal," induced by an "irresistible arbitrage movement" (*ibid*., p. 447). Equilibrium in the evenly rotating economy is such an unreal construct that it is difficult to apply its conclusions to the real world.[15] Such a conclusion would rely on goods across maturity spectrums being perfectly substitutable. Cash needs—both certain and uncertain—are heterogeneous across borrowers, giving rise to differences in the suitability of available loans (Culbertson, 1957, pp. 492–93). The further spectrum of expectations concerning future debt availability across the yield curve will also give rise to differing (although not elucidated *a priori*) bidding for funds of different maturities (*ibid*., p. 501).

Time preference and uncertainty aversion are both *a priori* categories of action. The ERE excludes, by definition, uncertainty from occurring—all future events are perfectly anticipated, leading to no preference between distinct savings' maturities. While economists are quick to point out that money as a medium of exchange would fail to prevail in equilibrium, they have generally neglected the associated conclusion that all maturities will be equally supplied and demanded for—entrepreneurs will be unable to differentiate or prefer one temporal dimension for another.[16]

In the real world with uncertainty and time preference, there is a tendency towards a rising yield curve. Even if borrowers and lenders expect no changes in economic data to occur, the possibility

[15] Howden (2009) stresses that the ERE must not be used beyond its original limitations: the separation of entrepreneurial profit from pure interest.

[16] As Paul Davidson points out, there is a neglect in modern economics concerning the disparities that may exist between present and future savings (2002, p. 77). In general equilibrium, as all contracts are paid for in full at initiation, or a perfect futures market ensures that all settlements are fully offset, there is no room for disconnect between these two components—present and future savings.

of unforeseen change alone is sufficient to cause uncertainty. There consequently arises a demand for liquidity sooner rather than later.

ARBITRAGING THE YIELD CURVE—MISMATCHING MATURITIES

As the yield curve is normally rising, there is an incentive for entrepreneurs to arbitrage this price disparity. There is a profit opportunity by borrowing short at low interest rates and investing long at a higher rate. The problem with this strategy is that the short-term loans must be renewed continually until the investment matures. When, for instance, a company starts an investment project that will amortize after 10 years, it might choose between a 10-year loan at 10 percent or, alternatively, a 1-year loan at 5 percent and roll it over until the investment project amortizes. This latter strategy is more profitable, but apparently riskier.[17] If the issuing company faces liquidity issues in the meantime, there might be no one to renew the loan. Alternatively, interest rates might rise during the project's duration affecting realized profits.

A financial intermediary might borrow short and lend long by continually rolling over their borrowings, relying on the correct anticipation of the future availability of savings for success. In a free market there is no general reason why one would systematically under- or overestimate the future availability of savings, and thus, the possibility to roll over loans (Bagus, 2010). These intermediaries fulfill an important function: by assuming the risk of the operation, they make short-term savings available for longer-term projects. Longer-term and more productive investment projects may be undertaken, thanks to the mismatched maturities enabled by an intermediary.[18]

[17] One strand of literature sees this practice as fundamentally fraudulent, leading to an oversubscription of property rights (Barnett and Block, 2009). Bagus and Howden (2009a) demonstrate that there is nothing fraudulent with the practice of maturity mismatching when the distinction of present versus future goods is taken into account. They do stress that the practice is fraught with peril, and greatly expanded when undertaken in conjunction with a fractional reserve banking system.

[18] Machlup (1932) argues that additional short-term funds tend to be invested for the long-term as submarginal long-term investments become profitable due to a

There is, however, the possibility of *individual* entrepreneurial error. Entrepreneurs might overestimate the availability of future savings. They may not be able to roll over their debt, revealing the malinvestment that stems from the overestimation of the resource availability. They will have engaged in an investment project without securing in full the funds necessary for its completion, similar to Robinson Crusoe in our previous example. When Friday does not roll over Crusoe's loan, Crusoe cannot complete the investment project and may be forced to liquidate it. Malinvestment and intertemporal discoordination result—the time structures of individual plans are not coordinated. The time preference and savings of Friday, expressed by his unwillingness to roll over the savings and to consume the previously available fruits, are not coordinated with the length of the production project undertaken by Crusoe. Crusoe, who may have correctly estimated the *amount* of available savings, has overestimated the *duration* of those savings and undertaken a project that cannot be sustained to completion.

