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MATURITY MISMATCHING AND ITS IMPACT ON THE YIELD CURVE

diplomová práce

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Prohlašuji na svou čest, že jsem diplomovou práci vypracoval samostatně a s použitím uvedené literatury.

……

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Poděkování

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Abstrakt

Tato diplomové práce řeší nový spor v rámci rakouské ekonomické teorie o vliv nesouladu mezi délkou vkladů a splatností bankovních úvěrů na tvar výnosové křivky a definuje dosud neetablovaný koncept přirozené výnosové křivky. Za tímto účelem jsou srovnány vzájemně si odporující argumenty rakouských autorů. Na základě této komparace je prezentována koherentní teorie vlivu nesouladu splatností v rámci modelu zápůjčních fondů. Syntézou teorie nesouladu splatností a rakouské teorie přirozené úrokové míry je definována přirozená výnosová křivka. Teoretické zkoumání vede k závěru, že jedna z forem nesouladu splatností nezbytně vede ke spuštění rakouského hospodářského cyklu. Empirická část zkoumá otázku vývoje tvaru výnosové křivky pod vlivem nesouladu splatností. Zvolené hypotézy nejsou potvrzeny, což je následně zdůvodněno.

Klíčová slova: nesoulad splatností, výnosová křivka, přirozená úroková míra, rakouská škola

JEL klasifikace: B53, E43, G21

Abstract

This diploma thesis 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. The empirical section examines the question of yield curve's behavior under the influence of maturity mismatching. An explanation concerning the selected hypotheses and their lack of confirmation is given.

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

JEL classification: B53, E43, G21

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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 makes it one of the most important theories in economics and 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. We will mainly focus on practices of the commercial banking sector in this thesis. 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 thesis 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 thesis has the following structure. The first section covers the basics of deposit and loan contract theory needed later in the text. The second section briefly introduces arguments for the illegitimacy of fractional reserve banking and for the 100% reserve requirement. The legitimacy of maturity mismatching is discussed in section three in order to decide whether a similar requirement as is the one of 100% reserves should be applied also to maturities. The fourth section briefly introduces the ABCT and shows the role of the natural interest rate. Section five 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 the fifth section. Section seven describes empirical tests of hypotheses based on the theory of maturity mismatching and discusses the results.

1 DEPOSIT AND LOAN CONTRACT THEORY

Huerta de Soto (2006) deemed it necessary to start his treatise with the clarification of loan and deposit contracts, their defining aspects and differences. I will operate with these terms very often throughout this thesis; therefore, it is essential to briefly explain them here, too. A condensed summary of this explanation can be seen in figure 1 at the end of this section.

De Soto (2006, ch. 1) describes two types of loan contracts. The first one is the *commodatum*, a loan contract with the purpose of *use*, where only the availability of a specific good is transferred from the lender to the borrower for a certain time, at the end of which the same good has to be returned. Examples of specific goods lend in a commodatum contract would be a book, a car or an apartment. The second one is the *mutuum*, a loan contract with the purpose of *consumption*, where both availability and ownership of a fungible[1] goods are transferred from the lender to the borrower for a certain time. The borrower has to return goods of the same quantity and quality, which is called the *tantundem*.

A typical example of a fungible good in a mutuum contract is money. In a monetary mutuum contract the lender transfers the *availability* and *ownership* of a monetary sum to the borrower. The borrower is authorized to use the money as he wishes, and he is obliged to return tantundem at a predetermined *fixed term*. "The mutuum contract, since it constitutes a loan of fungible goods, entails an *exchange of "present" goods for "future" goods"* (ibid., p. 3). *Interest* payment is common due to the nature of time preferences that yield present goods ceteris paribus more desirable than future goods.[2] The fixed term aspect is of upmost importance since it determines the time for which are the availability and ownership transferred to the borrower. "Without the explicit or implicit establishment of a fixed term, the mutuum contract or loan cannot exist" (ibid., pp. 2-3). Wherever the term loan is used in this thesis it refers to the mutuum, if not stated otherwise.

[1] Fungible good is a good of which individual units are interchangeable (e.g. wheat, oil, money). These goods are typically treated rather in terms of quantity, weight than separately (de Soto, 2006, p. 2).
[2] For a thorough explanation why people prefer present goods see Mises (1998, pp. 435-441).

Another type of a contract is a deposit contract – *depositum* (ibid., p. 4). The fundamental difference from a loan is that *the availability of the good is not transferred*. By a contract of deposit one person (the depositor) entrusts to another (the depositary) a movable good with the purpose of *safekeeping* until a *moment* the depositor asks the depositary to return the good. Therefore, the depositary is obliged to safekeep the good and return it immediately after the depositor asks for it. In contrast with a loan contract there is no fixed term for which the availability would be transferred; hence the deposit has to be available to the depositor at all times.

There are two types of deposits. *Regular* and *irregular* where *specific* and *fungible* goods respectively are deposited. There is no transfer of availability in both cases, and no transfer of ownership in a regular deposit. In the case of an irregular deposit a transfer of ownership can be supposed, because the depositor will not receive the same units upon withdrawal that he deposited since they mixed with units of the same good of other depositors and are undistinguishable from each other. However, de Soto (2006, p. 5) refers to an argument that the ownership is not truly transferred since the ownership refers abstractly to a tantundem. One way or the other, even a transfer of ownership would not change the fundamental nature of the irregular deposit, which is *safekeeping*. The immediate availability of the tantundem to the depositor remains (ibid.).

Figure 1: Typology of deposit and loan contracts

		Purpose		
		Transfer of ownership	**Transfer of availability**	**Safekeeping**
Type of good	Specific		*Commodatum*	Regular deposit
	Fungible	*Mutuum*	*Mutuum*	Irregular deposit

Source: Extended and corrected version of a table presented by Bagus and Howden (2013, p. 238).[3]

[3] For original version see appendix 1.

2 FRACTIONAL RESERVE BANKING

My aim in this section is merely to shed some light on the question of FRB's legitimacy in order to continue with the analysis of maturity mismatching. Maturity mismatching will be subjected to a more comprehensive scrutiny in the next section.

Before the description of approaches to fractional reserve banking (FRB)[4], it is necessary to explain why the mainstream economic view will not be discussed here. As we can read in Freixas's and Rochet's (2008) book, mapping mainstream micro-based models and theories of banking, depository institutions are pools of liquidity that protect depositors from idiosyncratic shocks.[5] Freixas and Rochet (ibid., p. 20) state "As long as these shocks are not perfectly correlated, the total cash reserves needed by a bank of size N (interpreted as a coalition of N depositors) increases less than proportionally with N.". In other words, banks do not have to hold reserves equal to the total sum of deposits, which is the definition of FRB. This ability can be used for financing illiquid investments. However, the mainstream does not ignore the risks of FRB. Freixas and Rochet (ibid.) actually dedicated a substantial portion of their book to the risks it introduces into the banking system. Nevertheless, the difference between the mainstream and the Austrian view of FRB is significant enough that they are basically unable to discuss the matter. The mainstream takes the legitimacy of FRB as axiomatic and focuses on how to regulate the industry in order to maximize the perceived benefits and to minimize the costs in the form of financial fragility (ibid., chapters 7-9).

The mainstream sees maturity transformation as one of the primal functions of the banking industry (ibid., p 4). Banks are supposed to transform illiquid assets into liquid assets. This could be interpreted as transforming loans of short maturity into loans of longer maturity.[6] However, the transformation is not limited to loans alone. Various models of the banking industry described by Freixas and Rochet operate with a balance

[4] FRB is a situation when banks hold reserves to deposits ratio of less than 1. Ratio of less than 1 is the ratio with which banks operate today.

[5] For a classic model behind this concept of banks see Diamond and Dybvig (1983, section 2) and Diamond (2007). It shows that the ability of banks to meet their obligations depends on the behavior of its depositors. The model has two outcomes. The first outcome, where depositors trust the bank and do not withdraw their funds, which leads to efficient allocation. The second outcome is a coordination failure in the form of a bank run, which is not efficient

[6] A practice I will refer to as "borrow short lend long" later in the text.

sheet where deposits constitute liabilities on one side and illiquid assets on the other.[7] The mainstream views deposits as one of the main sources for a bank's investments. Thus, enforcing 100% reserve requirement for demand deposits is not suggested.

2.1 FREE BANKING VS 100% RESERVE REQUIREMENT

The debate regarding 100% requirement can be traced back to the 19th century. First there was the clash between two British schools—the currency and the banking school. Although they differed in terms of the reserve requirement, neither of them disputed the existence of a central bank and whether it should be involved in solving the problems they identified. The French so-called false-money debate of 1866 soon followed, and both opposing sides of it agreed that a central bank was not needed. It was the first time that critiques of central banking clashed on the question of bank note issue (Juurikkala, 2002). "The French liberals have been called the free banking (Courcelle-Seneuil et al.) and the free currency (Cernuschi et al.) schools." (ibid., p. 44fn).

Tracing the history of these ideas is not the task of this thesis. Modern authors dealing with the topic at hand are chosen instead. What follows is a brief overview of two opposing positions in the free market realm. A free market monetary regime is a regime devoid of a central bank and governmental intervention. Different views on the consequences of FRB are not discussed here, because the goal is not to find a consequentialist argument for or against the legitimacy of FRB.[8] The important question is whether FRB is legitimate or inherently fraudulent.

There are two branches of Austrian economic school debating this particular question. The first one is the free banking branch. These economists advocate for no regulations of the banking system whatsoever. In general, they want to allow the market forces to determine the optimal reserves to deposit ratio. The second one is the 100% reserve branch. Its proponents advocate for an enforcement of the deposit contract (irregular deposit) as it was presented in previous section.

[7] These models are presented by Freixas and Rochet (2008) throughout their book.
[8] Legitimate things can have negative consequences. For example, a decrease in time preferences can lead to an economic down turn. No fraud has been committed and yet negative consequences occurred.

Rothbard (2010) describes the origin of banking as the establishment of warehouses for commodity money. Holders of commodity (gold) money faced the impracticalities of using a commodity as medium of exchange especially for large transactions. The free market response was the establishment of money warehouses (banks). Warehouses issued warehouse receipts for the depositors as claims on the deposited money. This corresponds with the irregular deposit. In time warehouse receipts for money started to circulate in the economy as a medium of exchange making them money substitutes. When money substitutes are excepted in exchange generally enough, then their holders do not claim the deposited money every time they receive such substitutes as a payment for their goods and services. The result is a residual level of reserves that are usually not redeemed by the depositors.

Warehouse owners (bankers) are tempted by these residual reserves to use them for their own purposes (e.g., granting loans). When they use these reserves directly or issue warehouse receipts in excess of reserves they hold only fractional reserves. Nevertheless, FRB is not limited to the previous examples. Banks practice FRB whenever they issue fiduciary media. 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). These claims can take a form of both bank notes and demand deposits.

Rothbard (2010, p. 42) states that "the bank note or deposit is not an IOU, or debt; it is a warehouse receipt for other people's property". Hence, he labels the issue of fiduciary media to be fraudulent as it would be fraudulent for any other warehouse to issue unbacked receipts. This is in accordance with the distinction between irregular deposit and mutuum contract made in the first section. Rothbard (ibid., p. 43) concludes "that, morally, such banking would have no more right to exist in a truly free market than any other form of implicit theft."

In contrast, Selgin and White (1996) deem fractional reserve banking to be justifiable. A bank practicing FRB commits fraud only when it misinterprets itself as a 100% reserve bank. Otherwise, it is perfectly within the contractual freedom of the depositor and the bank to agree on different reserve to deposit ratio than 100%. They argue in favor of this contractual freedom in case of demand deposits. Banks should be able to negotiate with depositors any terms of a demand deposit and the state should not intervene (e.g., demand

100% reserves). However, this approach is at least partially self-defeating when in reaction to Rothbard they suggest that banks and customers could agree to make them debts and not warehouse receipts (ibid., p. 87fn). Thereby, Selgin and White implicitly accept the presumption that the essence of a demand deposit contract cannot be completely changed. They, again implicitly, agree with a need to negotiate terms of a mutuum contract (a loan) and not a deposit contract.

Selgin and White (1996) argue that depositors historically preferred interest bearing fractional reserve deposits over costly 100% reserve deposits. They (ibid., p. 97) further suggest that depositors could use safe boxes in banks for the purpose of safekeeping, if safekeeping is the service they really want.[9] De Soto (2006, p. 144) opposes this consensual explanation of FRB's emergence and accuses banks of creating vague contracts, which lead customers to believe they are entering a true irregular deposit contract.

The debate between the two lines of thought is not decisively resolved. It boils down to a simple question: whether or not FRB violates property right. Deciding for either one or another position is problematic because it partially relies on the historical development of the banking practices, which is open to interpretation. On one hand, if the argument that contractual freedom means freedom to create demand deposit contracts of any form is accepted, then FRB does not violate property rights, and it is a legitimate practice. On the other hand, if the notion of traditional principles of law establishing an unchangeable form of irregular deposit contract is accepted, then FRB violates property rights and it is inherently a fraudulent practice.

The author of this thesis agrees that banks and clients should be able to exercise their contractual freedom; however, he sides with the opinion most comprehensively voiced by de Soto (2006) that the demand deposit contract is subjected to traditional law principles of irregular deposit and has to be enforced that way. Banks and their clients could enter loan contracts if the bank wanted to use client's funds and the client wanted

[9] The cost of choosing demand deposit with 100% against a demand deposit with fractional reserves is forgoing interest payments and paying a warehousing fee. However, safety boxes lack other complementary services such as bank transfers. Therefore, clients who want to enter an irregular deposit contract face additional costs in the form of absent services.

the same. This would likewise enable depositors to enter demand deposit contracts that follow traditional principles of law.

The deposit contract is qualitatively different from the loan contract as was explained in section 1. Therefore, for the purpose of this thesis it is assumed that the requirement of 100% reserves is justified.

