universität wien

Diplomarbeit

Titel der Diplomarbeit

"Currency Competition – Hayek revisited"

Verfasser:

Peter Schneider

angestrebter akademischer Grad:

Magister der Sozial- und Wirtschaftswissenschaften
(Mag. rer. soc. oec.)

Wien, im August 2010

Studienkennzahl lt. Studienblatt:	A140
Studienrichtung lt. Studienblatt:	Diplomstudium Volkswirtschaft
Betreuer:	Ao. Univ.-Prof. Mag. Dr. Wolfgang Weigel

… meinen Eltern, die mir mein Studium ermöglicht haben

… meinen Geschwistern, die mich im Studium unterstützt haben

… meinen Freunden, die mich während des Studiums ertragen haben

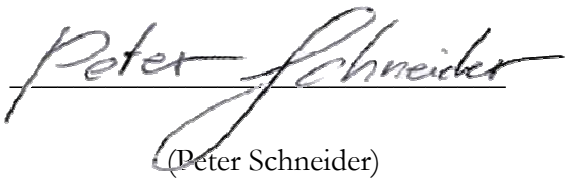
EIDESSTATTLICHE ERKLÄRUNG

Ich erkläre hiermit an Eides statt, dass ich die vorliegende Arbeit selbstständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht.

Die Arbeit wurde bisher in gleicher oder ähnlicher Form keiner anderen Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht.

Wien, im August 2010

Unterschrift:



(Peter Schneider)

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

1. INTRODUCTION

> "The purpose of this scheme is to impose upon existing monetary and financial agencies a very much needed discipline by making it impossible for any of them, or for any length of time, to issue a kind of money substantially less reliable and useful than the money of any other."[1]
>
> F. A. Hayek

Probably the best description of the state of today's monetary system might be Walther Bagehot's words: "Nothing but a revolution would effect it, and there is nothing to cause a revolution"[2]. In the absence of high inflation or recessionary tendencies, there is no great public clamour for a change in existing institutional arrangements. It is the experience of economic crises, which provokes regularly discussions about reforms of the existing regime or formation of an alternative economic regime. The most outstanding and controversial proposal about an alteration of the current system was made by Friedrich August Hayek. In his book "*Denationalisation of Money*", first published in 1976, he criticized the idea of centralized economic institutions (like central banks) and designed rules. In his view, both can never be as efficient as the market process guided by relative prices. The reason lies in the vulnerability of central banks to pressures from government or special interest groups and so central bankers will issue more money than socially efficient to collect revenues and finance government expenditures. Thence Hayek called for the introduction of competition in the process of money supply to free money from politics and its inflationary pressure.

However, much of Hayek's book combines an economic analysis and a more or less pamphlet-like description of the political process. This makes it quite difficult to extract the essence of his theoretical analysis and his argumentation appears to be very sketchy and

[1] All citations at the beginning of each chapter are taken from Hayek's book "Denationalisation of Money"
[2] Quoted after Selgin/White (1994) p. 1745

crude. (Boller 1992, pp. 48-53). The goal of this thesis is to revisit Hayek's idea and to focus on the economic implications and effects. The thesis tries to examine under which circumstances his idea of competing currencies could work. A striking feature of this approach to reconsideration is the assumption that there is no need for government intervention. All institutions are regarded as a spontaneous result of the intended interaction between economic agents. The only duty of government is to provide a legal framework in which the process of interaction can take place.

The outline of the paper is as follows. After the introduction, the second chapter examines the current financial system and stresses the relevance of its institutions, money, financial intermediation and central banking. This chapter shows that the development of all three of them is not necessarily subject to government intervention but rather can also be explained as a spontaneous result of interaction between humans. The section closes with an analysis of monetary policy which – especially expansionary monetary policy - is regarded as one of the main sources of inflation. It also offers a short description about two recent discussions in the conduction of monetary policy, respectively the independence and credibility problem. Although both are subject of several publications in the last two decades, they will not be part of the further work because the focus lies on other aspects.