If not faced with perverse incentives, there is no reason for entrepreneurs to overestimate systematically the future amount of savings. Just as an unhindered natural rate of interest allows for coordination between investment and consumption activities, unhindered interest rates for distinct durations allow for coordination between investment durations and the corresponding availability of savings. The structure of savings tends to match the structure of investments.[19]

Moreover, several mechanisms restrict the amount of maturity mismatching by intermediaries on a free market. Competitors might lend to a bank on a short-term basis and suddenly stop rolling over their savings. Speculators might pursue the same strategy by

reduction of interest rates. He (283–84) points out that this is not problematic when "[t]here is a continuous prolongation and turnover of the short-term loans and short-term investments…. We therefore reach the conclusion that private *short-term* capital is, in the system as a whole, either—by a permanent succession of savers—long-term capital, or—without this succession—not true capital at all."

[19] Rosenstein-Rodan (1936, pp. 173–74) clarifies the two sides of monetary equilibrium in light of both value and temporal dimensions of interest rates. On the one hand, savings must be balanced against the demand for consumers' goods, while on the other investment in capital must balance the production of consumers' goods (or circulating capital). See also Gunnar Myrdal (1939, pp. 22–23).

shorting the stock of the bank. Customers may be instigated by speculators and competitors to not roll over their savings, instead turning them to alternative avenues (i.e., consumption or equity investments). In other words, by organizing a run on the short-term liabilities of a mismatched agent, money may be earned and the agent forced into bankruptcy. This threat severely restricts maturity mismatching.[20]

MATURITY MISMATCHING AND CLUSTERS OF ERRORS

A fractional reserve banking system coordinated and supervised by a central bank reduces the risk of maturity mismatching (i.e., potential insolvency) considerably. This leads to excessive maturity mismatching, with detrimental effects for the coordination of individual savings and investment plans (Bagus, 2010). Excessive maturity mismatching is defined as lending funds for a longer-term than can be financed by rolling over short-term funds. Excessive maturity mismatching also implies a growing instability of the financial system that becomes ever more dependent on the eventual rollover of short-term funds. Matching maturities rules out these kinds of liquidity problems. There are several reasons for a reduction in the risk of the mismatched undertaking.

First, credit expansion of the fractional reserve banking system increases the availability of funds. During a credit expansion there is a continually increasing money supply that enters the economy through the loan market. The additional supply makes it less risky to find loans to roll over in the future as debts become due.

Second, the central bank periodically increases the availability of funds to roll over. In the case of an emergency, when a financial

[20] A debt holder may obtain products to insure against detrimental effects of maturity mismatching. Credit default swaps (CDS), for example, could be bought to insure against the future eventuality of an insolvency inducing rollover freeze. Investors will still only lend money in the first place if they believe that the debtor will be able to repay it in the future. The existence of a CDS does not give the debtor carte blanche to undertake a greater amount of maturity mismatching than would otherwise be the case. In fact, by purchasing a CDS and raising its price, the CDS spread on the debtor's borrowings tends to rise. The maturity mismatcher will pay higher interest rates, eventually losing the confidence of the market. Thus, purchasing credit default swaps will actually entice a borrower to mismatch securities less. (Bagus and Howden, forthcoming)

intermediary cannot roll over its debt, the central bank may step in and provide emergency loans. A fiat money system potentiates the capacity of the central bank to provide emergency loans.[21] If a central bank temporarily increases liquidity to assist an illiquid maturity mismatcher, the mismatcher will be more irresponsible: moral hazard results. Central banks greatly increase liquidity in the loan markets, making the business of borrowing short and lending long increasingly less risky.[22] In fact, banks may use their long-term assets (long-term investments) in order to secure short-term loans directly from the central bank. When problems emerge rolling-over short-term loans, they can use their long-term assets as collateral to receive funds from the central bank. In a fiat monetary system, a central bank as a lender or roller over of last resort can simply and effortlessly create those funds. Hence, the existence of a central bank enhances maturity mismatching by aiding financial institutions faced with troublesome situations.

