Maturity mismatching and the natural yield curve

WORKING PAPER

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Abstract

This paper deals with a new discord in the Austrian economic theory about the effects of maturity mismatching practiced by banks on the shape of the yield curve and defines the not yet established concept of the natural yield curve. The conflicting contributions of Austrian authors are compared for that purpose. Based on this comparison, a coherent theory of the effects of maturity mismatching is presented in a framework of the loanable funds market. A definition of the natural yield curve is then produced by a synthesis of the above-mentioned findings and the Austrian theory of the natural rate of interest. Theoretical research leads to the conclusion that one form of maturity mismatching inevitably results in an Austrian business cycle.

Keywords: maturity mismatch, yield curve, natural rate of interest, Austrian school

JEL: B53, E43, G21

Introduction

A business cycle is an economic phenomenon which influences the well-being of wide classes of society. Economic downturns result in unemployment, decreasing welfare and political turbulences that have the potential to endanger the very stability of democratic regimes. This provides a sufficiently strong incentive to answer what causes business cycles and how they could be prevented. Mainstream economics identifies a central bank's monetary policies and government's fiscal policies to be the remedy for the economic ill of booms and busts. However, more than one hundred years after the establishment of the most influential central bank, the US Federal Reserve System, we still experience the burden of reoccurring busts.

An alternative approach is offered by the Austrian business cycle theory (ABCT). It finds the workings of the central bank and the commercial banking sector to be the source of economic fluctuations. In ABCT, it is firmly established that commercial banks cause business cycles when they hold only fractional reserves against demand deposits. Credit expansion and a consequent decrease of the market rate of interest below the natural rate of interest leads to clusters of entrepreneurial errors, which inevitably end in a bust.

Two pairs of Austrian economists Bagus and Howden, and Barnett and Block argue that fractional reserve banking is not a necessary condition for the Austrian business cycle (ABC) to occur. While their findings are far from unified, they jointly suggest that maturity mismatching practiced by financial intermediaries is a sufficient condition for the development of the ABC. This uncovers the lack of a time dimension in the Austrian perception of saving and in the concept of the natural rate of interest. If we wish to eradicate the monetary based business cycle, it is necessary to study maturity mismatching and to broaden the concept of a single natural interest to its term structure, and in other words, a natural yield curve needs to be defined.

The yield curve has proved to be one of a few usable predictors of a financial crisis. If we find what fundamentally drives the shape of the yield curve, we can think of ways how to prevent or smooth out the business cycle. Thus, the aim of this paper is to clarify the debate between the above-mentioned economists, to come up with a coherent theory explaining how maturity mismatching influences the shape of the yield curve and to define the natural yield curve.

This paper has the following structure. The first section introduces the topic of maturity mismatching. The second section explores the impact of maturity mismatching on the shape of the yield curve and connects it with the business cycle phenomenon. A definition of a natural yield curve and its significance in the ABCT is presented in section three. The fourth section provides empirical evidence on basic assumptions regarding the practice of maturity mismatching by the banking sector.

1. Maturity mismatching

Despite earlier mentions, the question of the maturity mismatching legitimacy was first opened by economists Barnett and Block (2009a), from now on referred to as B&B. Banks support the loans they grant not only with demand deposits, but with time deposits also. It is important to realize that time deposits are not in fact deposits but loans given to banks by their clients. Therefore, I will analyze the mismatch between the maturity of loans that banks take in and the loans they lend out.

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Maturity mismatching can be done in two distinct ways (ibid.). Firstly, a bank (B) borrows money from a client (A) for a longer time, then is the time for which it lends the money to a third party (C). This practice is called BLLS – borrow long lend short (see Fig. *1* – BLLS). Secondly, a bank borrows money from a client for a shorter time than for which it lends the money to a third party. This practice is called BSLL – borrow short lend long (see Fig. *2*).

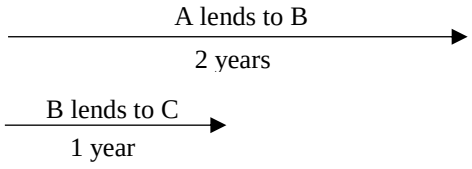

Fig. 1 – BLLS

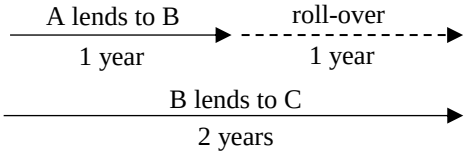

Fig. 2 – BSLL

The latter practice is the one of significance since it involves the need for rolling over bank´s debt otherwise it goes bankrupt. BSLL is therefore much riskier than BLLS. It can be paralleled to the fractional reserve banking. When banks hold fractional reserves, they count on that depositors do not withdraw all their funds at one time. If this happened, it would be equivalent to a maturity mismatching bank that is unable to roll over its debt by finding new lenders or convincing the current ones to prolong their loans.

The legitimacy of the BSLL practice was covered in other articles by B&B and by a second pair of economists Bagus and Howden (B&H), but that is not the focus of this paper. The objective here is to determine whether BSLL has necessarily a negative impact on the economy or not.

2. Maturity mismatching and the business cycle

The idea that fractional reserve banking (FRB) together with other ensuing factors leads to the development of a business cycle is firmly imbedded in the Austrian theory. But is it possible that maturity mismatching alone could cause a business cycle? Firstly, I overview the basic propositions of the ABCT. Then, I present B&B's and B&H's suggestions of how BSLL influences interest rates.