3 THE LEGITIMACY OF MATURITY MISMATCHING

So far, I have presented the arguments for the 100% reserve requirement. It can be argued that it is a question of maturity mismatching. Maturities match when the requirement is fulfilled since demand deposits of zero maturity are not used to finance loans of positive maturity but are held in the form of reserves.[10] With that in mind, we must ask one important question: if the requirement of a perfect maturity match (100% reserves) is justifiable for demand deposits, then is it also justifiable for time deposits? The following is an attempt to clarify that specific concern.

Despite earlier mentions,[11] the question of the maturity mismatching legitimacy was first opened by economists Barnett and Block (2009a), from now on referred to as BB. 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 lend out. Maturity mismatching can be done in two distinct ways.

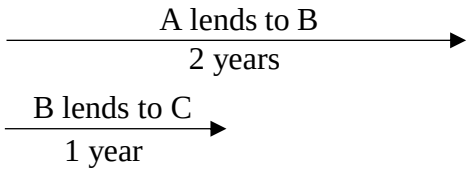
[10] Demand deposits in fact do not have any maturity. However, their instantaneous availability can be approximated by 0 maturity. The same applies to reserves.

[11] Mises (1976, p. 263) cited by Bagus (2010) did bring up the matter of correspondence between credit which banks grant and credit which they take in. Mises (ibid.) cites Knies (1876, p. 242): "The date on which the bank's obligations fall due must not precede the date on which its corresponding claims can be realized." However, Mises (ibid.) reduces the importance of maturity mismatching of aforementioned credits with the following statement: "…as far as money and monetary theory are concerned, even the function of the banks as negotiators of credit is of significance only so far as it is able to influence the issue of fiduciary media…" In conjunction with Mises (ibid., p. 278) definition of fiduciary media, "thus fiduciary media are claims to the payment of a given sum on demand, which are not covered by a fund of money, and whose legal and technical characteristics make them suitable for tender and acceptance instead of money in fulfillment of obligations that are in terms of money," it can be deduced that he did not fully consider the effects of maturity mismatching in the same way he scrutinized FRB.
Bagus (2010) also cites Rothbard (2008, p. 98), "…the time structure of the firm's assets should be no longer than the time structure of its liabilities.". Nevertheless, Rothbard, like Mises, did not follow with an analysis of longer term liabilities and continued his thought by pinpointing demand deposits in banks liabilities (ibid., p. 99).

Firstly, a bank borrows money from a client for a longer time, then is the time for which it lends the money to a third party. This practice is called BLLS – borrow long lend short. Secondly, a bank borrows money from a client for a shorter time, then for which it lends the money to a third party. This practice is called BSLL – borrow short lend long.

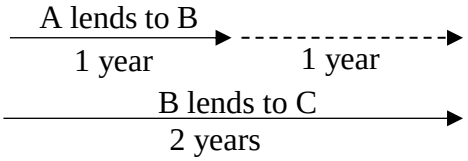
BB (ibid.) find BLLS to be a legitimate practice. Let's consider the following example. Subject A lends $100 (a time deposit) to subject B (a bank) for **2 years**. Then B lends these $100 to subject C for a **1 year**. If C repays his debt after 1 year, then B would be able to meet his obligations towards A. Of course, B is exposed to the risk that C will not be able to pay. However, this falls under the realm of entrepreneurial risk, and there is nothing fraudulent about it. Therefore, BLLS is indisputably a legitimate banking practice.

Figure 2: BLLS



In contrast with their position on BLLS, BB do criticize BSLL. Imagine the following situation with the same subjects but different maturities. A lends $100 to B for **1 year**. Then, B lends $100 to C for **2 years**. According to BB (ibid., p. 713) that is an illegitimate action from subject B, since the time dimensions of these two contracts do not match.

Figure 3: BSLL



When subject B practiced BLLS, the situation was such that if C paid his debt on time (in 1 year), then B would be able to repay his debt to A (in 2 years). That does not hold true

in the case of BSLL. BB demonstrate this with an illustrative example of borrowing a book under otherwise unchanged conditions. Even if C returned the book in time, B would not be able to meet his obligation towards A. It follows that B did not have the right to lend the book to C for a period longer than 1 year, and what applies to books also applies to money according to BB. A claims his $100 from B at the end of the first year while C was informed by B that he does not have to repay the debt for one more year. BB (2009a) claim that BSLL is not legitimate, because it leads to the existence of multiple property claims for the same thing**.** In other words, an *over-issuance* or *over-subscription* of property claims takes place. It would not be legitimate even if B managed to repay his debt to A by convincing subject D to lend him the sufficient sum of money.

Economists Bagus and Howden (2009), from now on referred to as BH, react to this critique of maturity mismatching in the following way. I will continue with the previous example, where A lends $100 to B for **1 year** and B lends it to C for **2 years**. In contrast with BB, BH claim that no property rights are violated, because B gains full disposition with the $100, and he can use it as he pleases. B is only obligated to repay the principal plus interest in 1 year. BB (ibid.) argue that property rights are violated in this case. BH (ibid.) oppose their argument on two grounds.

Firstly, the obligation of B towards A can be still met, because money is a fungible good. A fungible good has such characteristics that the distinguishing of individual units is either impossible or unnecessary in practice. When a debtor borrows a fungible good (e.g., money, wheat, water) an obligation to return the same amount and the same quality of a borrowed good (a so called tantundem) is created. The debtor is not obliged to return particular units of the good. This yields the parallel between money and a book drawn by BB as being irrelevant.

Secondly, BH (ibid.) contest the claim that property claims are being over-issued by differentiating between present and future goods. The present $100 is always owned only by one subject at a time. Loan contracts constitute an exchange of present goods for future goods. The $100 which A lent to B represent present goods which are then lent by B to C. The money which B has to repay to A in 1 year is a future good, a good distinct from present goods and different from future goods in 2 years, which C owes to B. In the case of a loan contract, an over-issuance of property claims is according to BH (ibid.) an

impossibility. That is only possible in case of demand deposits (not time deposits) where the depositor does not give up permanent availability of his money. Therefore, property claims can be over-issued only when these claims exist at the same moment. The issuance of fiduciary media, discussed in the section 2.1, is a clear example of that.

3.1 THE TIME CONTINUUM PROBLEM

The previous section implies that BH (2009) defend lending money which a bank gained as a term deposit from a client (in our example B received a loan from A), even when it practices BSLL. Nevertheless, they label the lending of money deposited on demand as fraudulent. BB (2011) see the position of BH as indefensible given that time is continuous. The all-important question is how can one distinguish a term deposit from a demand deposit. What if A opened an account at subject B and in the contract agreed to wait after his withdrawal request for a specified period before he receives his money? Which period still defines a demand deposit and which a time deposit? BB arbitrarily choose one minute as an example. Then to convert a demand deposit to a time deposit, it is supposedly sufficient for a bank to create a contract such that the depositor has to wait more than a minute before he receives his money.

Deciding who is right in these arguments has broader implications that apply not only to time deposits. Cachanosky (2011) builds his defense of fractional banking on a fusion of the two arguments. He combines BH's defense of BSLL and BB's time continuum problem. If BSLL were a legitimate practice and if it were also impossible to distinguish time and demand deposits, then fractional banking would be legitimate too.

BH (2011) see the time continuity problem as a superfluous construct lacking a practical meaning, because people are not able to distinguish infinitely small changes. BH use a pound of butter, but troy ounce, which is the most common weight of golden coins, can serve as an example, too. One troy ounce is equal to 31,103476**8** grams. It is very improbable, that after buying and reweighing the coin a buyer would call the seller a fraud, if that coin weighed "only" 31,103476**7** grams (buyers do not react to even larger deviations). Where does a gold troy ounce coin start and where does it end then? In a free society, it is given by conventions and courts. BH (ibid., p. 296) apply the same logic to

law and ethics. People do not react to infinitely small changes, therefore BH see the time continuity problem as constituting a nonissue.

As with the troy ounce we can ask whether the client still deposits his money with the purpose of safekeeping (a demand deposit) or if he wants to lend the money to the bank (a time deposit). Is it true that what applies to separating proper gold coins and gold coins that are too light also applies to the differentiation between demand and time deposits? The aspect of waiting is always present in the banking sector – the account holder's identity verification and the transportation of money from the vault into the hands of the client create delays. However, these time lags do not negate the fact that demand deposits have to be available at any given time (ibid.). According to BH it is up to judges to decide how long of a delay still represents the full availability of money (representing a demand deposit) and which delay is too long leading to a qualitative change in the service from a demand deposit to a loan.

This position of BH raises the question concerning what the real implications of such a judicial decision would entail. What if judges draw the line at 12 hours? That would determine all contracts with a maturity shorter than 12 hours to be demand deposits. Nobody would be able to lend money for a shorter time than 12 hours. The overnight market used by banks would be greatly affected. BH (ibid.) offer a more individual approach: "Consequently, the legal system has to determine if a certain contract was designed to conceal a deposit or whether it is a genuine loan."

3.2 THE CONCEPT OF FUTURE GOODS

Barnett and Block (2011) disagree with BH that a distinction between present and future goods would defend the legitimacy of BSLL, because BB do not acknowledge the existence of future goods. They say that unfinished goods like houses under construction and half-made sweaters exist, but that none of them is a future good. BH (2009) define a loan as an exchange of present goods for future goods, but that is impossible according to BB (ibid.) since future goods do not exist. That is why, BB's critique of BSLL practice is based on the over-issuance of property claims to present goods. BH (2013) react to that by clarifying their definition of a loan. A loan is an exchange of present goods for claims on future goods. In contrast with that, a demand deposit creates a claim on a present good.

So, when a bank uses a depositors' money, it over-issues property claims, but when it uses money lent to it, an over-issuance does not take place.

BB's conclusion is incorrect, despite BH altering their definition. The way in which BB support their claim is more than questionable. I quote: "Mises (1998) states: ''As the consumers' goods are present goods, while the factors of production are means for the production of future goods….'' It is obvious from this that future goods do not exist" BB (2011, p. 231). It is not obvious why they are so brisk at making such a conclusion, because a brief search through Mises (1998) reveals that he operates with the concept of future goods on multiple occasions (e.g. p. 255, p. 288, p. 291). Mises talks about human preference for present goods before future goods many times. That alone does not suggest the non-existence of future goods. Yet, the following quote constitutes even a more credible reason to believe that Mises would not agree with BB. "Let us now scrutinize the social and economic consequences of changes in the purchasing power of money under the following three assumptions: … second, that there is only exchange of present goods and no exchange of present goods against future goods" (ibid., p. 417). In this case, Mises made an explicit limiting assumption to make his analysis simpler. He ruled out the otherwise possible option of such an exchange.

The source of BB's confusion might be the fact that future goods, indeed, do not exist in the present. They exist in the future, which is self-evident from the very term. So, the exchange of present goods for future goods cannot take place at one point of time. But that does not mean that it cannot span over multiple points in time. A loan by its definition is an inter-temporal exchange of goods.

3.3 THE FUNGIBILITY OF MONEY

It was mentioned earlier that BH view BSLL as legitimate because of the fungible character of money. They do not perceive BSLL to be legitimate anymore in the case of a specific good (e.g., a painting). BB (2011) claim that the fungibility of money only veils the real crux of what the bank practices. Let's return to our example of BSLL. A lends to B for **1 year** and B lends to C for **2 years**. If B is supposed to repay his debt, then he has to do one of the following actions. Convince subject D to lend him a needed sum, pay the debt from his own budget, or ask A to cancel the debt, forgive it or lengthen its maturity.

The sole fact that subject B has to do something like this is for BB a proof of property rights violation (2011, p. 234). In other words, the ability of B to compensate A does not mean that B is not guilty of fraud. BB use Bernie Madoff as an example and say that Madoff stole a lot of money, and even if he could repay to all victims of his pyramid scheme, he still would remain a thief.

Let's consider the intent with which fungible goods are lent. BH (2011, p. 298) stress that the very essence of lending a fungible good is its destruction. Sugar borrowed from a neighbor serves them as an example. We can consume the sugar and we are obliged to return a tantundem. By this logic, B is entitled to use the money from A (lend it to a third party for a longer period), and only after that he has to figure out how he is going to repay his debt to A in very much the same way we borrow our neighbor's sugar, consume it and then work on returning it. If we were supposed to return specific units of sugar, then the loan would lose meaning. It would not be a loan anymore but a deposit with the purpose of safekeeping.[12]

In conclusion, practicing BSLL is legitimate because in the case of a loan contract,

(1) the continuous time problem would be resolved by judges as are other continuum problems in our society,
(2) there is no over-issuance of property claims, since present and future goods are distinct from each other and
(3) the availability and ownership of lent goods are transferred to the borrower who can use them at his will.

Points (2) and (3) are in contrast with a demand deposit contract, which firstly, does not involve the exchange of present for future goods. Secondly, it does not transfer the availability and ownership. A demand deposit can be associated with the over-issuance of property claims in the form of fiduciary media as was explained in section 2. Thus, BH's assertion that BSLL is a legitimate practice is correct. The remaining question is

[12] On top of that, it would be a special kind of fungible good deposit when the depositor does not require only the tantundem, but requires the same units of the good. Depositing banknotes in a bank's safety box is an example of that.

determining if BSLL can have a negative impact despite its legitimacy. That will be covered in section 5.

4 ABCT AND THE NATURAL RATE OF INTEREST

This section covers the basics of the Austrian business cycle theory (ABCT) and its use of the natural interest rate, since it is the basis for a further investigation of BSLL's effects on the economy. The coordination of inter-temporal choices regarding consumption and production is the crucial problem that lies at the core of this theory. This problem will be elucidated using Garrison's graphical representation of the ABCT because of its illustrative nature.

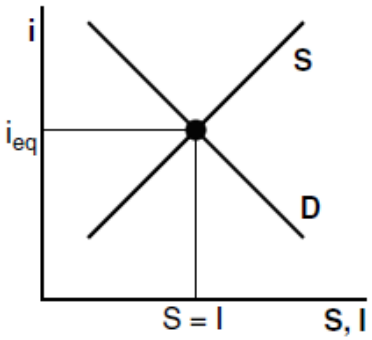
4.1 THE FRAMEWORK

Garrison's framework has three elements: (1) the market for loanable funds; (2) the production possibilities frontier (PPF); and (3) the inter-temporal structure of production.