Hayek's proposal of competing currencies was hatched out of the consideration how it could be possible to avoid inflation. Therefore the second chapter is dedicated to a brief examination on inflation. It continues where the previous chapter ended and offers an explanation how monetary policy is linked to the emergence of inflation. By describing the social and economic costs of inflation, the end of Chapter 3 provides the reasons why low and stable inflation is desirable.

Chapter 4 constitutes the main part of this thesis and deals with the possibility of currency competition. In the beginning the work develops a typology of currency competition by proposing that the different types are determined by the money issuing instance and the type of money. Thus, this framework provides four possibilities: (1) Monetary Standard Competition (2) International Currency Competition (3) Free Banking Competition and (4) Private Currency Competition. Subsequently the chapter will have a closer look on every single type and analyses their prospects in the current financial system. Finally, the work goes into recent developments in the idea of currency competition as well as a short discus-

sion about reserve banking (fractional or 100 %), as a factor for the inherent instability of the banking sector.

The last chapter is dedicated to some concluding comments, where the essences of the previous sections will be summarized. Additionally the chapter gives a perspective on a possible future of monetary policy with currency competition.

2. FINANCIAL INSTITUTIONS

> "On the effects of the adoption of the proposal all I will add at this point is that is of course intended to prevent national monetary and financial authorities from doing many things politically impossible to avoid so long as they have the power to do them."
>
> F. A. Hayek

Elaborating a theory of currency competition is just possible with a basic understanding of the institutional framework in which a possible currency competition takes place. The link between financial institutions/financial system and real economic output is subject to uncountable works and publications in the last decades, and even if an additional description by this author will not produce further insights in this topic, the need for it stems from its relevance for the examined issue. Standing in the tradition of Hayek the considerations about financial institutions are made under the assumption that there is no necessity of governmental intervention, but rather they are a "spontaneous result"[3].

2.1. Money

One of the key problems in Economics is the role of money in the structure of economic decisions and its effects on the economy. Because of the numerous connotations and variant uses of the word, it is useful to define the term and examine its different functions.

2.1.1. Definition of Money

An easy and useful way to convey a correct and general impression of money is to define it as "that which constitutes means of payment" (Hart 1968 p. 427). This broad defini-

[3] Spontaneous in that sense that institutions are not designed by a single planer, but rather emerge in a process of sequential learning.

tion could be narrowed down by defining money as "anything that is generally accepted in payment for goods and services or in the repayment of debts" (Mishkin 2007, p. 49). Both definitions give a first idea about the functions of money: (1) Medium of Exchange and (2) Unit of Account. The third one, which is not so obvious, is its function as a Store of Value. A missing dimension in the definition is its function as a legal tender i.e. when it is established by governmental rules as a satisfactory medium for settling debts in case of dispute. As it will be shown later, money is a product of social convergence and therefore the function as a legal tender could be neglected for now.

2.1.2. Functions of Money

Analyzing the functions of money, does not only improve the understanding of the monetary institutions, but is also crucial for the understanding of some aspects of currency competition. The reason is that in the literature about currency competition the combination of the functions "Unit of Account" and "Medium of Exchange" is often questioned. (Greenfield/Yeager 1983, p. 304; Boller 1992, pp. 95-100). Among the scholars seems to be a consensus that money serves in general three functions:[4]

The starting point in this argumentation is a pure barter economy with n individuals. Each of the individuals is specialized in producing one single good called g_n, where n denotes the produced good of each n individual.