2.1. Austrian business cycle theory overview

It is out of the scope of this paper to fully explain and defend the ABCT. However, the further investigation of BSLL's effects on the economy is based on the ABCT and its use of the natural interest rate. Thus, the basic notion has to be at least briefly introduced.

The loanable funds market is a place which by its nature coordinates consumers' inter-temporal consumption plans with the inter-temporal structure of production. The interest rate equilibrates both the demand and supply side of this market and in effect facilitates this coordination. The natural interest rate would emerge as a market interest rate in a barter economy, where money does not create any disturbances. However, the use of a medium of exchange can cause a divergence of the market interest rate from the natural interest rate.

Banks holding fractional reserves against demand deposits can increase the money supply by issuing fiduciary media.[2] This causes the market interest rate to fall below the natural level of interest rate that would otherwise prevail in the absence of credit expansion (Garrison, 2001). An artificially low interest rate induces investment that would not be otherwise profitable. These so called malinvestments are indicative of the boom phase of the business cycle. The surplus of saving over real saving is forced saving, which temporarily supports the increased investment activity.

At this point the inter-temporal structure of production does not correspond to the inter-temporal consumption plans. According to the ABCT this mismatch is unsustainable and inevitably leads to a crisis during which the malinvestments are liquidated. The problem is not too much investment, but investment that does not correspond to inter-temporal consumer preferences. The production structure has been altered due to an artificially low interest rate in a way that would deliver more consumer goods in a more distant future, despite the fact that people want to consume sooner.

[2] Fiduciary media are "demandable bank claims that are not 100 percent backed by bank reserves of basic money..." (Selgin and White, 1996, pp. 83-84).

The most important points for our further inquiry are the following. Production ideally has a structure that matches the inter-temporal preferences of consumers. The market interest rate has to coincide with the natural interest rate in order to achieve such production. Therefore, a divergence of the market interest rate from the natural interest rate corrupts its ability to coordinate consumption and production inter-temporally. If the interest rate is too low, then producers falsely believe that people prefer future consumption relatively more and malinvestment is created.

2.2. BSLL and shifts of the yield curve

As was previously described, the ABCT identifies an increase in the money supply to be the primal cause of the business cycle. BSLL does not lead to an expansion of the money supply in the way that issuance of fiduciary media does; therefore, it should not cause a business cycle.

Nevertheless, this is not correct according to B&B (2009b, p. 466) and they present us with the following situation. Imagine an economy where banks do not exist as intermediaries between lenders and borrowers. Subject A wishes to lend money to somebody for **2 years with a 3%** p.a. interest rate. Subject C wants to borrow money for **10 years with 5%**. In the absence of a bank subjects A and C would have to negotiate the terms of a loan themselves. Let's say that A would be willing to extend the maturity of the loan to **10 years** only if C paid him an interest of **7%**. In contrast with that, a bank practicing BSLL would simply borrow money from A and lend the sum to C, under the assumption that 2% spread would be profitable. Of course, the bank would have to roll over its debt in two years. B&B (ibid., p. 467) infer: *"…that upon the entry of the mismatched time deposit bank, interest rates for any loan of any given length of time will be lower than would otherwise prevail."* This decrease in interest rate is supposed to be the cause of the ABC. This downward shift of interest rates for all maturities (according to B&B) is depicted by the blue yield curve ($YC_{B\&B}$) in Fig. 3.

B&H (2010, p. 73-82) studied the arbitrage along the commonly increasing yield curve (YC) and stated the following. Financial intermediaries practice BSLL for a purpose of such arbitrage and rely on estimates of future availability of savings. In a free market environment, there is no reason why entrepreneurs[3] should systematically under or overestimate this future availability of funds and consequently their ability to roll over their debts. Yet, an individual overestimation and the inability to roll over debt can occur. An ABC should not develop, as long as nothing systematically deforms the judgment of market agents. On top of that, there are market mechanisms that restrict the magnitude of BSLL. Competition could lend to a bank and then stop rolling over the debt. At the same time, it can short stocks of the bank. Therefore, disabling the bank from rolling over its debt would be profitable (ibid.).

However, the current system is not undistorted like the one described above. Today there is an intervening central bank and rules are set in such a way which leads to the excessive practice of BSLL. *"Excessive maturity mismatching is defined as lending funds for a longer-term than can be financed by rolling over short-term funds"* (Bagus and Howden, 2010, p. 75). A central bank performs the role of a lender of last resort in most cases when commercial banks have problems with rolling over debts. Furthermore, fractional reserve banking causes a credit expansion, which increases the money supply. This growth of money supply makes rolling over easier. There is also a possibility of government bailouts.[4] These three factors significantly lower the riskiness of BSLL under its natural level (ibid.; Bagus, 2010). Because of that banks exploit differences in interest rates along the yield curve to an unnaturally large extent.

Fig. 3 illustrates my interpretation of B&H's theory (ibid., p. 77). The black YC_0 represents the situation without financial intermediaries, where borrowers and lenders negotiate directly. BSLL creates additional demand for short term and an additional supply of long term loans. The additional demand creates upward pressure on the short end of the yield curve (orange arrow, left of maturity X), whereas, additional supply creates downward pressure on the long end of the yield curve (orange color, right of maturity X). Combined effect of the two flatten the yield curve (ibid.). The resulting yield curve is $YC_{B\&H}$. Change in the slope is associated with a reduction of long term saving in favor of short term savings (e.g. the average maturity of time deposits is shortening).