The first element is the market for loanable funds (see figure 4). The supply of loanable funds "represents the willingness to lend at different interest rates, and the demand … represents the eagerness to borrow" (Garrison, 2001, p. 36). Consumer lending is netted out, because it consists of both saving and dissaving at the same time. Loanable funds include retained earnings and purchases of equity shares. "The supply of loanable funds, then, represents that part of total income not spent on consumer goods but put to work instead earning interest (or dividends)" and "the demand for loanable funds represents the borrowers' intentions to participate in the economy's production process" (ibid., p. 37).[13]

[13] For a more detailed explanation of the loanable funds market see Garrison (2001).

Figure 4: The market for loanable funds

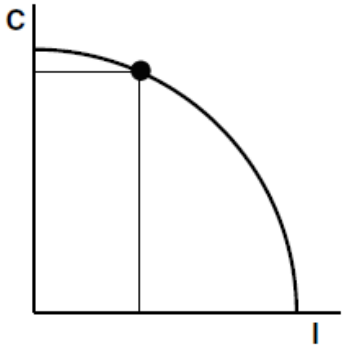


Source: Garrison (2001, p. 37, figure 3.1)

The loanable funds market is a place where consumers postponing their consumption meet with producers seeking funds for their investments. Therefore, by its nature it 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 (Wicksell, 1936, p. 102), and all saving is real saving. Of course, that does not mean that money impedes the establishment of the natural interest rate, because real saving is created by people postponing their consumption, for which a barter economy is not a necessary condition. However, the use of medium of exchange can cause a divergence of the market interest rate from the natural interest rate.

Production possibilities frontier (PPF) is the second element (see figure 5). Garrison (2001) uses the concept of PPF to depict the tradeoff between consumption (C) and investment (I) in the economy (see figure 5). Given a positive level of capital depreciation, there is a point on the PPF that corresponds to an equilibrium point, at which the investment is equal to depreciated capital. The net investment is zero, and the economy is stationary at this point. Garrison (2001, p. 70) defines the line as "*sustainable* combinations of consumption and investment." Thus, it is possible to move beyond the PPF for other than sustainable combinations. Such development will be described later.

Figure 5: Stationary point at the production possibilities frontier

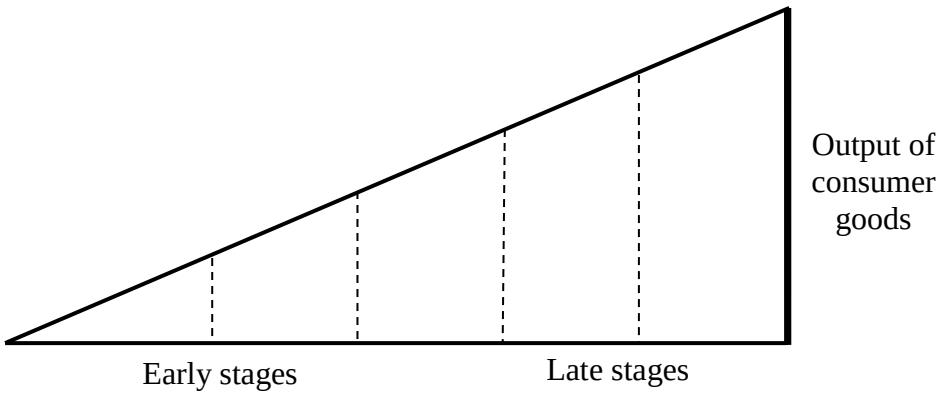


Source: Garrison (2001, p. 43, figure 3.4)

The third element of Garrison's framework is the inter-temporal structure of capital represented by Hayek's triangle (see figure 6).[14] It is a simplified concept, yet it is sufficient for our purposes. In contrast with a classical perception of capital as a homogeneous entity, Austrian theory considers both its value and time dimension, because production inevitably takes time. The inter-temporal structure of production has many consecutive stages. The production process starts at early stages producing higher order goods that are further from consumption and gradually continues to later stages producing lower order goods that are closer to consumption. The first order (the lowest order) goods are consumer goods that serve our needs directly (Menger, 2007, p. 56). All other goods form capital. Hayek's triangle reflects the structure of capital in two ways. Firstly, the succession of vertical legs represents the sequence of production stages going from late to early stages as it is marked on the horizontal leg. Secondly, the vertical height at any point of the triangle represents the value of goods-in-process at a given production stage. The value of produced consumer goods is denoted by the height of the leg on the right.

[14] For the original exposition see Hayek (1935, lecture II).

Figure 6: The structure of production



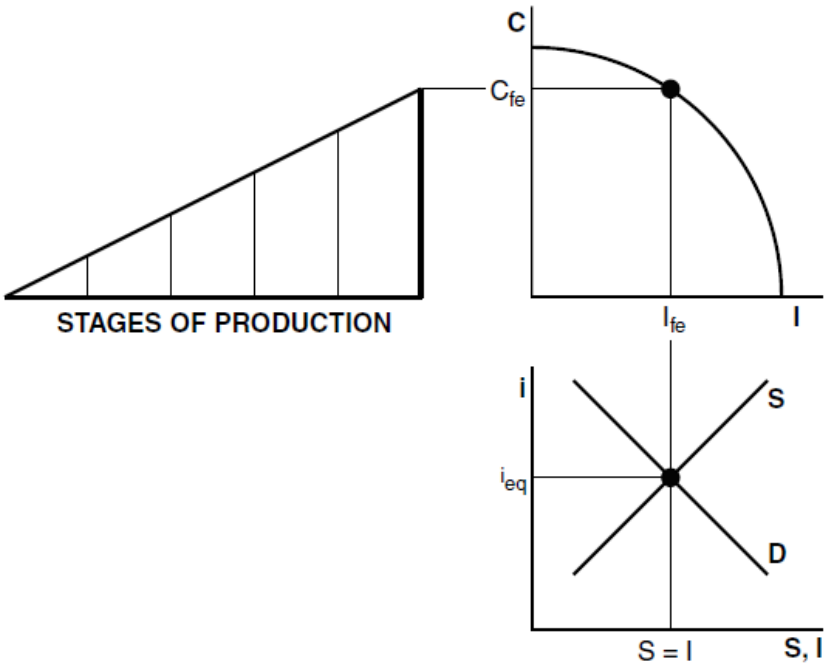
Source: Based on Garrison (2001, p. 47, figure 3.5).

What gives Hayek's triangle a positive slope are progressively lower values of unfinished goods in earlier stages in comparison with the value of consumer goods. Values of higher order goods are derived from the value of the first order goods that directly satisfy human needs (Menger, 2007). Lower values of higher order goods are in accordance with the notion that people discount the future (Böhm-Bawerk, 1891). The higher the order of goods the longer is the period separating them from consumption; therefore, higher order goods are discounted more than lower order goods.[15]

The three above-mentioned elements are integrated by Garrison (2001) in the following manner (see figure 7). The loanable funds market directly connects to the PPF through the common axis of investment. The PPF connects to Hayek's triangle through the common axis of consumption. However, the connection between the loanable funds market and the structure of production is not so straightforward.

[15] Uncertainty is another reason for the lower value of higher order goods. A holder of consumption goods is certain of their quantity and quality; however, a holder of higher order goods is uncertain of these characteristics regarding goods of first order that he will possess at the end of the production process (Menger, 2007, p. 69).

Figure 7: The macroeconomics of capital structure



Source: Garrison (2001, p. 50, figure 3.7).

"The slope of hypotenuse of the Hayekian triangle reflects the market-clearing rate of interest in the market for loanable funds" (Garrison, 2001, pp. 50). Despite the fact that the slope also reflects other things, it does move in the same direction as the market-clearing interest rate. The economy depicted in figure 7 is located on the PPF, which implies a natural rate of unemployment and a market interest rate equal to the natural interest rate (ibid., p. 51). The volume of investment just offsets the depreciation of capital and is distributed through the production stages in a way that preserves the capital structure.

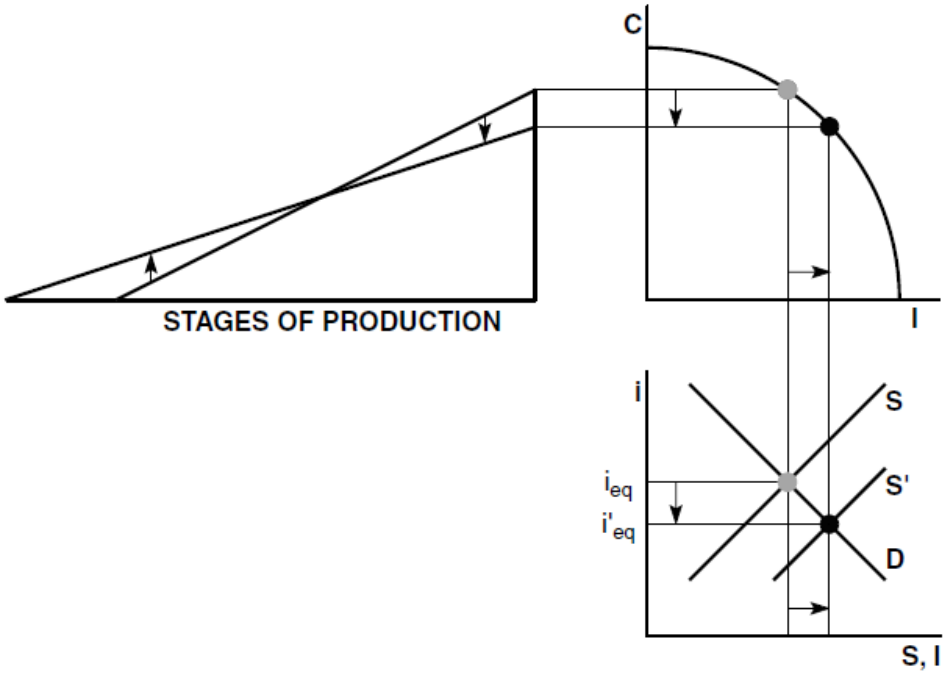
4.2 CHANGE IN TIME PREFERENCES

Now we can introduce different types of shocks. We will not discuss the labor market adjustments here since they are redundant for our purposes.[16] Let's consider an economy-wide decline in time preferences, which is most relevant for our exposition (see figure 8). In this case people become more patient and start to value future consumption relatively

[16] For a description of labor market adjustment see Garrison (2001).

more than before. This change in preferences results in a rightward shift of the supply curve and a decrease in the market interest rate. The natural interest rate also decreases due to increased real saving. The market and natural interest rates, therefore, coincide. In effect, the business community borrows more and transforms this postponed consumption into investment, as we can see on the PPF.

Figure 8: Saving-induced capital restructuring



Source: Garrison (2001, p. 62, figure 4.2)

In Hayek's triangle we can observe how the production reacts to the changes in inter-temporal preferences. A lower interest rate favors longer term investments relatively more due to the effect of time discount; therefore, early stages of production bid away resources from late stages, which shrink due to a temporarily decreased demand for consumption goods. The point where these two effects (time discount and derived demand) offset each other lays at the intersection of the old and new hypotenuse. As well, early stages already in existence increase their production, but new and more roundabout ways of production develop, as depicted by the prolonged horizontal leg of the triangle. This shows how the interest rate coordinates inter-temporal consumption preferences with the production of consumption goods. When people begin to favor future consumption relatively more, the

production structure alters in a way that it increases a supply of consumer goods in the future and satisfies the higher demand.

It should be noted that the visualization in figure 8 gives the impression that an increase in patience results in a lower output of consumption goods. This is initially true; however, after the investments are finished the more productive production structure yields higher output consumption goods.[17]

4.3 MONETARY DISRUPTION OF THE INTEREST RATE

The previous section described a decrease in the market interest rate and the natural interest rate induced by a drop in time preferences. More patient savers logically demanded lower compensation. Investment was spurred by cheaper loanable funds and an appropriate adjustment of the production structure followed. As we could observe, this adjustment was sustainable since higher investment was supported by real saving.

This section will discuss a different cause for the change in interest rate than the previous one. Garrison used an exogenous increase of the money supply by a central bank. However, that is not the only channel through which the money supply can increase. An endogenous increase caused by fractional reserve banking (FRB), when the reserve to deposit ratio falls, is also possible. The case of FRB is even more important for our purposes, because it can emerge on a market in a similar way to BSLL, which is the ultimate focus of this thesis. Fortunately, these two sources create the same disruption – a higher money supply. Therefore, we can utilize the same analysis that Garrison (2001) applies to an intervention of a central bank.

Banks practicing FRB increase the money supply by issuing fiduciary media. Mises (2006, pp. 104-105) differentiates between "(1) credit which a bank grants by lending its own funds or funds placed at its disposal by depositors, which we call "commodity credit," and (2) that which is granted by the creation of fiduciary media…, which we call "circulation credit."" The creation of circulation credit constitutes a credit expansion, which lowers the reserve to deposit ratio and increases the money supply. In contrast,

[17] Garrison (2001, p. 64) suggests that this change should trigger a secular growth. For critique of this position see Salerno (2001). For a further discussion of the effect, which a decrease in time preferences has on the production process and the level of output see Potužák (2015, chapter 1).

commodity credit does not affect the money supply; however, commodity money is not used anymore. Commodity credit can be approximated today by loans granted by a bank which holds 100% reserves and gains required funds from savers (not from a central bank, which would constitute an increase in the money supply. too). Hence, the previous example was not an instance of credit expansion, since granted credit was the "commodity credit".

Below, we can see a situation when FRB induces a credit expansion (see figure 9). Garrison constructed the illustration in a way that a decrease in the market interest rate equals to the decrease in the previous example. It clearly demonstrates the sharp contrast between a naturally induced economic growth and a boom brought by a disruption to the money supply.

The loanable funds market shows an increase of loanable funds made available by the issuance of fiduciary media in the volume of ΔM_c. Banks have to lower the price of loans in order to attract additional borrowers. 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, p. 67). This artificially low interest rate induces a discrepancy between real saving and investment. Therefore, investment increases in reaction to more total saving (real saving plus ΔM_c) available. The fall of market interest rate causes real saving to decrease, because time preferences of savers have not changed.