Third, implicit and explicit bailout guarantees of particular financial institutions by the government may exist. The moral hazard problem in light of bailouts not only entices entrepreneurs to undertake riskier investments, but also to increasingly detach their investment durations from their funding durations, as explained by Mises (1971, p. 263) furthering the work of Karl Knies (1876, p. 242). Some institutions are considered too big to fail, assuming that their failure would adversely affect others due to the connectivity of financial institutions. Other institutions may

[21] It should be pointed out that in a fractional reserve commodity standard, credit expansion faces harsher limits than in a fractional reserve fiat money system, but still allows for this credit forming facility.

[22] This has come to be seen as the primary function of the modern banking industry (see, for example, Xavier Freixas and Jean-Charles Rochet [2008, p. 4]). While maturity transformation is considered today as a prime function of banking this has not always been so. One referee asserts that since the creation of the demand deposit, the business of banking has been borrowing short (taking on deposits) and lending long. Notable counterexamples abound. The Bank of Amsterdam, maintained "for all intents and purposes" a 100-percent cash reserve from 1609–1772 (Huerta de Soto, 2006, pp. 98–101). The Bank of Stockholm (the Riksbank) originally began operations in 1656 with two separate departments—one for 100-percent reserve deposits, and one for loans (Charles P. Kindleberger and Robert Z. Aliber 2005, p. 69). The creation of central banks, fiat money and government guarantees have contributed to the eradication of the golden rule of banking (which demands a matching of maturities) during the 20th century.

have an explicit guarantee from the government or are actually state-owned. These institutions tend to behave more irresponsibly and engage heavily in the risky but highly profitable business of maturity mismatching under the assurances that profits will be forthcoming, while insolvency losses are mitigated.

Due to these state-born incentives, in our present financial system there exists a tendency towards excessive maturity mismatching. Financial institutions exploit the yield curve to a degree more extreme than under a system free of bailout guarantees (whether implicit or explicit). Borrowing short at a low interest rate and lending long at a higher interest rate makes a handsome profit while externalizing the downside risks to society through credit expansion, central bank money creation and government interventions.[23] Borrowing short and lending long implies an additional demand for short-term funds and an additional supply of long-term funds. The demand for short-term funds by the banking system leads to upward pressure on short-term rates. The increased supply of long-term funds leads to a downward tendency for long-term rates. As a result the yield curve is artificially flattened. Credit expansion adds its own effect by lowering interest rates across all terms.[24]

More significantly, due to the reduction in the differential spread, savers tend to reduce their long-term savings in favor of shorter-terms.[25] Artificially low long-term interest rates may mislead

[23] One salient feature of the present crisis has been central banks' interventions at the long end of the yield curve. Both the Federal Reserve and the European Central Bank have extended the maturities of the loans granted to the banking system, as well as broadening the terms of acceptable collateral (Bagus and Schiml, 2009; Bagus and Howden, 2009b, 2009c).

[24] Although rates at the long end of the yield curve face a counteracting upward pressure due to increased inflation expectations (Cwik, 2005, pp. 6–9). Commenting on the elasticity of interest rate expectations, Mises (1943) notes that it is not necessary that interest rates across all durations are equally lowered, only that they are lower than they were before. The conventional ABCT story has one interest rate being lowered—implying that all interest rates are lowered equally. We demonstrate that maturity mismatching causes not all rates in the structure of savings to be equally lowered.