[3] Entrepreneurs in general can roll over their debts. Banks are only a subcategory.

[4] When banks anticipate a bailout, they are motivated to take on interest rate risk and mismatch maturities of assets and liabilities (Diamond, Dybvig, 1983, p. 417).

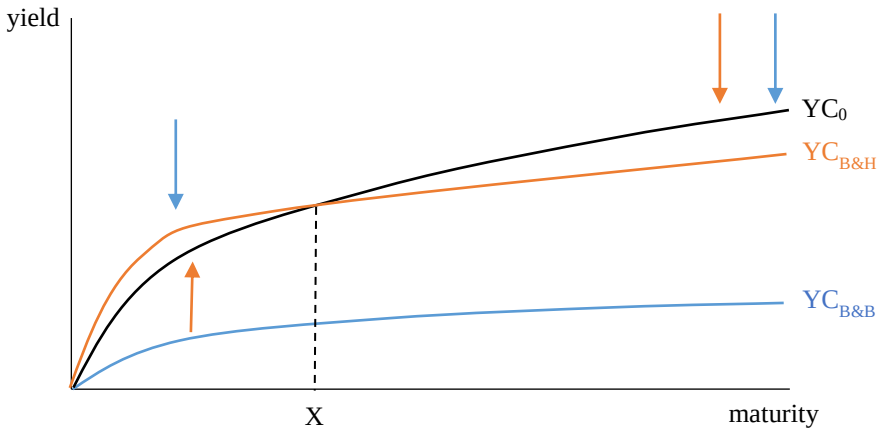

Fig. 3 - The impact of BSLL on the yield curve

Flattening of the yield curve can be interpreted as pivoting. This interpretation gives space for a more specific description of the shift. It suggests an existence of a pivot point, which lies at maturity X and divides the horizontal axis into short and long maturities. Banks arbitrage loans across this point from the short-term spectrum of maturity to the long-term spectrum.

Entrepreneurs influenced by lower long-term interest rate succumb to the illusion that more long term real savings exist. Investment projects that otherwise would not be profitable materialize. However, there cannot be an increase in real savings without a change in time preferences. Investment projects that cannot be finished are the result (B&H, 2010, p. 78). How does the artificial boom end? It happens after people are no longer willing to roll over their savings and start to demand consumer goods. A detailed description of this process can be found in B&H (ibid., p. 79-81).

The expectations of B&B and B&H regarding a yield curve shift due to BSLL are in conflict. B&B expect the whole curve to shift down. B&H (ibid., p. 78) expect a downward shift of the whole yield curve only in case of a credit expansion (caused by fractional reserve banking), not of BSLL. However, in both cases, the resulting yield curve shifts and a misallocation of resources can be expected.

3. Natural yield curve

Austrian school economists commonly refer only to a single interest rate in the economy. They built up the theory of the business cycle using a single natural interest rate. Time has been used in the definition of capital ever since Böhm-Bawerk. It is obvious that loans of different maturities are despite the same per annum interest rate two different loans. It is then necessary to embody the term structure of the natural interest rate into the Austrian theory.

However, there has been an important attempt at integrating the term structure of interest into the ABCT by Cwik (2004 and 2005),[5] where the term "natural yield curve" was mentioned once (Cwik, 2004, p. 102) in context of a very precise assertion that will be supported at the end of this section.[6] However, his approach is distinct from the one used in this paper. Cwik addressed the question of why does the yield curve tend to invert prior to recession, which is not the ultimate goal of this paper. In addition, he abstracts from BSLL (Cwik, 2004, p. 121fn) and explains yield curve's behavior in the current system of fractional reserve banking and government interventions. Specifically, Cwik assumes that a monetary injection increasing money supply initiates the ABC. In contrast, in this paper the effect of BSLL that does not increase the money supply is isolated.

Before establishing what the natural yield curve is, one specific issue needs clarification. B&H as well as B&B do not write about a natural yield curve *per se* in their papers. However, they state that changes of interest rates for some or all maturities, in other words shifts of the yield curve, can cause an ABC. A yield curve can be described as a term structure of interest rates. This is reminiscent of how the Austrian school uses the natural interest rate to explain the business cycle. On that basis, I establish the term *natural* yield curve, which can be described as a term structure of *natural* interest rates. The position of a natural yield curve is discussed below.

3.1. Position of the natural yield curve

We can see a conflict between the theories of B&B and B&H. According to B&B the practice of BSLL lowers the whole yield curve (YC). This fall of interest rates under the natural interest rates should cause an ABC. On the contrary, according to B&H

[5] McCulloch (1981) was another economist who investigated the interconnections between the term structure of interest and the ABCT.

[6] *"As long as the market yield curve differs from the equivalent of a "natural yield curve," entrepreneurs will change their production practices and create malinvestments"* (Cwik, 2004, p. 102).

lowering of the whole YC happens only during credit expansion, whereas BSLL leads to its flattening. Furthermore, B&H (Bagus and Howden, 2010 and Bagus, 2010) think that if calculations of market agents are not distorted by a government or a central bank, BSLL should not cause an ABC. This gives us three options regarding relative positions of an original YC and a YC influenced by the practice of BSLL: *first*, a YC that lies under the original for all maturities; *second*, a YC that is flatter than the original caused by increased yields for short maturities and decreased yields for longer maturities; and *third*, a YC determined by excessive BSLL that is flatter than the second YC.