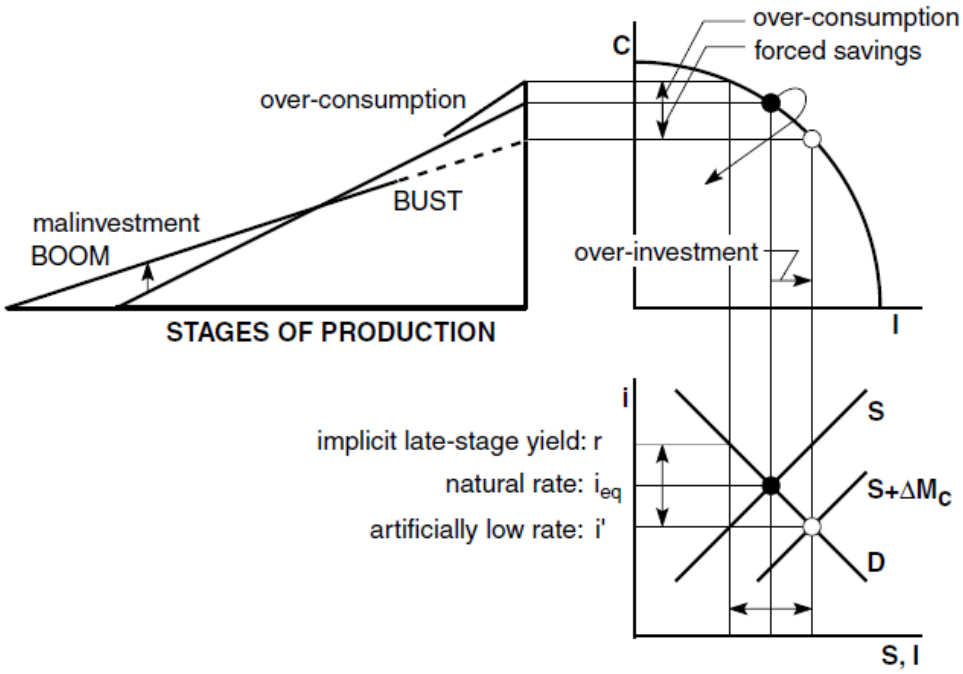
Now, there are two conflicting forces at play. Firstly, a lower interest rate leads to a higher demand for consumption goods because time preferences of savers have not changed, although the interest rate did. A higher demand for consumption goods pulls the legs of the late stages upwards. Secondly, cheaper loanable funds spur investment. Longer term investments are more sensitive to changes in the interest rate;[18] therefore, demand increases disproportionately more in early stages and more roundabout ways of production are initiated. "Increases in the employment of all resources, including labor, beyond the level associated with a fully employed economy cause the economy to

[18] This is apparent from the equation for a present value of an investment. A lower interest rate increases the present value of future cashflows that the investment is expected to yield.

$$PV = \frac{CF_1}{(1+IR)} + \frac{CF_2}{(1+IR)^2} + \cdots + \frac{CF_n}{(1+IR)^n}$$

produce at a level beyond the PPF." (Garrison, 2001, p. 69). Thus, the growth is not sustainable.

Figure 9: Boom and bust



Source: Garrison (2001, p. 69, figure 4.4)

There is a fight for scarce resources between early and late stages of production which compete for them on the market and try to outbid each other; or, to put it differently, there is a fight between consumers and investors. However, investors have an upper hand, because they use new money lent into existence (Garrison, 2001, p. 71). For that reason, the investment side is the stronger one out of the two conflicting forces and the supply of consumption goods decreases despite higher consumer demand. Lack of consumer goods and their consequently increasing price constitute the so-called forced savings. In short, forced saving is a result of the issuance of fiduciary media, which leads to a depression of both the purchasing power of money and purchasing power of consumers, since an increase in wages lags behind the increase in prices (Mises, 2006, p. 111).

However, forced saving supports increased investment only temporarily. Investment eventually translates into income, which strengthens the consumer demand again. Increasingly scarce resources put an upward pressure on factors of production and the

interest rate. Businesses realize that in order to finish their projects more resources are needed than they anticipated. Those who cannot afford to borrow at the currently higher interest rate have to stop and liquidate their projects. This disinvestment associated with rising unemployment starts an economic bust, which rids the economy of the accumulated malinvestment. Malinvestment, as used by Mises, is not merely an over-investment. It is characterized rather by its structure than by its quantity. The problem is not too much investment, but investment that does not correspond to inter-temporal consumer preferences. In this case the production structure has been altered due to an artificially lower 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.

The most important points for our further inquiry are the following. Capital is not homogenous. 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.

5 MATURITY MISMATCHING AND THE BUSINESS CYCLE

The idea that 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 present the BB's and BH's suggestions of how BSLL influences interest rates in section 5.1. Then I discuss the definition of credit expansion in order to answer the question in section 5.2. Shifts of the YC will be revisited in section 6.

5.1 BSLL AND SHIFTS OF THE YIELD CURVE

As was previously described, 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 (see section 3); therefore, it should not cause a business cycle.

Nevertheless, this answer is not correct according to BB (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. BB (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 is depicted by the blue line in figure 10.

BH (2010, p. 73-82) studied the arbitrage along the commonly increasing[19] 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[20] should systematically under or overestimate this future availability 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.).

[19] There are two reasons for its positive slope (BH, 2010, p. 70-71). Firstly, savers are ceteris paribus willing to give up the availability of their money for a longer period only for a higher interest rate. An individual has two options: A – give up his money for 10 years for 5% p.a. or B – give it up for 5 years for 5% p.a. He will always choose A in such case, because he prefers higher liquidity sooner than later. Also, the risk of a default increases with time and a compensation in form of a higher interest rate is necessary. Secondly, entrepreneurs are willing to pay higher interest rate for loans with longer maturities, because such loans represent lower risk. BB (2009b, p. 462) provide very similar explanation.

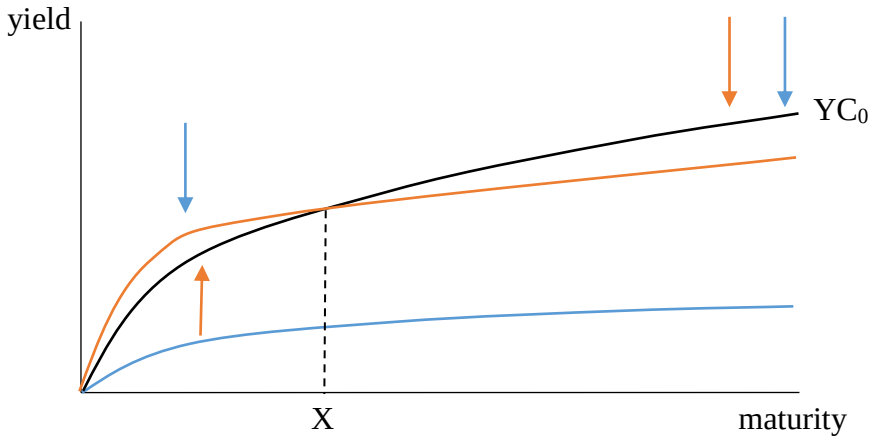
[20] Entrepreneurs in general can roll over their debts. Banks are only a subcategory.

However, the current system is not undistorted like the one described above. Today there is an intervening central bank (CB) 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 CB performs the role of a lender as last resort in most cases when commercial banks have problems with rolling over debts. Furthermore, FRB causes the credit expansion, which increases the money supply. This growth of money supply makes rolling over easier. There is also a possibility of government bailouts.[21] These three factors significantly lower the riskiness of BSLL under its natural level (ibid.; Bagus, 2010). Because of that banks exploit differences in interest rate along the yield curve to an unnaturally large extent. The formation of a YC under excessive BSLL is discussed in section 6.

Figure 10 illustrates my interpretation of BH's theory (ibid., p. 77). The black YC_0 represents the situation without financial intermediaries. 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 color, on the left of maturity X), whereas, additional supply creates downward pressure on the long end of the yield curve (orange color, on the right of maturity X). Combined effect of the two flatten the yield curve (ibid.). 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).

[21] 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).

Figure 10: The impact of BSLL on the yield curve[22]



Notes: *Black YC represents original YC without BSLL*

Blue YC represents YC under BSLL according to BB.

Blue YC represents YC under BSLL according to BH.

Flattening of the YC 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. The point lays 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. I will further cover this idea in section 6.1.

Entrepreneurs influenced by lower long term interest rate succumb to the illusion that more long term real savings exist. The capital structure lengthens, and 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 (BH, 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 BH (ibid., p. 79-81).

[22] All yield curves start at zero, because they represent theoretical YCs. These theoretical YCs do not include only maturities corresponding to government bonds, which constitute what is commonly referred to as a YC. YCs depicted in the graph approach zero in the limit, because loans can theoretically have any positive maturity. Additionally, I abstract from FRB leading to potentially positive interest rates even at zero maturity (demand deposit).

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

5.2 CREDIT EXPANSION IN TIME DIMENSION

BB (2009b, p. 464) emphasized an important fact that savings does not have only one dimension, since there is a difference between saving $100 for 1 year or for 2 years. In other words, even though BB do not acknowledge the concept of future goods, exchanging present goods worth $100 for future goods in 1 or 2 years is not the same. The same applies to investment; therefore, it "…is important to remember that investment and saving have two dimensions, each: a quantity dimension, say $, and a time dimension, for example years." (ibid.).[23] As Böhm-Bawerk (1890) introduced the time dimension into the definition of capital, it is also necessary to enhance the definition of savings in the same way to put forward a more comprehensive ABCT.

The established ABCT considers only the quantity dimension of savings, and in effect operates only with a single natural interest rate and not its term structure.[24] This is puzzling since "the complex unit of dollar-years is not foreign to capital theory. It measures Gustav Cassel's (1903) "waiting" and underlies Böhm-Bawerk's (1890)[25] roundaboutness." (Garrison, 2001, p. 49). If the Austrian school is familiar with these units, why has it not used them in ABCT?

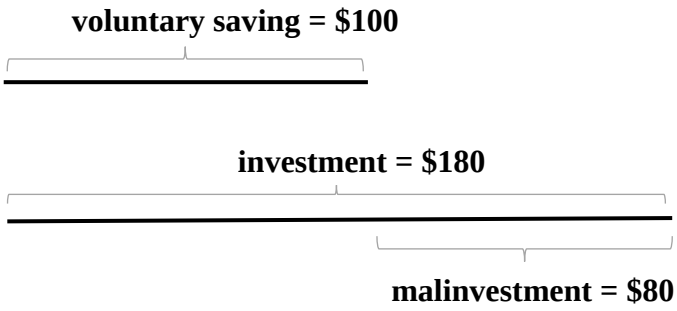
A possible explanation of that is the focus of ABCT on FRB and how it affects the interest rate with all of the consequences described in section 4. In the case of FRB it does not have to consider any other dimension of savings than its quantity, because demand deposits are not savings in the sense of exchanging present goods for future goods. It was enough for economists establishing ABCT to prove that investments surpassing voluntary

[23] Bagus (2010, p. 4) states virtually the same.
[24] Although, there have been strong attempts at connecting the ABCT and a term structure of interest. Mainly Cwik (2004) and (2005). However, it is not a resolved issue.
[25] Garrison refers to a different edition of the same Böhm-Bawerk's book ([1889] 1959) in the original text.

savings in quantity cause a fall in the interest rate under the natural interest rate and consequently create malinvestment.

Figure 11 shows why a single quantity dimension of saving and investment is sufficient to show that FRB causes ABC. The lengths of the lines represent the quantity of saving in terms of dollars. As we can see in the example, investment exceeds voluntary saving by $80, which implicates the existence of malinvestment in the volume of $80. The creation and inevitable liquidation of malinvestment constitute the downward and the upward phases of the ABC.

Figure 11: Volumes of saving and investment during

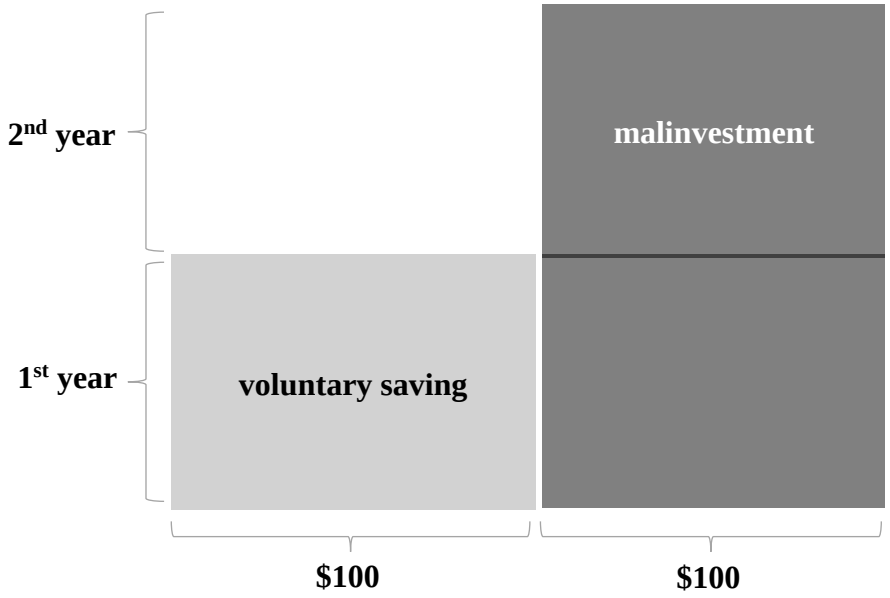


BB (2009b) operate along dollar-year units with an average[26] period of saving and investment that should ideally match. Another more visual way is translating time and monetary units onto a surface. An example of BSLL that we are familiar with is depicted in figure 12. Subject A lends $100 to subject B for 1 year. B lends this money to subject C for 2 years. The horizontal dimension still represents the monetary quantity of saving and investment in the same way as in figure 11. The added vertical dimension represents time. In dollar-year units, there is $100-1 year worth of voluntary saving and $100-2 year worth of investment (dark gray rectangular). It is important to note that the previous figure would not reveal the existence of malinvestment, because saving and investment are equal in terms of dollars. However, when we account for time, we can see that $100-1 year units in the dimension of the 2nd year[27] worth of malinvestment takes place.