[4] In his book, Denationalisation of Money – The Argument Refined, Hayek distinguish between four functions (cash purchases of commodities and services, holding reserves for future needs, contracts for deferred payments and unit of account), but in his view the could be more or less deduced from the function as a medium of exchange. (Hayek 2007, p. 67)

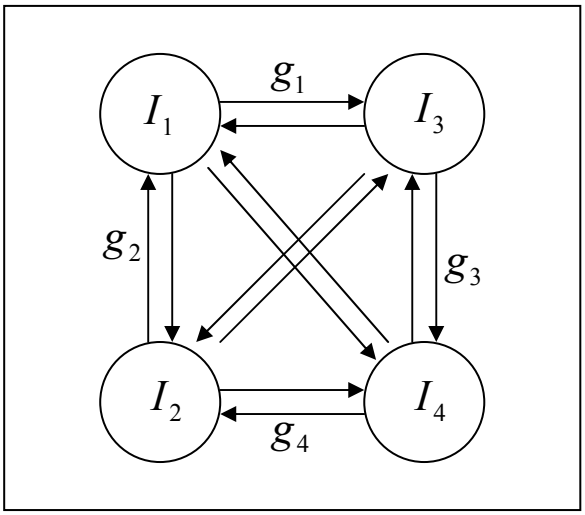


Figure 1: A Barter Economy with four individuals

Since each individual reaches a higher utility level when consuming a variety of goods, specialization in producing must be accompanied by exchange. In this situation one fundamental problem emerge: the "double coincidence of wants". This expression was introduced by Jevons and describes a situation where direct trade is only possible, when one individual can meet the needs of the other individual and vice-versa. A hungry tailor can only exchange her produced goods against bread, when the baker needs new clothes. Otherwise she has to exchange her clothes into something the baker needs and these sequences of bilateral trades (i.e. indirect trade) will be difficult and time consuming. This time spent trying to exchange goods or services, is called transaction cost. A commonly accepted **Medium of Exchange** reduces such transaction costs and makes decentralized exchange, specialization and division of labour possible. (Boller 1992, pp. 115-129; Hartmann 1998, p. 7; Jones 1976, pp. 760-761; Mishkin 2007, pp. 50-51)

The second function of money is its use to measure value in the economy i.e. a **Unit of Account**. In the sketched barter economy above, prices would be expressed in terms of the amount of goods being exchanged. This procedure will lead to a tremendous amount of prices.[5] The more complex the economy is, the more costs arise to gather information about prices. A unit, a numéraire, which by social convention (or imposition from government) is accepted in a society to value commodities and services sold, to compute costs, to reckon wealth, and to state debts, reduces again the transaction costs in an economy.

[5] With n goods the formula that tells us the number of prices is: $\frac{n(n-1)}{2}$

(Boller 1992, pp. 107-114; Hart 1968 p. 426; Mishkin 2007, pp. 51-52). The linkage between the function of Money as a Unit of Account and Money as a Medium of Exchange arises from the fact, that the unit of account often has a distinct name, but is defined in terms of the Medium of Exchange. Before 1933 the "Dollar" (Unit of Account) was defined as 0.04838 troy ounce of gold (Medium of Exchange), 90 percent fine. (White 1999, p. 27)

Indirect trade can be described as a two stage sequence, where in the first stage a good i is exchanged against one good n (Medium of Exchange) and in the second stage good n is exchanged against the desired good j. When the time span between the two stages grows, money also serves as a repository of purchasing power, as a **Store of Value**. (Miskin 2007, p. 52) As we will see later, it is this function, which constitutes the starting point for the explanation of money demand.

2.1.3. Evolution of Money

Up until now, no governmental intervention appeared in the functions of money.[6] The reason for that is that money is not an invention of any sovereign or governmental institution, but the result of social convergence. In every barter economy exist goods that are more likely to be accepted than other goods. For Menger this was a question of the degree of marketability (or saleableness). In the presence of transaction cost (i.e. where trade is costly) a more marketable good is a good that is easier to sell for a good price. Through communication, or trial-and-error experience, or by imitation of successful traders, market participants converge to the most suitable[7] Medium of Exchange. (Hartmann 1998, pp. 11-12, Selgin 1987, pp. 441-443; White 1999 pp. 3-7)