In order to analyze these possibilities, I will show how the BSLL manifests itself in a loanable funds market. We need to realize that there is not a single loanable funds market. To simplify the exposition, I will work with three representative markets (see Fig. 4).

Firstly, there is a short-term market determining the interest rate for loans of short maturities. Secondly, there is a market for long-term loans determining the interest rate for loans of long maturities. Thirdly, there is a market for loans of maturity X that divides the continuum of maturities on short and long. It is an empirical task to show what interval of maturities falls under which market. In other words, to show where the maturity X lies. For our purposes, it is sufficient to say that short-term maturities are the ones used by financial intermediaries as a source of funds for long-term loans, whereas long-term maturities are the ones where savings are channeled.

There are differences in supply and demand functions across these markets. Market for maturity X will not be discussed explicitly at times where its characteristics are deducible from the other two.

Demand for loanable funds is relatively lower in the short-term market than in the long term one (see Fig. 4). This is represented by a rightward shift of the demand curve, when we transition from the short-term market to the long term one. There are different fundamentals driving this divergence. Entrepreneurs prefer long term loans ceteris paribus to short term ones, because they increase certainty (B&H, 2010, p. 71). Therefore, an entrepreneur who wants to borrow a sum *m* is willing to offer a higher interest rate as a compensation for a longer maturity. Also, loans of longer maturities support investments creating more roundabout methods of production, which are more productive in comparison with less roundabout methods (Böhm-Bawerk, 1930, p. 84). For this reason, entrepreneurs investing into long term projects can afford to pay a higher interest rate and bid up the price of loanable funds on the long-term market.

Supply curves are also situated in different positions depending on the market (see Fig. 4). However, the changes are in the opposite direction than with the demand curves. The effect of which is lower quantity of funds supplied at the same interest rate when we transition to a market of a longer maturity. This can be explained by the Liquidity Preference Hypothesis (LPH).[7] Holding bonds is riskier for investors than holding cash due to the interest rate risk they have to face. Because of this discouragement from holding bonds there is a liquidity premium attached to them. The longer is the maturity the higher is the liquidity premium. This premium forms a supply side cause of the positive slope of the yield curve. Fig. 4 displays a linear yield curve. This simplification was done for the sake of a more direct presentation of BSLL's effect.

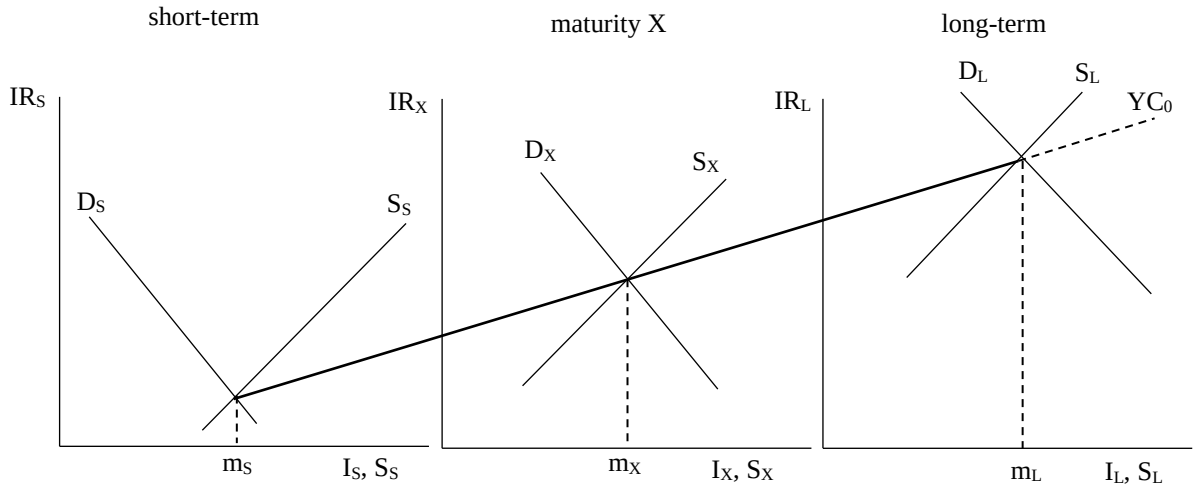

Fig. 4 - Loanable funds markets for different maturities

This framework enables us to show the fundamental forces shifting the yield curve when financial intermediaries practice BSLL. Fig. 4 depicts the initial situation without intermediaries practicing maturity mismatching. In this situation time preferences, and therefore the structure of saving, are aligned with the investment and production structure. An ABC does not develop in this setting.

Financial intermediaries entering the market will be motivated to exploit the price difference between short term and long-term markets. They demand additional loanable funds, shifting the demand curve in short term market and offer them on long term

[7] For a more detailed description of LPH see Cwik (2004, section 3.7).

market, shifting the supply curve. This increases IR_S and decreases IR_L. Fig. 5 shows a resulting rotation of the original YC_0 into the position of YC_{BSLL}, which is flatter. The reason why the interest difference is not arbitraged away completely is twofold – transaction costs and imperfect substitutability of loans with different maturities.[8]

B&B argued that upon the entry of a mismatched time deposit bank, all interest rates are lowered. This argument reveals itself erroneous, because, if we were to depict B&B's hypothesis, we would shift all supply curves on the loanable funds markets to the right, and that conflicts with the description of BSLL in the previous paragraph.