[26] BB are not explicit about the calculation of such an average, however, a weighted average would be suitable.

[27] This clumsy specification of the year where the dollar-years worth of malivestment take place is necessary, because $100-1 year of malinvestment has different properties if they happen one year from now or thirty. This is part of the old question of how to properly quantify capital, which has not been satisfyingly resolved yet.

Figure 12: Volumes of saving and investment in two dimensions



We can see that an increase in the money supply is not necessary to cause ABC. BB (2009b) claim that BSLL creates time *ex nihilo*. This 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. 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.

Figure 12 depicts a simple example of BSLL between 3 economic agents. But would it be possible to add all credit transactions in the economy into a dollar-year unit aggregate? If it were possible, we would not be only able to tell if an ABC occurs, we also would be able to measure its severity. BH (2009b, p. 465) would oppose such an idea, because they believe that "in contradistinction to the International System of Units, these [dollar-year units] cannot be combined into derived dimensions. For example, in the equation for force, F = ma, a mass of 3kg accelerated at a rate of $2ms^{-2}$ = a mass of 2kg accelerated at a rate of $3ms^{-2}$ = 6n. However, a loan of $3.00 for 2 years is a quite different thing from a loan of $2.00 for 3 years. And neither is equal to a loan of $6.00 for 1 year." That might be true. A dollar-year unit aggregate may not be usable for measuring the amount of malinvestments in the economy; therefore, the severity of ABC in absolute terms but

possibly in relative terms. Nevertheless, the ability to identify the sole occurrence of ABC still holds.

In the next section I will present and deal with a counter argument to this hypothesis. BH (2010) and Bagus (2010) argue that BSLL and rolling over debt is a sustainable possibility in a free market. Applied to this example, a liquidation of malinvestment would not have to occur after one year if subject B could roll over his debt.

6 NATURAL YIELD CURVE

The concept of a natural yield curve is not a new one. Using a single short term interest rate can negatively affect a central bank's ability to design its monetary policy when the interest rate hits zero lower bound. For that reason, mainstream economists use the concept of a natural interest rate which is an interest rate associated with zero output gap and applied it to all maturities (Brzoza-Brzezina, Kotłowski, 2012) and (Imakubo et al., 2015). Their approach does not consider the loanable funds market and any fundamental driving forces for the interest rate; therefore, I do not consider their findings further in the text.

Austrian school economists commonly talk only about a single interest rate in the economy. They built up the theory of the business cycle using a single natural interest rate. It is interesting that it took such a long time to this group of economists to broaden the perception of loans and savings from one dimensional to two in conjunction with ABCT. 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 p.a. 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),[28] where the term "natural YC" was mentioned once (Cwik, 2004, p. 102) in context of a very precise assertion that will be at the end of

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

this section.[29] However, his approach is distinct from the one used in this thesis. Cwik addressed the question of why does the YC tend to invert prior to recession, which is not the ultimate goal of this thesis. In addition, he abstracts from BSLL (Cwik, 2004, p. 121fn) and explains YC's behavior in the current system of FRB and government interventions. Specifically, Cwik assumes that a monetary injection increasing money supply initiates the ABC. In contrast, in this thesis 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. BH as well as BB 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 ABC. Yield curve (YC) 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 of a *natural* YC, which can be described as a term structure of *natural* interest rates. The position of a natural YC is discussed below.

6.1 POSITION OF THE NATURAL YC

We can see a conflict between the theories of BB and BH. According to BB the practice of BSLL lowers the whole YC. Although BB do not explicitly call it a YC, what they describe is in fact a decrease of the whole YC. This fall of interest rates under the natural interest rates should cause ABC. On the contrary, according to BH lowering of the whole YC happens only during credit expansion (FRB), whereas BSLL leads to its flattening. Furthermore, BH think that if calculations of market agents are not distorted by a governmental intervention,[30] BSLL should not cause ABC.[31] 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 lays under the original for all maturities longer than zero; second, a YC that is flatter than the original caused by increased yields for short maturities and

[29] "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).
[30] It can be argued that central banks are government institutions. They vary in degree of their independence, but are never market institutions.
[31] McColloch (1981, p. 106) assets the same: "Presumably in a world of laissez-faire financial market, intermediaries would be forced by competition for the deposits of risk-averse depositors to match the maturity structures of their assets and liabilities much more closely."

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. There are markets for different maturities. For example, savers can buy government bonds from the US government with maturities discontinuously spanning from 1 month up to 30 years. However, these bonds are traded on secondary markets, which justifies plotting a continuous YC, since savers can buy bonds maturing in terms of days. To simplify the exposition, I will not plot an infinite number of loanable funds markets reflecting the continuity of time. In figure 13 we can see three representative markets I choose instead.

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 does the maturity X lie. 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. 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 (BH, 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.

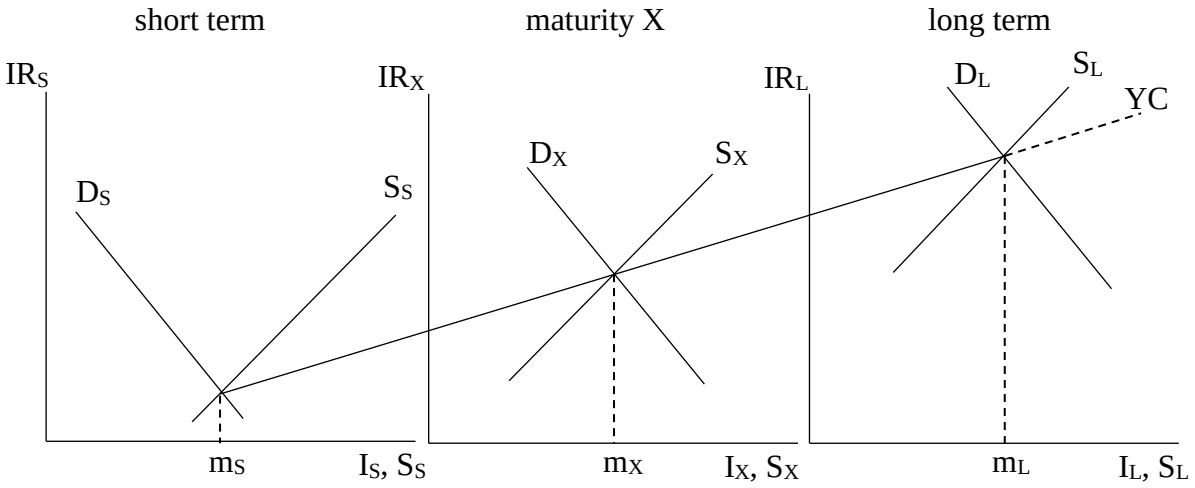
The following statement of Böhm-Bawerk (1930, p. 84) supports two assumptions made about the shape of the yield curve: "…every lengthening of the roundabout process is accompanied by a further increase in the technical result; as the process, however, is lengthened the amount of product, as a rule, increases in a smaller proportion." First, the YC is upward sloping due to the increasing productivity of more roundabout production methods. Second, its positive slope is decreasing with longer maturity, since the returns to roundaboutness are marginally diminishing.[32] Figure 13 displays a linear YC. This simplification was done for the sake of a more direct presentation of BSLL's effect. Otherwise, the slope would be steeper between short term market and maturity X.

Supply curves are also situated in different positions depending on the market. 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).[33] 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 rate of the premium's growth diminishes as the maturities increase…" (Cwik, 2004, pp. 62-63). This marginally diminishing premium forms a supply side source of the decreasing positive slope of the YC. I again point out the fact that figure 13 shows a simplified linear YC.

[32] Adherents of the pure-time-preference theory (PTPT) oppose the idea of interest rate determined by productivity. Potužák (2015) exposes PTPT's shortcomings and shows that "…the time preference in the Misesian sense (the superiority of present satisfaction) is neither a necessary nor a sufficient condition for the existence of interest." (ibid., p. 147).

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

Figure 13: Loanable funds markets for different maturities



This framework enables us to show the fundamental forces shifting the yield curve when financial intermediaries practice BSLL. Figure 13 depicts the initial situation without intermediaries practicing BSLL. In this situation time preferences, and therefore the structure of saving, are aligned with the investment and production structure. ABC does not develop in this setting.

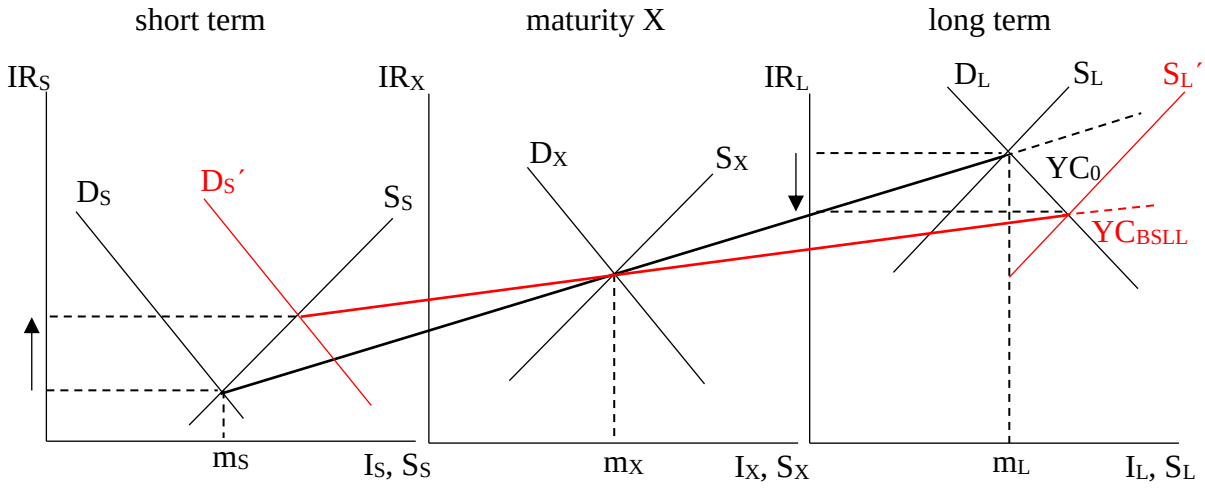
Financial intermediaries entering the market will be motivated to exploit the price difference between short term and long term markets. They demand additional loanable funds, shifting the demand curve in short term market and offer them on long term market, shifting the supply curve. This increases IR_S and decreases IR_L. Figure 14 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.[34]

BB 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 BB's

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

hypothesis, we would shift all supply curves on the loanable funds markets to the right, and that conflicts with the description of BSLL in previous paragraph. [35]

Figure 14: The effect of BSLL in loanable funds markets



The effect of BSLL described above corresponds to the theory of BH. Thus, they are right about how the BSLL affects the YC. However, it is not clear in their argumentation what the position of the natural YC 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 YC generated on a maturity matching market is not such. The following citation is a reminder of BH's position.

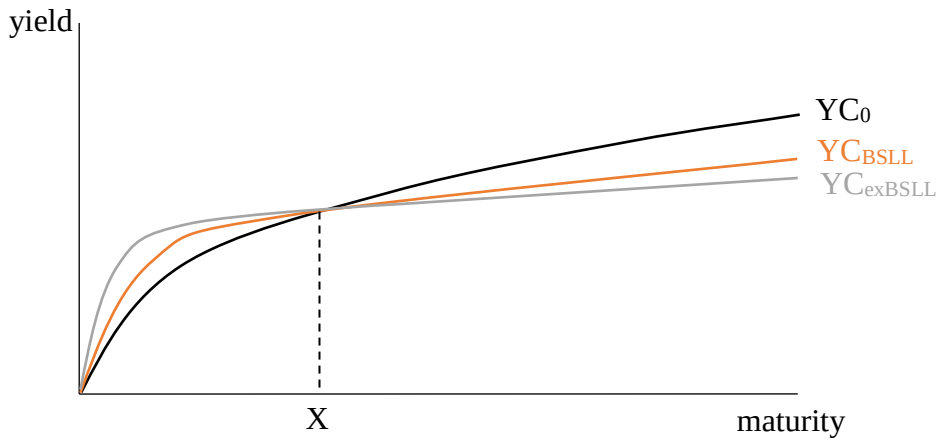
"There is nothing inherently unethical about banks transforming maturities within their loan portfolios. It is, indeed, an essential service for both savers and borrowers, and thus serves a definite welfare enhancing social function. There is too much of a good thing, however." (BH, 2013, p. 242)

BH suggest the existence of another YC that is not associated with ABC. This YC is generated on a market where intermediaries practice BSLL and their estimations

[35] However, lowering of the whole term structure for all positive maturities is caused by the entry of a mismatched *demand* deposit bank (bank practicing FRB). FRB also causes flattening of the YC. The only difference is the position of the pivot point X. The pivot point rests at zero maturity in case of FRB, if we assume zero interest rate for demand deposits. This would be in compliance with BB's theory that FRB is only a subset of BSLL.

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 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 YCs are shown in figure 15 – 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.

Figure 15: Shifts of the YC



BH (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.

So, why would Friday roll over Robinsons debt or why would he not? Let's further analyze that example. Friday lends berries to Robinson for 10 days. Robinson's project takes 20 days to complete; therefore, he is unable to repay after 10 days. Friday could roll over the loan for Robinson, but he originally wanted to consume in 10 days not 20, so, if his time preferences did not change, Robinson would have to offer a higher interest rate in order to roll over the loan. Friday would renew the loan with the same interest rate only if his time preferences decreased.[36]

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. The only way in which they could continuously roll over their debts is a steady decline in time preferences every time they need to roll over the debt. Assuming the long term stability of time preferences, periods of BSLL practice (decreasing time preferences) would need to be compensated by periods of BLLS (increasing time preferences). In the case of constant time preferences, there cannot be any BSLL that would not lead to ABC. Decreasing time preferences can sustain a natural YC in the form of a YC_{BSLL}. Increasing preferences would demand a YC that is under the YC_0 for short maturities and over YC_0 for long maturities (practicing BLLS would be necessary to achieve that).