Whereas Menger focus on the price and the cost of trade Jones (1976) provides an explanation which emphasizes the importance of decentralized trade and beliefs of the market participants. Individuals believe that a randomly encountered individual would wish to exchange good j for good i with probability $p_i p_j$, where p_i denotes the probability that

[6] Only in the case of the unit of account when two parties have to agree upon a denomination standard. But also here government isn't a necessary condition to impose a standard for contracts. Even if lenders would prefer an appreciating and borrowers a depreciating currency, "it seems unlikely that market forces would produce a predominant bias in one direct". (Hayek 2007, pp 68-69)

[7] Suitability of good depends on (1) the ability to recognize its quality (2) its durability (3) whether it is divisible and fusible and (4) its portability

a randomly encountered trader would wish to buy/sell good i and p_j denotes the probability that a randomly encountered trader would wish to buy/sell good j. In the case of direct exchange, the number of encounters expected would be $\frac{1}{p_i p_j}$, and in the case of indirect exchange $\frac{1}{p_i p_n} + \frac{1}{p_n p_j}$, where $p_i p_n$ denotes the probability that a randomly encountered trader would wish to exchange good i against the medium of exchange n. Indirect trade takes place if and only if $\frac{1}{p_i p_j} > \frac{1}{p_i p_n} + \frac{1}{p_n p_j}$ or equivalently $p_n > p_i + p_j$. (Jones 1976, pp. 764-765) Through this approach could be shown, that in every barter economy a Medium of Exchange emerge, but it can also be applied on the Unit of Account function as well.

The above sketched model is very simple in the sense that its traders are somewhat naïve concerning both the equilibrium matching distribution (Jones simply assumes the condition that the beliefs of the sellers and the buyers have to be equal) and their choice of strategies. There are more sophisticated approaches (Kiyotaki/Wright 1989; Ritter 1995), but all have in common the existence of multiple locally stable equilibrium combinations. This implies that a common used Medium of Exchange (full monetization) is a possible, but not a necessary result and is sometimes only achieved through governmental intervention. This shortcoming[8] could be met with the introduction of network structures. Given a network structure it would constitute a stable equilibrium, when all players agree on using the same medium of exchange. (White 1999, pp. 93-94; Jackson/Watts 2002[9])

The next development money was subject to, was the transition from commodity money to (fiat) paper money. The first step could be interpreted as a result of efficiency claims. Although commodity money has all the attributes of an efficient medium of exchange paper money has some more advantages. Paper is highly divisible, portable and it can be made durable with the proper processing. However, there is no scarcity of paper[10],

[8] In the sense of Hayek's rejection of governmental disturbances in the evolution of money
[9] Even if the paper deals with a general case i.e. strategies are A and B, it is possible to apply it on the evolution of a common accepted medium of exchange.
[10] The reason is that the raw material for the production of paper, wood, is at the moment sufficiently available. A scarcity can occur, when (a) the natural resource tree disappears or (b) the knowledge of paper production vanishes into oblivion.

so paper itself would poorly function as a commodity money. The reason why people started to accept paper as Medium of Exchange was, that paper money based a claim on a commodity like gold or silver. (Goodfriend 1991, pp. 8-9) In times of crisis governments often suspended the convertibility of paper currency, but it continued to be an acceptable Medium of Exchange. People believed that convertibility would soon be restored and accepted intrinsically worthless pieces of paper. The value of money was decoupled from the value of the commodity and the credibility of the money issuing institution became the determining force in the supply of money. (Ritter 1995, p. 135) Another reason for the last step could be found in the use of sophisticated accounting methods. If all transactions are carried out without any physically Medium of Exchange, then the commodity could easily be replaced by a pure nominal commodity as the numéraire (Fama 1980, p. 42). It was that decoupling which enabled monetary institutions to conduct monetary policy on a high level of intensity and triggered the discussion about currency competition as a next possible step in the evolution of money.[11]