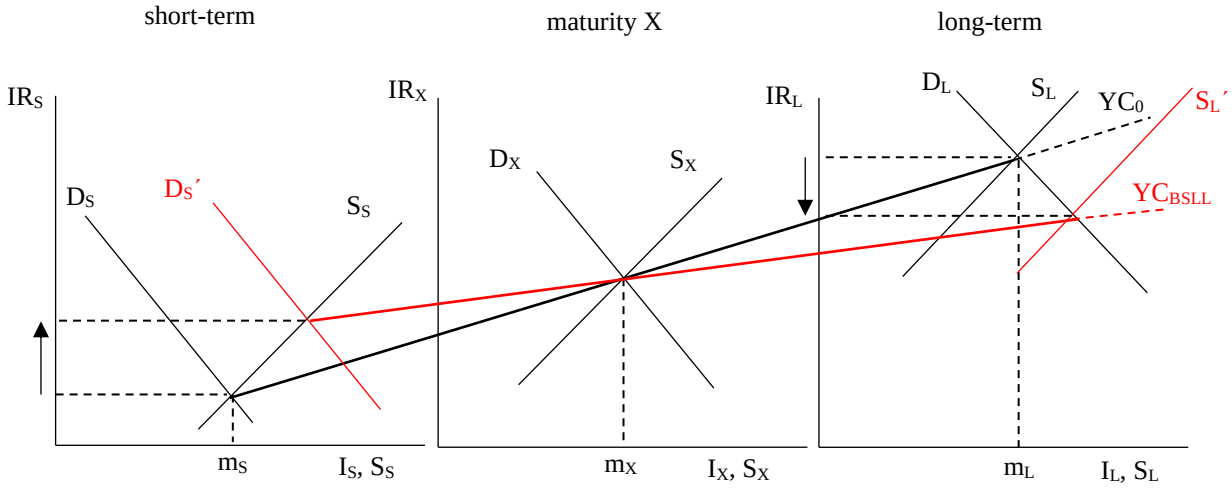

Fig. 5 - The effect of BSLL in loanable funds markets

The effect of BSLL described above corresponds to the theory of B&H. Thus, they are right about how the BSLL affects the yield curve. However, it is not clear in their argumentation what the position of the natural yield curve is supposed to be. In general, it should be a curve that is not associated with development of the ABC. The primal assumption is that a yield curve generated on a maturity matching market does not lead to ABC.

B&H (2010) suggest the existence of another yield curve that is not associated with the ABC. This yield curve is generated on a market where intermediaries practice BSLL and their estimations regarding future time preferences are not systematically distorted. BSLL is therefore limited by market forces to a "reasonable" extent, and it does not create an ABC. On the other hand, intermediaries can be motivated to further mismatch their loan portfolios by the lender of last resort or the possibility of a bailout. This sort of excessive BSLL is no more malign, because the mismatching does not correspond to an unbiased estimation of future saving and consumption anymore. These three yield curves are shown in Fig. 6 – original YC_0 (no maturity mismatching), YC_{BSLL} affected by maturity mismatching and YC_{exBSLL} created by excessive BSLL. The original YC_0 and YC_{BSLL} under (non-excessive) BSLL are potentially natural.

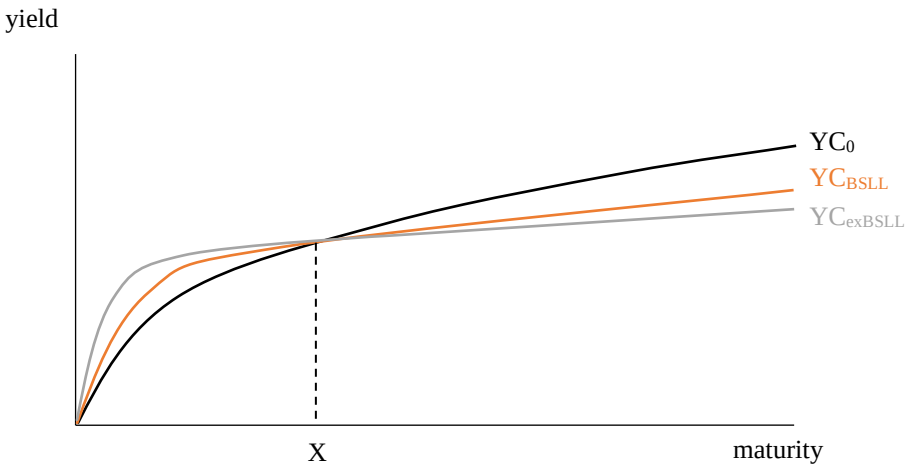

Fig. 6 - Shifts of the YC

[8] These two reasons are the building blocks of Preferred habitat theory (PHT). For explanation of the PHT see (Cwik, 2004).