So far, we have established that a natural YC embodies multiple loanable funds markets where the investment structure mirrors the saving structure. It seems to be the same as with the natural interest rate; yet, there is an ambiguity. The natural interest rate reflects the situation when saving and investment are aligned. An increase in time preference resulting in less real savings causes an economic downturn.[37] However, if entrepreneurs can predict future changes in time preferences, then a natural interest rate and natural YC

[36] There is a problem with BH's Robinsonian example. In this case, it does not merely simplify the reality by reducing the number of agents in the economy. It also leaves out the intermediary between lenders and borrowers, which might not be a problem. Assuming that financial intermediaries can predict future time preferences, the same could be said about other entrepreneurs in the economy, too. These entrepreneurs would be able to mismatch their assets and liabilities without banks as Robinson does. This would mean that our original YC would already be affected by BSLL to some degree (under the assumption that future time preferences are different from current ones) even without financial intermediaries. By holding such assumption we would completely separate the problem of maturity mismatching from the institutions providing financial intermediation.

[37] For a more detailed explanation see de Soto (2006, pp. 344-346).

respectively have to reflect that in the present. Therefore, no economic downturn should occur due to time preference change, since the information about future time preferences is already carried out by present term structure of interest. For the same reason, any movements in the term structure of interest rate due to time preference changes would be rendered impossible. The question needs to be asked whether or not entrepreneurs are really able to predict future time preferences.

A potential parallel can be drawn between the prediction of future time preferences and the argument of large numbers that defenders of FRB 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 FRB to protect themselves from withdrawals, because the very existence of FRB sets in motion such processes (the boom phase of 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 FRB.

Additionally, de Soto (ibid.) argues that when banks are allowed to practice FRB by law, they will utilize this privilege, despite increasing the probability of their bankruptcy and development of ABC. De Soto treats it as a typical tragedy of commons. Banks internalize all the benefits of holding fractional reserves and inflict costs onto other banks in the system. It is possible that maturity mismatching banks are prone to similar tendency. BSLL is legal, therefore banks are motivated to reap its benefit, while sharing their costs with other banks in the system. If the assumption of BSLL's legitimacy is correct, and if the tragedy of commons applies, then ABC caused by maturity mismatching is inevitable even in free market environment and under the assumption of entrepreneurs being able to predict future time preferences.

The above analysis of BH's theory was done without scrutinizing an implicit assumption of their Robinsonian example, where Robinson and Friday represented maturity mismatching banks and their clients. However, one of their assumptions is highly questionable. 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 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 BH and BB 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.

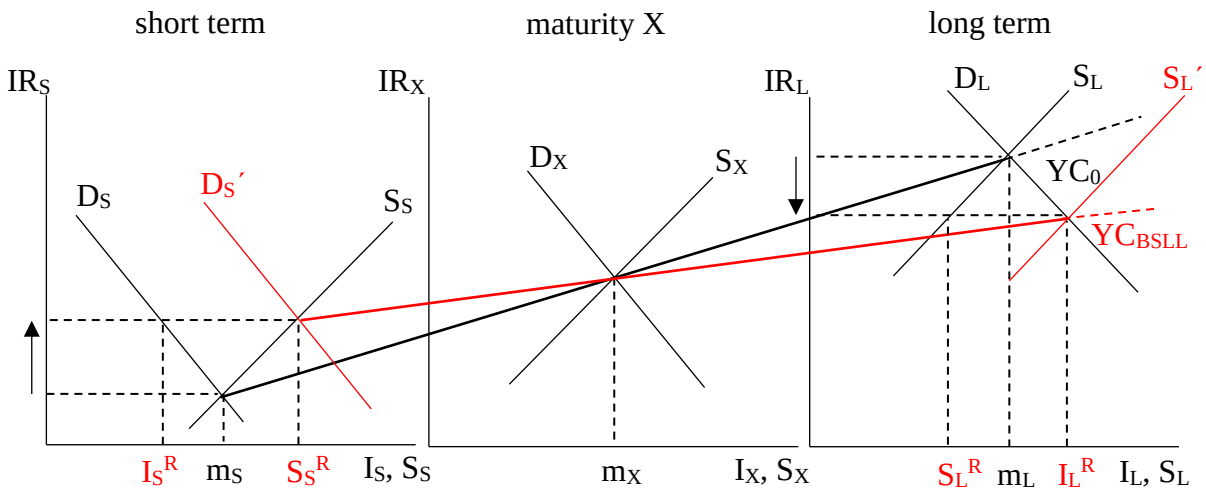
Assuming no information asymmetry between banks (borrowers) and their clients (lenders), the choice of maturity mismatching would come at a price. Clients of mismatching banks would require higher interest payments on their time deposits than clients of matching banks. Therefore, the ability of banks 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 FRB deposits 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 ensues.

The previously mentioned miscoordination can be demonstrated in our loanable funds framework (see figure 16). 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 market YC from natural YC 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 consumers goods in the distant future, which is in conflict with inter-temporal choices of savers whose saving and dissaving schedules reflect opposite consumption plans.

Figure 16: The mismatch of real saving and real investment



In conclusion, any degree of BSLL causes malinvestment; therefore, natural YC is the original YC_0 (see figures 14 and 15). The YC_{BSLL} and the YC_{exBSLL} are only quantitively different from each other. BSLL can cause ABC despite its legitimacy. It decreases real short term investment and increases real long term investments (see figure 16). 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 YC (term structure of natural interest). When the actual YC falls under or more generally deviates from the natural YC, an ABC develops.

7 BSLL IN DATA

The main objective of this thesis to clarify the theory of maturity mismatching and to advance the concept of natural YC has been completed at this point. Austrian methodology, mainly a Misesian purely praxeological approach, does not require and even denies the possibility of empirical verification and falsification of economic theories; [38] however, I see studying empirical data as the next logical step.

Although Austrian empirical literature is not quite as broad as the mainstream one, Austrian economists try to find empirical evidence of ABCT despite their methodological

[38] "It is impossible to reform the sciences of human action according to the pattern of physics and the other natural sciences. … Neither experimental verification nor experimental falsification of a general proposition are possible in this field" (Mises, 1998, p. 31).

inheritance. The first one was Wainhouse (1984), who tested his ABCT based hypotheses on USA data from period of 1959-1981. Three of these hypotheses were tested with the use of the Granger causality test. Since Wainhouse's application of the Granger causality test, others followed and applied it in empirical research focusing on the ABCT.[39] Therefore, I will use the concept of Granger causality to test my own hypotheses, since it proved to be a useful tool at analyzing dynamic relationships which constitute the ABCT.

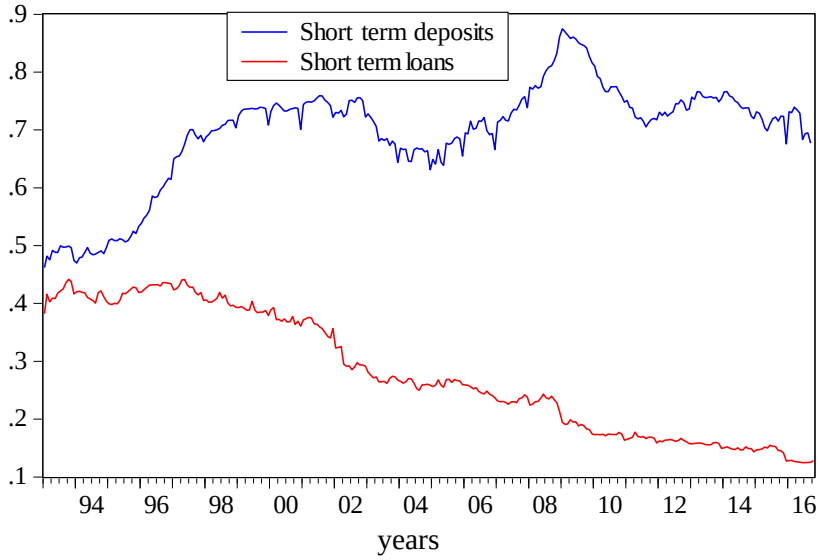
The previous sections presented a theory which explains the effects of BSLL on the slope of the YC. Before proceeding with an econometric analysis of the hypotheses based on this theory, a basic graphical analysis can be used to demonstrate the most underlying assumption regarding loan intermediation. Throughout this thesis, it has been assumed that financial intermediaries are motivated by the interest rate spread to mismatch maturities (borrow short, lend long), and that they also act upon this motivation. The graphs below (figures 17, 18 and 19) depict ratios of loans and term deposits of different maturities to the total volume of loans and term deposits.[40] 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 figure 16). 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. Figure 17 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 figure 19). This is in accordance with the findings presented at the end of section 6 in figure 16. We can see that the divergence in the short term market accelerated both before the Czech currency crisis in 1997 and before the financial crisis in 2008. In addition, medium term loans and deposits are relatively

[39] For example Carilli and Dempster (2008), Bjerkenes et al. (2010) and Komrska (2013) also used tests of Granger causality. Other authors applied different econometric methods (e.g. Keeler, 2001).
[40] These graphs are based on data from the Czech banking sector. Only loans and deposits made in CZK are counted.

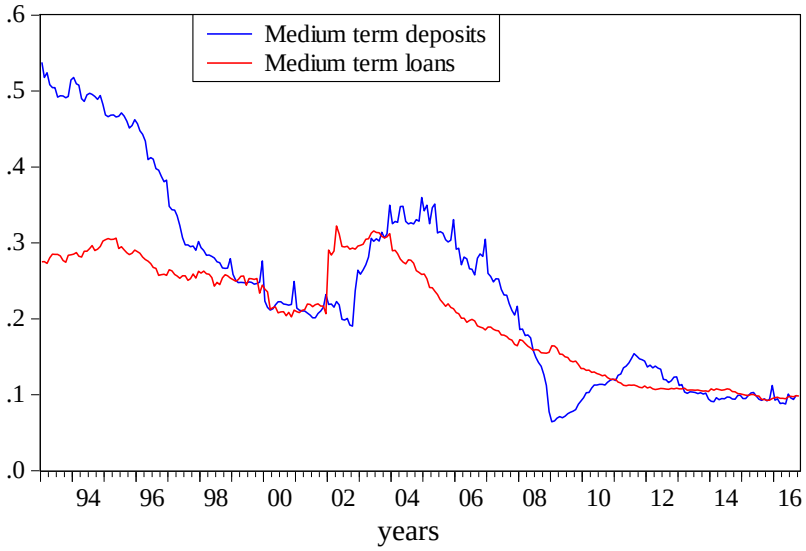
equalized, which supports the existence of a loanable funds market with maturity X. Volume of real saving and investment (loans granted by banks) does not diverge in this market when banks practice BSLL. Therefore, the data suggest maturity X to lay between one and five years.

Figure 17 – The development of the share of short term loans and short term deposits on the total volume of loans and term deposits (1993-2016)



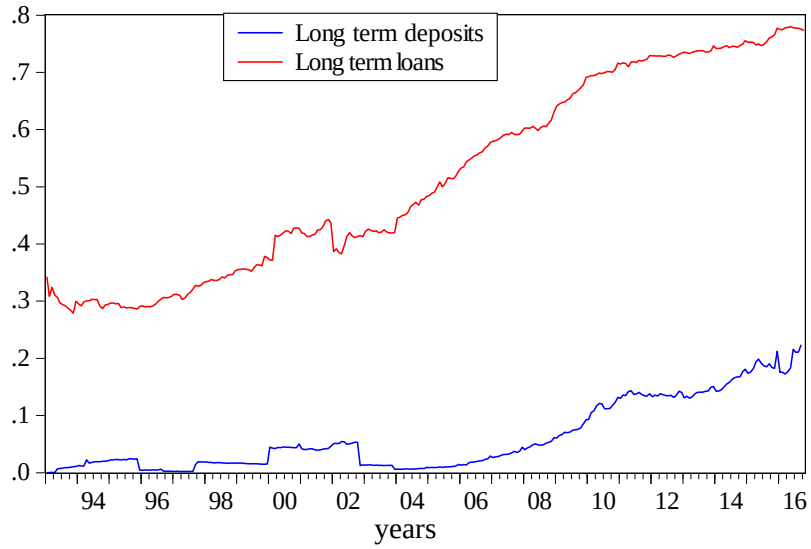
Source: Czech National Bank, ARAD

Figure 18: The development of the share of medium term loans and medium term deposits on the total volume of loans and term deposits (1993-2016)



Source: Czech National Bank, ARAD

Figure 19: 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: Czech National Bank, ARAD

7.1 HYPOTHESES

The basic assumption of the existence of BSLL has been proved by the graphical analysis above. Section 6.1 showed that BSLL ceteris paribus causes the slope of the YC to decrease. First, this is associated with lower volume of loans granted by banks in the short term market (I_S^R decreases) and with more funds lend out in the long term market (I_L^R increases). Second, BSLL is associated with an increase in short term deposits (S_S^R) and a decrease in long term deposits (S_L^R). I derive four hypotheses from these conclusion:

(1) A relative increase in long term loans to short term loans causes the slope of the YC to decrease.
(2) A relative increase in short term deposits to long term deposits causes the slope of the YC to decrease.
(3) A relative increase in short term deposits to short term loans causes the slope of the YC to decrease.
(4) A relative increase in long term loans to long term deposits causes the slope of the YC to decrease.

7.2 MODEL

These hypotheses will be subjected to two empirical tests: the test of Granger causality and impulse response function (IRF). Granger causality is a method of determining a certain form of a causality that is not identical with a common perception of causal relations. By Granger´s (1969, p. 428) definition, variable Y is causing variable X, denoted by $Y_t \rightarrow X_t$, when the use of the variable Y in prediction of the variable X improves the results. Thus, the Granger causality will be used to determine whether there is an observable and to our theory relevant connection between given variables. However, the Granger causality test determines only the existence of a causal relation, but it does not reveal if the effect of one variable on another is positive or negative. Therefore, it will be supplemented by an analysis of IRF, which is designed to do that. In order to perform these tests, I will estimate two-variable VAR models without a constant[41] for each pair of variables. The number of lags used in VAR models will be determined on the basis of information criteria.