[25] This effect is similar to the phenomenon of overconsumption in some branches (i.e., Misesian) of Austrian business cycle theory. As interest rates are reduced artificially, there is overconsumption. Due to maturity mismatching, the spread between long and short-term interest rates is reduced artificially leading to an "over-shortening" of savings.

entrepreneurs concerning the real amount of available long-term savings contained in the term structure of savings. As long-term interest rates are artificially reduced, more investment projects (especially long-term projects) appear to be profitable. Longer duration projects are more affected by a reduction in long-term interest rates than are shorter projects. Credit expansion lowers the absolute level of the yield curve—propagating a "traditional" Austrian business cycle—while maturity mismatching flattens it.

A secondary effect arises as prices of capital goods tend to increase due to the reduction of long-term interest rates. Prices of capital goods tend towards the present value of their discounted future cash flows. As these cash flows are capitalized at lower rates, the present value of the goods producing them will tend to increase. In particular, interest rates have a greater impact on fixed capital values than working capital (Machlup, 1932; Cwik, 2008). Capital goods are produced mainly for the higher stages of production. Thus, as entrepreneurs try to lengthen and broaden the structure of production, it becomes more capital intensive. These changes in the structure of production are partly financed by excessive maturity mismatching.

With no counteracting change in the base time preference rate, there can be no increase in real savings. Changes to the term structure of savings alone cannot sustain changes in the structure of production. People are not willing to wait increasingly longer to resume consuming. They originally desired to save until some future point where they would consume, and do not wish to roll over the short-term savings until new projects mature. As a result more investment projects are undertaken than can be completed successfully. Not only are investments not aligned with social time preference rates and available savings, they are not even aligned with their specific maturities. The term structure of savings and the term structure of investments have become discoordinated. A business cycle ensues.

Lacking adequate savings for the terms of the projects, these malinvestments must be liquidated. But when exactly will the recession set in? Two cases may be distinguished. In the first, the disturbance directly affects productive ventures. In the second case, financial intermediates first enter distress and only later affect productive enterprises.

In the first case, companies finance additional long-term investments with short-term loans. This is the case of Crusoe getting a short-term loan from Friday. Once savers fail to roll over the short-term loans and commence consuming, the company is illiquid (assuming other savers also curtail their lending activities). It cannot continue its operations to complete the project. More projects were undertaken than could be completed with the finally available savings. Projects are liquidated and the term structure of investments readapts itself to the term structure of savings.

In the second case, companies finance their long-term projects with long-term loans via a financial intermediary. This financial intermediary borrows short and grants long-term loans. The upper-turning point of the cycle comes as a credit crunch when it is revealed that the amount of savings at that point in time is insufficient to cover all of the in-progress investments. There will be no immediate financial problems for the production companies when the rollover stops, as they are financed by long-term loans. The financial intermediaries will absorb the brunt of the pain as they will no longer be able to repay their short-term debts, as their savings are locked-up in long-term loans. The bust in this case will reverberate backward from the financial sector to the productive sector. As financial intermediaries go bankrupt, interest rates will increase, especially at the long end of the yield curve, lacking the previous high-degree of maturity mismatching driving them lower. Short-term rates will also increase due to a scramble for funds by entrepreneurs who try to complete their projects. This will place a strain on those production companies that did not secure longer-term funding, or rule out new investment projects that were previously viable under the lower interest rates. Committed investments will not be renewed at the higher rates.

Several effects trigger the readjustment of the structure of production to the structure of savings that occurs during the liquidation phase of the business cycle.

First, when people do not roll over short-term savings and start demanding consumer goods, consumer goods industries will demand factors of production which had been used previously in an effort to broaden and lengthen the structure of production. Thus, prices of input factors tend to increase, making the new projects financed by maturity mismatching relatively more expensive.