B&H (2010) assert that BSLL can be practiced at a sustainable level unless it is magnified by a government or central bank's intervention. Bagus (2010) correctly links prediction of future availability of saving to prediction of future time preferences, since the former is determined by the latter. They use the example of Robinson borrowing berries from Friday to fund his project. Robinson borrows berries for a shorter time than is the length of his project. Therefore, Robinson is unable to repay in the time he originally agreed on with Friday. He either fails to finish his project or Friday rolls over Robinson's debt. Both these options are perfectly viable. Robinson can correctly predict the possibility of rolling over his debt or he can make an error. If he is right, he will finish the project. If he is wrong, the project will not be finished. It reveals itself to be a malinvestment, because the length of the investment did not match Friday's saving and dissaving pattern.

The same logic can be applied to a more complex economy. When BSLL is practiced *"the only way, the longer term projects could have been finished, would have been to continuously roll over the short term loans"* (Bagus, 2010, p. 14). Entrepreneurs are forecasting the future availability of loans for rolling over their debts.

We can draw a parallel between the prediction of future time preferences and the argument of large numbers that defenders of fractional reserve banking use. Although banks cannot predict withdrawals for individual depositors, they are supposed to find an optimal reserve to deposit ratio based on the law of large numbers. While, this law is applicable to the field of natural science, de Soto (2006, pp. 385-395) explains why it cannot be applied to the field of human action. In short, banks cannot use fractional reserves to protect themselves from withdrawals, because the very existence of fractional reserve banking sets in motion such processes (the boom phase of the ABC) that lead to a sharp, unpredictable increase of withdrawal requests in the future. The same is applicable to BSLL because its practice causes a boom in economic activity similarly to fractional reserve banking.

An implicit assumption of B&H's Robinsonian example, where Robinson and Friday represented maturity mismatching banks and their clients, has to be scrutinized. Why would Friday lend money for a project longer than is the maturity of the loan? He cannot know that his future time preferences will decrease, and there is not even a third party that could potentially roll over Robinson's debt. The setup of their example suggests that Friday did not know what is the purpose of the loan or at least how much time Robinson's project should take. There are two possible explanations. First, Robinson explicitly lied to Friday about the length of his project. This behavior should not survive on the free market in the long run. Honest financial intermediaries would be preferred by savers and would drive out dishonest ones.

Second, Friday apparently decided what interest rate he demanded without any further information about the risks involved. He did not know how Robinson planned to use the berries; nevertheless, he negotiated a certain interest payment. That is not a rational behavior and our theory cannot be based on it. In reality risks involved in a loan contract are evaluated and choice of the interest payment is based on information about the borrower and his plans. Both B&H and B&B make the same mistake in their theories by assuming that a lender would lend money to a maturity mismatching bank for the same interest rate as to a maturity matching counterparty. It is puzzling that they recognize the need of the lender to be compensated for the rising risks of longer maturity; yet they fail to recognize that lenders would demand a compensation for the risk involved in lending to a maturity mismatching agent.

Assuming no information asymmetry between banks (borrowers) and their clients (lenders), the choice of maturity mismatching would come at a price. Clients of mismatching banks would require higher interest payments on their time deposits than clients of matching banks. Therefore, the ability of banks to lower interest rates on long term loans is in theory hindered. Secretive banks, which would not disclose information to their clients, would be driven out of the competitive market. Matching banks would not generate profit from the interest rate gap that occurs between short and long maturities but rather from fees for their intermediating services. These fees could have the form of an interest rate spread; however, this spread would be applied to a single maturity.

Mises (1998, p. 439fn) claims, *"the notion of "normal" credit expansion is absurd. Issuance of additional fiduciary media, no matter what its quantity may be, always sets in motion those changes in the price structure the description of which is the task of the theory of the trade cycle. Of course, if the additional amount issued is not large, neither are the inevitable effects of the expansion."* Similarly, any degree of BSLL leads to its negative consequences, the severity of which is either unnoticeable, though not nonexistent, or severe enough to cause economic downturn that we would classify as a crisis. If deposits backed by fractional reserves are seen as certain as cash, then miscoordination ensues. The same is true for loans of different maturities. If the information symmetry condition is violated, thus long-term loans are perceived by the lenders as risky as loans of shorter term. In other words, they perceive them as less risky than they are, and BSLL and miscoordination of consumption and production plans arises.

The previously mentioned miscoordination can be demonstrated in our loanable funds framework (see Fig. 7). Natural YC_0 generated by original (fundamental) demand and supply curves D_S, D_L, D_X, S_S, S_X and S_L connects natural interest rates of the respective markets. New demand and supply curves produced by BSLL are by definition equal at new levels of interest rates (higher IR_S, lower IR_L). The same is not true for real investment I^R and real saving S^R. Original demand and supply curves represent real demands and supplies of loanable funds because entrepreneurial opportunities and savers' time preferences have not changed in either of these markets. Natural interest rates remained the same, despite the change in observable market interest rates. This deviation of the market yield curve from the natural yield curve causes an increase in short term real saving and decrease in short term real investment. The opposite is observed in the long-term market. Therefore, the production structure is altered in ways that produce less consumer goods in the near future and more consumer's goods in the distant future, which is in conflict with inter-temporal choices of savers whose saving and dissaving schedules reflect opposite consumption plans.