Two conditions have to be fulfilled in order to confirm a hypothesis. Firstly, the Granger causality test has to identify a causality in an appropriate direction. Secondly, the IRF has to exhibit behavior in accordance with a given hypothesis.

7.3 DATA

The required data are not available for states which commonly offer longer time series than the Czech Republic; therefore, I use Czech data.[42] The bottom border of the dataset is determined by the availability of yields for Czech bonds with a maturity of two years which starts in 1/2004. The original dataset spanning from 1/2004 to 10/2016 has been restricted to 1/2004-12/2010 after the analysis did not bring any significant results. It was observed that the significance of results was decreasing when longer periods after the start of the crisis in 2008 were included. Nevertheless, the dataset still includes two years of data after the crises began. Relationships that can be observed within the period 1/2004-12/2010 break down completely in the year 2012 and thereafter. This change can be a

[41] This is done in accordance to Granger (1969, p. 427) who does not use a constant in his two-variable model.
[42] Data have not been found for USA, Great Britain and Japan. Germany does offer similar data, however, the Czech methodology of constructing required aggregates is clearer.

result of the basic interest rate set by the Czech National Bank hitting technical zero at the end of 2012.[43] A second possible explanation is the verbal and consequently currency based exchange rate intervention carried out by the Czech National Bank after depleting its basic monetary tool of interest setting. Exchange rate interventions caused a speculative demand for Czech currency, which the Czech National Bank compensated for by foreign currency purchases. This can be observed in the graph of increasing foreign exchange reserves (see appendix 2). This speculative demand for Czech currency most likely had an impact on yields of Czech government bonds since speculators are motivated to hold interest bearing bonds rather than zero yield currency. It could be asserted that the system of monetary relations has been corrupted when central banks started to use less orthodox methods in dealing with consequences of the financial crisis.

Monthly data is used in order to maximize the number of observations in the dataset and to prevent an erroneous identification of an instantaneous causality.[44] All underlying data (yields of government bonds, volumes of short term and long term deposits and loans) has been tested for seasonality by analysis of autocorrelation functions. None of the underlying data has been found to be seasonal; therefore, they have not been seasonally adjusted. Summary statistics of the underlying time series can be found in appendix 3.

7.4 VARIABLES

LOAN RATIO

A simple ratio of long term to short term loans was constructed to represent their relative movement. Short term loans are all loans with maturities of one year and less granted by the Czech banking sector as a whole and denominated in CZK. One year is the shortest

[43] The two-week repo rate reached 0.06% in 11/2012 and then technical zero of 0.05% a month later.

[44] Instantaneous causality between two variables occurs when the use of current values of one variable helps to better predict current values of the other. "Suppose Y_t => X_t with lag one unit but that the series are sampled every two time units. Then although there is no real instantaneous causality, the definitions will appear to suggest that such causality is occurring" (Granger, 1969, p. 430).

maturity for which the Czech National Bank generates aggregate data. Long term loans have the same characteristics with the exception of their maturity which is longer than five years.

$$LOAN\ RATIO = \frac{LONG\ LOANS}{SHORT\ LOANS}$$

DEPOSIT RATIO

The relative movement of short term and long term deposits is captured in a similar way to the movement of loans. Respective variable is constructed using the volume of long term deposits with maturities longer than five years. In contrast to short term loans with maturities of up to one year, short term deposits in this case include deposits with maturities of three months and shorter. Maturity of three months is the shortest maturity for which the Czech National Bank generates aggregate data. The use of short term deposits with maturities shorter than one year was not possible since a stationarity of the variable *DEPOSIT RATIO* could not be achieved in a straight forward manner.

$$DEPOSIT\ RATIO = \frac{SHORT\ DEPOSITS}{LONG\ DEPOSITS}$$

SHORT RATIO and *LONG RATIO*

The third hypothesis requires a variable expressing the relative movement of loans and deposits in the short term market. The ratio of short term deposits and short term loans serves this purpose. Short term deposits and short term loans have the same characteristics to values used in the construction of the first two variables.

$$SHORT\ RATIO = \frac{SHORT\ DEPOSITS}{SHORT\ LOANS}$$

A variable expressing the relative movement in the long term market is constructed in a similar way.

$$LONG\ RATIO = \frac{LONG\ LOANS}{LONG\ DEPOSITS}$$

YIELD

The slope of the yield curve was chosen over the gap between long term and short term rates, because a slope is closer related to our theory. However, using the gap version produced similar results.

$$YIELD = \frac{1 + GOV10Y}{1 + GOV2Y}$$

The Czech National Bank calculates yields of Czech government bonds only for maturities of two, five and ten years. Therefore, the widest maturity differential of two and ten years was used for the construction of the variable *YIELD*. The interbank interest rate PRIBOR or REPO rate of the Czech National Bank could be used to push the short end of the YC further to shorter maturities. Yet, the yield of government bonds is still preferred because the REPO rate is not directly influenced by market forces, and the PRIBOR is an interest rate set for subjects with different risk profile than is the Czech Republic.

7.4.1 STATIONARITY

Stationary time series are required to prevent a spurious regression that can occur when the variables used in a certain model demonstrate a trend. The correlations between such variables is then driven rather by the trend than by real relations. From the development of our time series in figure 20 we can see that given data exhibit such a trend. Non-stationarity was confirmed by Augmented Dickey-Fuller (ADF) test (see figure 21).[45]

[45] The null hypothesis of the ADF test is the existence of a unit root. Therefore, p-values lower than 0,05 lead to a rejection of non-stationarity on a significance level of 5%.

Figure 20 – Development of level time series (1/2004-12/2010)

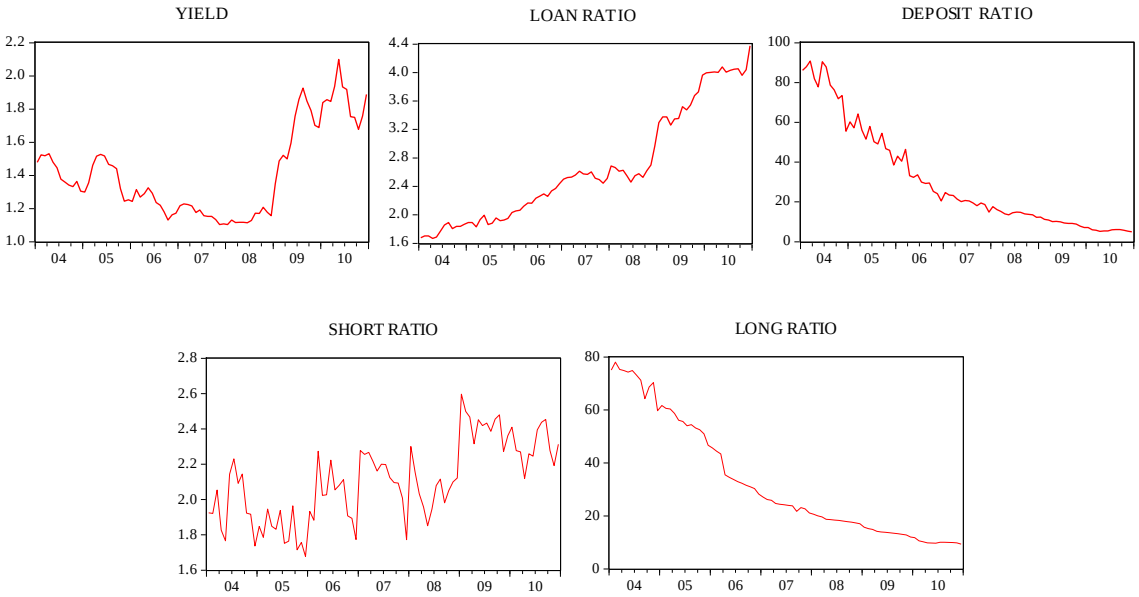


Figure 21 – The results of the Augmented Dickey-Fuller test for variables at their level values and their percental changes

Variable	p-value for level	p-value for percentage change
YIELD	0.7948	0.0000
LOAN RATIO	0.9981	0.0001
DEPOSIT RATIO	0.4432	0.0001
SHORT RATIO	0.1069	0.0001
LONG RATIO	0.2271	0.0001

The most basic method how to stationarize time series is differentiation. However, in this case it proved more efficient to convert level data to the inter month percentage changes. Hereafter, all variables will include a "pc" prefix. Figure 21 presents results of ADF tests which lead to a rejection of non-stationarity for all converted variables on a 5% level of significance.

7.5 RESULTS OF EMPIRICAL ANALYSIS

7.5.1 HYPOTHESIS (1)

The first hypothesis states that a relative increase in long term loans to short term loans causes the slope of the YC to decrease. To confirm that, two conditions need to be fulfilled. First, we have to observe that *pc_LOAN_RATIO* Granger causes *pc_YIELD.*[46] As we can see in figure 22, null hypothesis has been rejected only in the first case. Therefore, *pc_LOAN_RATIO* is Granger causing *pc_YIELD* and the condition is met.

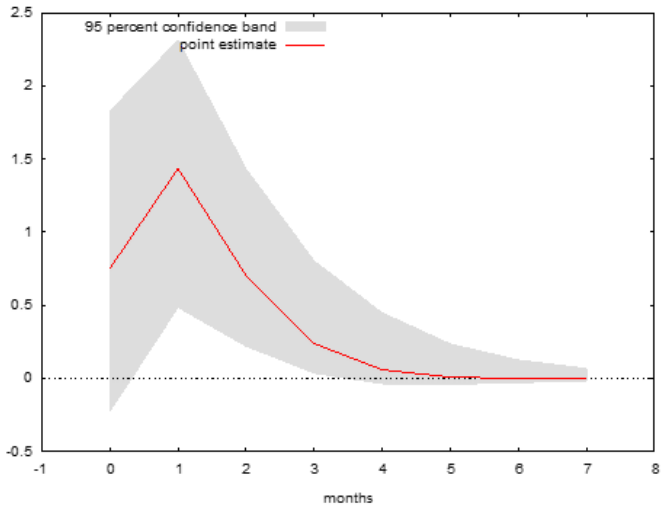
Figure 22 – Results of Granger causality test for pc_YIELD and pc_LOAN_RATIO

Relation direction	**p-value**	**H_0: Granger causality does not exist**
pc_LOAN_RATIO → pc_YIELD	0.0065	Rejected
pc_YIELD → pc_LOAN_RATIO	0.4151	Not rejected

The second condition that has to be fulfilled involves the behavior of the IRF. We should observe a decrease in the variable *pc_YIELD* when a positive shock in *pc_LOAN_RATIO* is introduced. Figure 23 shows the opposite. The variable *pc_YIELD* increases immediately and continues to do so in the first two months after the shock and only after six months returns to its initial level. This change is statistically significant for 1st, 2nd and by a small margin also 3rd month after the shock. All results will be commented in the next section.

[46] Number of lags included in the VAR model was set to one based on all three information criteria (Akaike criterion, Schwarz Bayesian criterion and Hannan-Quinn criterion). The VAR model was then tested for autocorrelation and heteroskedasticity; none of them was detected.

Figure 23 – Response of pc_YIELD to a shock in pc_LOAN_RATIO, with bootstrap confidence interval



7.5.2 HYPOTHESIS (2)

The second hypothesis states that a relative increase in short term deposits to long term deposits causes the slope of the YC to decrease. To confirm that we first have to observe *pc_DEPOSIT_RATIO* Granger causing *pc_YIELD*.[47] As we can see in figure 24, null hypothesis has not been rejected in either case on the 5% level of significance. Therefore, *pc_DEPOSIT_RATIO* is not causing *pc_YIELD* and the condition is not met. However, the null hypothesis is not rejected in the appropriate direction at a 10% confidence level, which weekly suggest a connection between the two variables.

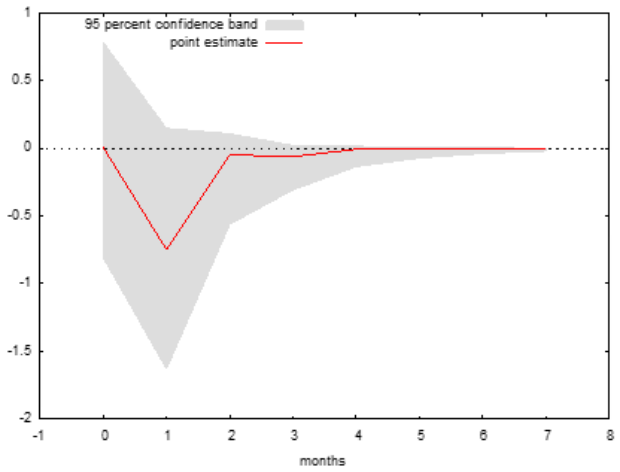
[47] Number of lags included in the VAR model was set to one based on all three information criteria (Akaike criterion, Schwarz Bayesian criterion and Hannan-Quinn criterion). The VAR model was tested for autocorrelation and heteroskedasticity. Autocorrelation was not present in the equation which served as a basis for the Granger causality test in direction *pc_DEPOSIT_RATIO → pc_YIELD*. It was present in the other, for our purposes less crucial equation. Heteroscedasticity was not detected.

Figure 24 – Results of Granger causality test for pc_YIELD and pc_DEPOSIT_RATIO

Relation direction	p-value	H_0: Granger causality does not exist
pc_DEPOSIT_RATIO → pc_YIELD	0.0920	Not rejected
pc_YIELD → pc_DEPOSIT_RATIO	0.9556	Not rejected

To fulfill the second condition, we would have to observe a decrease in the variable *pc_YIELD* when a positive shock in *pc_DEPOSIT_RATIO* is introduced. Figure 25 shows that *pc_YIELD* exhibits this behavior. The variable *pc_YIELD* increases in the first month after the shock and then gradually returns to its initial level. Even though the response has the right direction, it is not statistically significant.