2.1.4. Inside-Outside Money

The last point in the considerations about money is dedicated to the difference between inside and outside money. This distinction becomes important, if we want to examine the possibility of privately issued money. Generally the term outside money refers to full-bodied coins (and other types of full-bodied commodity money)[12] which has its origin outside of any commercial banking system. Outside money is an asset for its holder but not a liability of, or financial claim against, anyone else. Contrary, a Medium of Exchange issued by a commercial bank is inside money and would represent a financial claim against it. (White 1999, pp. 11-12)

2.2. Financial Intermediaries

For nearly a half century the linkage between financial institutions and real economic activity was neglected. (Gertler 1988, pp. 563 – 564) After the Great Depression the following works focused on money as the financial variable most relevant to aggregate eco-

[11] The expression evolution to money does not refer to technological improvements, but rather to changes in the conception of money.
[12] The expression full-bodied is a little bit delusive, because the issued fiat money of most economies operates on a limited, provisional gold bullion standard. Therefore it is irredeemable and constitutes not a financial claim against the issued bank (mainly central banks), which classifies it as outside money.

nomic behaviour. Questions about the quantity of money supply were the only topic which appeared regularly in macroeconomic framework. In the 50's the role of financial intermediation received again more attention: According to Gertler (1988), Gurley and Shaw demonstrated, that the difference between developed and underdeveloped countries can be found in the existence of a highly organized and broad system of financial intermediation. They suggested that the principal channels of monetary policy may be different form the convention one which stresses effects on the quantity of money supply. But this shift of attention lasted only few years when Modigliani-Miller-Theorem came into the scientific discourse. In the presence of perfect markets real economic decisions were regarded independent of financial structure. It was not until the 70's the role of financial intermediation came back into the centre of attention. Gertler (1988) argued, that authors like Mishkin and Bernanke found out that the Great Depression was not just a matter of money supply, but the disruption of credit markets contributed more to explain the collapse in real activity (Gertler 1988, pp. 561-668) As currency competition will happen in the environment of financial intermediaries it will be useful to examine the functions of financial intermediaries and theories concerning the banking firm.

2.2.1. The role of Financial Intermediaries

The important role of financial intermediation can be deduced from following simple situation. Consider an economy with h_i households and f_i firms, where households spend a certain fraction of their income and save the other fraction. If in this economy a firm wants to carry out an investment and has not the necessary capital, it has to lend capital. One possibility is to borrow it directly from the households, but as the saved fraction is general smaller than the investment, it will be harder to raise funds directly the greater the investment is. Only indirect finance using financial intermediation (i.e. an institution which collects all the small saved fractions) ensures the realization of investment. In today's economy it is the primary route for moving funds from lenders to borrowers and guarantees the soundness of the financial system. (Mishkin 2007, pp. 23-25)

2.2.2. *Models of Financial Intermediation*

The Models of financial intermediation are closely related to question why financial intermediaries exist. The literature emphasizes three reasons why financial intermediation will exist in the financial market.[13]

The first and maybe most important thread stresses the relevance of allocative effects of **asymmetric information** in financial markets i.e. the application of the "lemons" problem[14] on financial markets. Ex ante, the financial intermediary cannot distinguish between "good" (lower default probability) and "bad" (higher default probability) borrowers. Therefore the credit interest rate will incorporate a premium which serves to compensate potential losses. "Good" borrowers suffer at the expense of bad-quality borrowers, and refuse to borrow credits. This increases the market average default probability and consequently the interest rates. As the process continues the loan supply curve may bend backwards and credit rationing can emerge as a consequence. (Gertler 1988, p. 569)

The second reason why financial intermediaries exist arises with the intermediaries' asset transformation function and emphasizes the relevance of transaction cost. Following the example in "The role of Financial Intermediaries", the primary function of the financial market is to channel funds from lenders to borrowers like firms, households, etc. Because of the usually small amount a lender wants to invest, a large percentage of the purchase price of the shares is spent on transaction costs. By specialization financial intermediaries have developed a **minimization of information and transaction costs** (Santomero 1984, pp. 577-580; Mishkin 2007, pp. 35-36) as well as a minimization of interest rates.