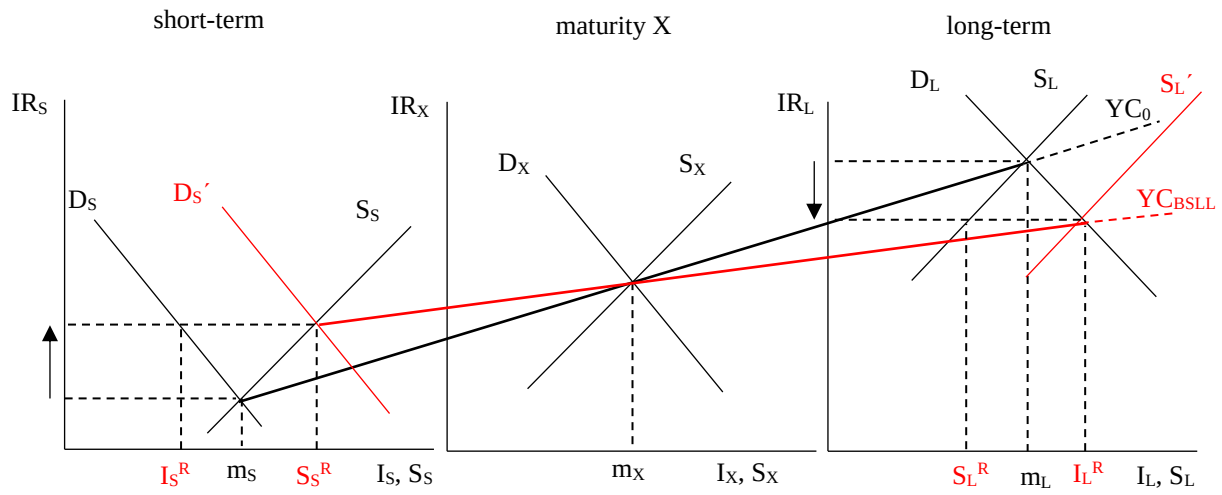

Fig. 7 - The mismatch of real saving and real investment

We can see that an increase in the money supply is not necessary to cause the ABC. B&B (2009b) claim that BSLL creates time *ex nihilo*. That is true. Banks practicing BSLL do not give the impression that more dollars were saved; they give the impression that saved dollars are saved for a longer time than they really are. This process could be viewed as a credit expansion in the time dimension. Entrepreneurs react to this false information by lengthening the capital structure, which in effect does not match the actual time preferences of the population. It corresponds to a fictitious population of more patient savers. Therefore, malinvestments occur and will be liquidated in the future.

In conclusion, any degree of BSLL causes malinvestment; therefore, the natural yield curve is the original YC_0 (see Fig. 5 and Fig. 6). The YC_{BSLL} and the YC_{exBSLL} are only quantitively different from each other. BSLL decreases real short-term investment and increases real long-term investments (see Fig. 7). Even if these two effects netted out in their quantity dimension, the investment would not match the saving in the time dimension. What applies to the natural interest rate in the ABCT also applies to the natural yield curve (term structure of natural interest). Thus, when the actual yield curve falls under or more generally deviates from the natural yield curve, an ABC develops.

4. Maturity mismatching in the data

The previous sections presented a theory which explains the effects of BSLL on the slope of the YC. A simple graphical analysis can be used to demonstrate the most underlying assumption that banks mismatch maturities when they perform loan intermediation. Graphs below (Fig. 8, Fig. 9 and Fig. 10) depict ratios of loans and term deposits of different maturities to the total volume of loans and term deposits.[9] Short term loans and deposits have a maturity shorter than one year. Medium term includes maturities between one and five years. Long term loans and deposits have a maturity longer than five years. Short term loans and deposits correspond to values of I_S^R and S_S^R from our loanable funds markets framework (see Fig. 7). Long term loans and deposits correspond to values of I_L^R and S_L^R.

If there were no maturity mismatching and no fractional reserve banking, fractions of loans and term deposits should be in theory equal for all maturities, because short term deposits would be used by banks for granting short term loans etc. Fig. 8 shows that the ratio of short term deposits is persistently higher than the ratio of short term loans. The opposite is observed for the fraction of long term loans which is higher than the fraction of long term deposits (see Fig. 10). This is in accordance with the findings presented at the end of section 3 in Fig. 7. In addition, medium term loans and deposits are relatively equalized, which supports the existence of a loanable funds market with maturity X. Volume of real saving and investment (loans granted by banks) does not diverge in this market when banks practice BSLL. Therefore, the data suggest that maturity X lies between one and five years.

[9] These graphs are based on data from the Czech banking sector. Only loans and deposits made in CZK are counted.

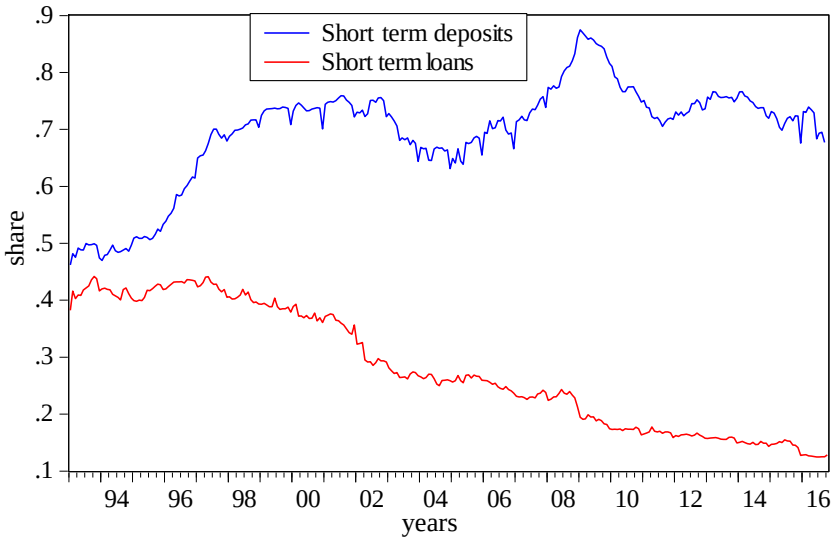

Fig. 8 – The development of the share of short term loans and short-term deposits on the total volume of loans and term deposits (1993-2016)