Figure 25 – Response of pc_YIELD to a shock in pc_DEPOSIT_RATIO, with bootstrap confidence interval



7.5.3 HYPOTHESIS (3)

The third hypothesis states that a relative increase in short term deposits to short term loans causes the slope of the YC to decrease. To confirm that we first have to observe *pc_SHORT_RATIO* Granger causing *pc_YIELD*.[48] As we can see in figure 26, null

48 Number of lags included in the VAR model was set to one based on all three information criteria (Akaike criterion, Schwarz Bayesian criterion and Hannan-Quinn criterion). The VAR model was tested for autocorrelation and heteroskedasticity.

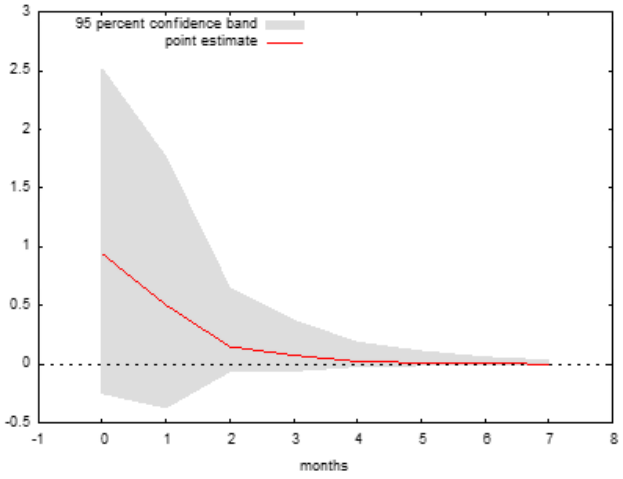
hypothesis has not been rejected in either case on the 5% level of significance. Therefore, *pc_SHORT_RATIO* is not causing *pc_YIELD* and the first condition is not met.

Figure 26 – Results of Granger causality test for pc_YIELD and pc_SHORT_RATIO

Relation direction	**p-value**	**H_0: Granger causality does not exist**
pc_SHORT_RATIO → pc_YIELD	0.7454	Not rejected
pc_YIELD → pc_SHORT_RATIO	0.3350	Not rejected

To fulfill the second condition, we would have to observe a decrease in the variable *pc_YIELD* when a positive shock in *pc_SHORT_RATIO* is introduced. Figure 27 shows that *pc_YIELD* does not exhibit this behavior. The variable *pc_YIELD* increases immediately after the shock and then gradually returns to its initial level. The response does not have the appropriate direction, however, it is not statistically significant.

Figure 27 – Response of PC_YIELD to a shock in PC_SHORT_RATIO, with bootstrap confidence interval



Autocorrelation was not present in the equation which served as a basis for the Granger causality test in direction *pc_SHORT_RATIO → pc_YIELD.* It was present in the other, for our purposes less crucial equation. Heteroscedasticity was also detected only in the case of the less crucial equation.

7.5.4 HYPOTHESIS (4)

The fourth hypothesis states that a relative increase in long term loans to long term deposits causes the slope of the YC to decrease. To confirm that we first have to observe *pc_LONG_RATIO* Granger causing *pc_YIELD*.[49] As we can see in figure 28, null hypothesis has not been rejected in either case on the 5% level of significance. Therefore, *pc_LONG_RATIO* is not causing *pc_YIELD* and the condition is not met.

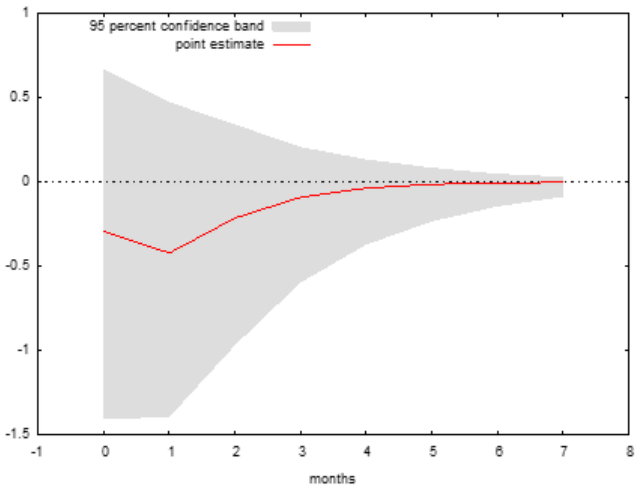
Figure 28 – Results of Granger causality test for pc_YIELD and *pc_LONG_RATIO*

Relation direction	**p-value**	**H_0: Granger causality does not exist**
pc_LONG_RATIO → pc_YIELD	0.1604	Not rejected
pc_YIELD → pc_LONG_RATIO	0.4526	Not rejected

To fulfill the second condition, we would have to observe a decrease in the variable *pc_YIELD* when a positive shock in *pc_LONG_RATIO* is introduced. Figure 29 shows that *pc_YIELD* exhibits this behavior. The variable *pc_YIELD* increases immediately after the shock and then gradually returns to its initial level. While the response has the right direction, it is not statistically significant.

[49] Number of lags included in the VAR model was set to one based on two information criteria (Schwarz Bayesian criterion and Hannan-Quinn criterion). The VAR model was tested for autocorrelation and heteroskedasticity. Autocorrelation was not present in the equation which served as a basis for the Granger causality test in direction *pc_LONG_RATIO → pc_YIELD.* It was present in the other, for our purposes less crucial equation. Heteroscedasticity was not detected.

Figure 29 – Response of PC_YIELD to a shock in PC_LONG_RATIO, with bootstrap confidence interval



7.5.5 A SUMMARY OF EMPIRICAL RESULTS WITH COMMENTARY

Only tests of the first hypothesis yielded statistically significant results. While the Granger causality was detected in the expected direction, the IRF exhibited opposite behavior from the hypothesized one. Tests of hypotheses (1), (2) and (3) produced insignificant results in both the Granger causality test and the IRF. These are the possible explanations.

First, our hypotheses are based on a BSLL analysis that holds other things equal. One of which are inflation expectations. It was also assumed that banks hold full reserves. Other authors such as Cwik (2004, 2005) and Keeler (2001) dealt with a general credit expansion and did not hold the same assumptions. On the contrary, Cwik simplified his theoretical analysis by assuming maturity matching banks. He came to a conclusion that a downward pressure on the long term interest rate created by new loans should be countered by increasing inflation expectations. However, fixed long term rate would still lead to a decreasing slope of the YC in case of BSLL. It seems that fractional reserve banking and demand (not term) deposits play a crucial role here. Keeler (2001) in his empirical analysis showed that the YC shifts down and becomes steeper during credit expansion. This partially corresponds to the findings presented in section 6 that credit expansion based on fractional reserves puts a downward pressure on the whole YC. What is missing are the increasing inflation expectations stabilizing the long term interest rate. Thus, effects of BSLL and FRB have to be separated if we want to identify the true

consequences of BSLL. In addition, yields of government bonds could be adjusted for inflation expectations.

A second explanation is more fundamental and relates to the way in which hypotheses (1) and (2) were formulated. It might be the case of confusing a *movement along* a supply or demand curve with a *movement of* the curve itself. In the hypothesis (1), short term interest rate increased by BSLL decreases the volume of funds lent on the short term market (I_S^R decreases); the opposite happens in the long term market (I_L^R increases). These two movements reflect in an increased slope of the YC (see figure 16). However, an exogenous shock to the demand for loanable funds such as the one in IRF has the opposite effect. When the volume of demanded loanable funds is increased exogenously we do not move along the original demand curve, but the curve shifts instead. An exogenous increase in the variable *pc_LOAN_RATIO* would be demonstrated by a relatively larger shift of the D_L curve (larger than the shift of D_S) to the right. This shift would result in an increased slope of the YC, which corresponds to the behavior of the IRF presented in figure 23.

The explanation presented in the previous paragraph can be also applied to insignificant results in the case of hypothesis (2). When banks practice BSLL, increased short term interest rate causes an increase in the supply of short term loanable funds (S_S^R increases); the opposite happens in the long term market (S_L^R decreases). The YC becomes flatter as a result (see figure 16). In contrast, exogenous shock in *pc_DEPOSIT_RATIO* would be represented by a relatively (relative to the S_L) larger shift of the short term supply curve (S_S) to the right. This relative movement of supply curves would be associated with an increasing slope of the YC, not decreasing as it is assumed in the second hypothesis.

Hypotheses (3) and (4) do not have the same flaw as hypotheses (1) and (2). The divergence of short term loans and deposits (I_S^R and S_S^R) and divergence of long term loans and deposits (I_L^R and S_L^R) is necessarily the result of maturity mismatching in a closed system. Nevertheless, effects of inflation expectations and FRB are still omitted; therefore, the first explanation of insignificant results still applies.

Lastly, there is a discrepancy between the loanable funds variables in theory and in reality. In theory, the supply of loanable funds is the net saving. Consumer loans are netted out

against consumer saving. In reality, we regard term deposits as saving without subtracting consumer loans. The same applies to investment. Thus, in order to improve an empirical study of BSLL, loanable funds variables should be adjusted for consumer loans. This proves to be difficult if not impossible to do, since the data aggregation is either based on a maturity or on a purpose of loans. In other words, we do not know what portion of short term loans is purposed for consumption and which for investment. This also applies to other maturities.

CONCLUSION

This thesis clarified the debate between Bagus and Howden, and Barnett and Block. Firstly, it showed that maturity mismatching in the form of BSLL is a legitimate practice. BB make the mistake of not acknowledging the distinction between present and future goods, in other words they ignore the inter-temporal character of a loan contract. Their other mistake is that they blend definitions of a mutuum and commodatum contract. In turn, BH's assessment of the BSLL's legitimacy proves to be the correct one. Thus, the requirement of 100% reserves cannot be generalized in the form of perfect maturity matching and applied to term deposits. Although BSLL should not be forbidden by law, it has detrimental effects when banks have increased motivation to practice it. The central bank as a lender of the last resort and the state with its "too big to fail" policies artificially increase this motivation.

Secondly, using the loanable funds market framework, it was proved that BSLL causes the YC to pivot rather than to shift downward. This once again revealed a flaw in BB's theory. While, BH correctly assess the movement of the YC, 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 YC as the term structure of the natural interest rates. Natural YC corresponds to a situation when maturities match along the whole term structure. Only then the production structure matches the inter-temporal choices of consumers.

Four hypotheses based on the theory of maturity mismatching were empirically tested in the last section. None of them has been confirmed, and the first one was rejected on a statistically significant level. The rejection of hypothesis (1) and insignificant results in case of hypothesis (2) can be explained by their fundamentally flawed construction. On one hand, they do correspond to the observations from the loanable funds market. On the other hand, they constitute a mistaken substitution of moving along a curve with a move of the curve itself in an economic sense. However, hypotheses (3) and (4) are constructed in a way that should exclude the possibility of such an error. Despite that, empirical results were statistically insignificant in both of those cases. As is discussed at the end of the

empirical section, the results of the empirical tests could be improved if the YC time series was adjusted for inflation expectations. This would bring additional complications because this information is not straightforwardly attainable and a proxy variable would have to be chosen. Also, volumes of loans and deposits would need to be adjusted for consumer loans to better fit the theoretical concepts of saving and investment. Last but not the least, separating the effect of FRB on the YC should help to provide a better estimate of the influence of BSLL.

The natural YC represents one of the missing pieces in the Austrian theory, and this thesis represents one of the first steps (if not the very first step) at methodically defining the natural YC 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 framework of a single loanable funds market and Hayek's triangle. Besides the obvious use of the natural YC in the ABCT, there is space for a synthesis with mainstream models of the YC and other models such as the bank run model of Diamond and Dybvig (1983).

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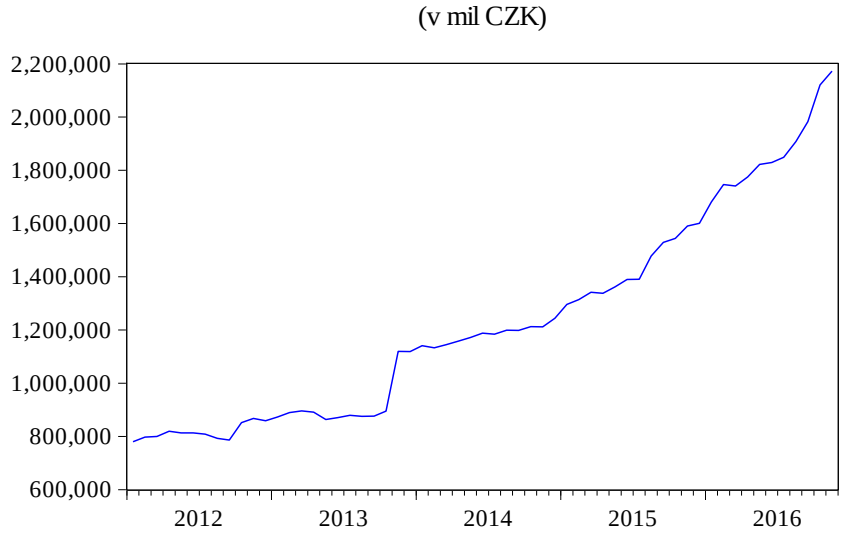
APPENDICES

Appendix 1: Original table used by Bagus and Howden (2013, p. 238)

		Purpose	
		Transfer of ownership	**Safekeeping**
Type of good	Specific	*Commodatum*	Regular deposit
	Fungible	*Mutuum*	Irregular deposit

Appendix 2: Foreign exchange reserves of the Czech National Bank (2012-2016)



Appendix 3: Summary statistics of underlying data (1/2004-12/2010)

	GOV2Y	*GOV10Y*	*SHORT LOANS*
Mean	2,84	4,26	303363,43
Median	31444,00	4,23	309746,25
Maximum	42494,00	16558,00	422485,20
Minimum	15707,00	45717,00	211777,00
Std. Dev.	0,80	0,58	56732,46
Observations	84,00	84,00	84,00

	LONG LOANS	*SHORT DEPOSITS*	*LONG DEPOSITS*
Mean	832184,49	643676,83	48279,81
Median	814526,90	668008,80	33786,10
Maximum	1343104,50	902532,90	143203,10
Minimum	363612,40	393277,50	4706,80
Std. Dev.	331713,82	155920,27	42869,47
Observations	84	84	84