Second, consumer goods' prices tend to increase (relative to prices of producers' goods) when the rollover stops and consumption increases. Actually, consumer goods' prices may even start to rise before the rollover stops. This arises as the term structure of savings has an influence on prices. A person whose savings mature in 3 months (making him liquid) bids differently for goods and services than a person who granted a 20-year loan and whose savings are illiquid for the whole duration. The person who is liquid in 3 months is able to confidently purchase consumers' goods, assured that their coming liquidity will be able to cover the interim expenses.

Consequently, consumer goods' prices start to rise relative to producer goods´ prices when the maturity of short-term savings approaches.[26] Because of the increase in consumer goods' prices, profits in consumer goods industries rise relative to profits in the sectors in the highest stages of production that expanded due to maturity mismatching. Entrepreneurs abandon projects in the higher stages and resources re-shift toward stages nearer consumption.

Third, long-term interest rates start to increase when the initial depressing effect of maturity mismatching ends, i.e., when maturity mismatching slows down. Previously committed projects still require financing, leading to a scramble for funds, whether short-term or long-term. This relatively steady demand causes the long-term rate (coupled with the reduced supply) to rise, as people do not roll over short-term savings but consume. The additional artificial supply of long-term loans will be reduced.

Furthermore, short-term rates tend to increase even more as the lack of long-term funding creates a high demand for short-term funds to roll over loans and complete projects. This may actually lead to an inverted yield curve. As interest rates increase, projects that appeared to be profitable at lower rates will fail to remain profitable. The increase in interest rates negatively affects capital-intensive industries and longer duration projects. The highest stages of production that were initially lengthened by maturity mismatching are the most affected. Due to these effects, it becomes obvious that not all investment projects can be finished due to a

[26] We assume here that savers' demand to hold cash balances are fulfilled and unchanged.

lack of real savings. As investments were not adapted to the term structure of savings, they will be liquidated.

The liquidations in the real economy also affect the financial sector as it incurs losses due to malinvestments. Loans will not be repaid and collateral assets will lose value, reducing equity. Solvency problems further complicate the rolling-over of short-term debts. The rollover stoppage and its subsequent losses incurred by the financial sector combine to create solvency and liquidity problems.[27] If the sector is interconnected and strongly engaged in the business of borrowing short and lending long a crisis in the financial sector will augment the one already afflicting production-based industries.

CONCLUSION

The term structure of savings is an important though oft-neglected concept. The term structure of savings indicates the length of time until consumers want to increase their consumption. While there is always the possibility that existing savings will be renewed, there is no guarantee. This makes the business of maturity mismatching risky. On the free market, there will always be maturity mismatching to some extent as entrepreneurs try to anticipate future savings availability. Arbitrageurs earn a profit by shouldering the risk of mismatching and arbitraging between terms.

Excessive maturity mismatching discoordinates the term structure of savings and the term structure of investments (the time structure of individual savings and investment plans). Three phenomena foster excessive (i.e., nonsustainable) maturity mismatching: credit expansion, the existence of a lender of last resort and government bailout guarantees. Excessive mismatching caused by government interventions leads to an unsustainable misalignment of the term structures of savings and investments. As a result, financial institutions unsustainably borrow short and lend long. Long-term

[27] This rollover risk can be mitigated, although aggregate risk exacerbated, in the present fractional reserve banking system as banks can use demand deposits to finance short-term liabilities. It is no longer necessary in such a system for banks to attract short-term savings to finance longer-dated loans, as they can rely on the demand deposit base "entrusted" to them to fund these mismatched liabilities.

interest rates are reduced artificially and more long-term investment projects are undertaken than there will be real savings available to fund them. An unsustainable boom ensues.

Credit expansion alone does not always explain fully the severity of business cycle discoordinations. To better understand the occurrence of malinvestment, we must analyze the maturity mismatching that contributed to it and account for the importance of the time structure of savings—specifically as it pertains to the sustainability of the structure of production.

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