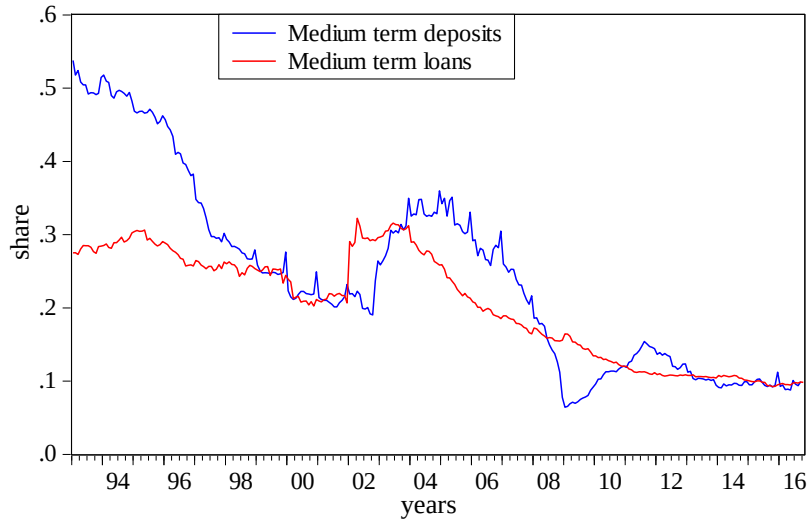

Fig. 9 - The development of the share of medium term loans and medium-term deposits on the total volume of loans and term deposits (1993-2016)

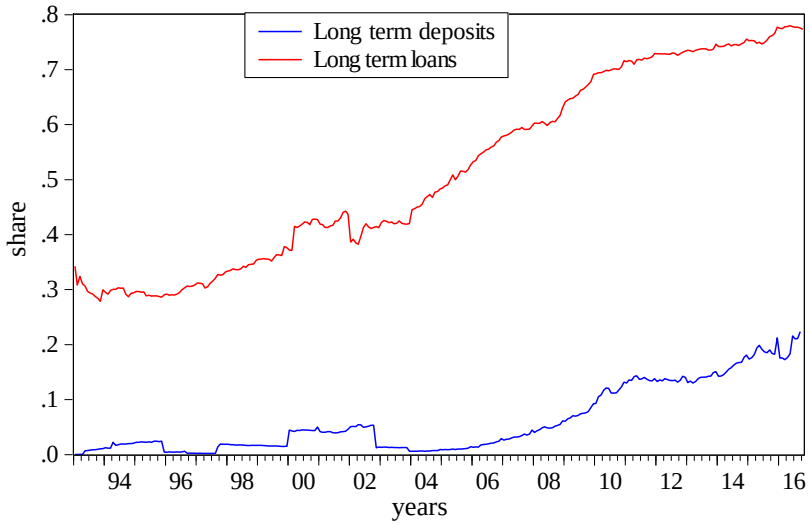

Fig. 10 - The development of the share of long term loans and long-term deposits on the total volume of loans and term deposits (1993-2016)

Source of data for Fig. 8, Fig. 9, Fig. 10: Czech National Bank, ARAD

5. Conclusion

This paper clarified the part of the debate between Bagus and Howden, and Barnett and Block considering the effects of maturity mismatching on the term structure of interest and its connection to the ABC. Using the loanable funds market framework, it was proved that BSLL causes the yield curve to pivot rather than to shift downward. This revealed a flaw in B&B's theory, which suggested a decrease of the whole yield curve. While, B&H correctly assess the movement of the yield curve, they incorrectly assume that sustainable level of BSLL can exist in a free market environment. Any level of BSLL causes a credit expansion in the time dimension and leads to misallocation of resources. This theoretical research lead to the definition of the natural yield curve as the term structure of the natural interest. Natural yield curve corresponds to a situation when maturities match along the whole term structure. Only then the production structure matches the inter-temporal choices of consumers.

The natural yield curve represents one of the missing pieces in the Austrian theory, and this paper represents one of the first steps (if not the very first step) at methodically defining the natural yield curve and implementing it into the ABCT. There is a wide range of future research that can be based on this theory. Multiple loanable funds markets giving rise to a term structure of interest should be merged with Garrison's ABC framework of a single loanable funds market and Hayek's triangle. Besides the obvious use of the natural yield curve in the ABCT, there is space for a synthesis with mainstream models of the yield curve and other models such as the bank run model of Diamond and Dybvig (1983). Second strain of possible research is empirical since the yield curve has demonstrated significant predictive power regarding the business cycle.

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