The technological progress in recent years did not stop at payment systems. Due to developments like internet, electronic payment, electronic money or smart card the focus on transaction costs and asymmetric information is not anymore adequate. In a situation with declining transaction costs and (nearly) perfect information traditional theories of financial intermediation predict that financial intermediation would be on the decline, how-

[13] This classification is only one possibility. Fama (1980) argues that intermediaries have two functions: (1) providing transactions services and (2) providing portfolio management services. (Fama 1980, pp. 44-45) On the other hand Santomero (1984) classifies the reasons how the approaches centre upon a specific portion of the intermediaries' activity. These are (1) Asset Transformation Function (2) The role of the intermediaries' liability and (3) the two-sided nature of the financial firm. (Santomero 1984, pp. 577-580)
[14] Based on George Akerlof's (1970) paper "The Market for Lemons"

ever, the reversed happened and financial intermediation has increased. The reason for this is intermediaries' activity to distribute risk across different participants. In the context of trading in new markets the focus on **risk sharing / risk management** through diversification contributes much to the theory of financial intermediation. (Allen/Santomero 1998, pp. 1482-1483; Mishkin 2007, pp. 36-37)

2.2.3. The Banking Firm

By so far the focus lay on functional theories of financial intermediation and totally ignored a microanalysis i.e. the optimization problem from the standpoint of the financial intermediary. In addition to their intermediary role, the bank[15] can also be considered as a firm which sells liabilities (deposits) and buys assets (loans and securities). Viewed in this light banking is therefore just another industry whose equilibrium is subject to standard economic analysis. The first attempt to model the banking firm was done by Klein (1971). The banking firm attempts to maximize an objective function in terminal wealth and uses quantity and/or prices variables (like asset quantities and asset prices) as control variables. (Klein 1971, pp. 207-214) Following Santomero (1984) the general form of the problem can be specified as

$$\max E[V(\tilde{W}_{t-\tau})] \tag{1}$$

subject to

$$W_{t+\tau} = W_t(1+\tilde{\Pi}_{t+1})(1+\tilde{\Pi}_{t+2})...(1+\tilde{\Pi}_{t+\tau}) \tag{2}$$

$$\tilde{\Pi}_{t+k} = \frac{\sum_i \tilde{r}_{A_i} A_i - \sum_j \tilde{r}_{D_j} D_j - C(A_i, D_j)}{W_{t+k-1}} = \frac{\pi_{t+k}}{W_{t+k-1}} \tag{3}$$

where

$V(\bullet)$ ≡ the objective function, where $\partial V / \partial W_{t+\tau} > 0$ and $\partial^2 V / \partial^2 W_{t+\tau} \leq 0$

$W_{t+\tau}$ ≡ the value of terminal wealth at the horizon time τ

[15] Among the different types of financial intermediaries (Depository institutions, Contractual savings institutions and Investment intermediaries) it makes most sense to apply the concept on Depository institutions i.e. banks. Even if their relevance in the period from 1980 to 2005 was slightly decreasing, they are still the most important financial intermediary. (Mishkin 2007, p. 41)

$\widetilde{\Pi}_{t+k}$ ≡ the stochastic profit per unit of capital during period $t+k$, where $1 \le k \le \tau$

$\widetilde{r}_{A_i}$ ≡ the stochastic return from asset i

A_i ≡ the asset category i, where $1 \le i \le n$

$\widetilde{r}_{D_j}$ ≡ the stochastic cost for deposit j

D_j ≡ the deposit category j, where $1 \le j \le m$

$C(\bullet)$ ≡ the operations cost function, where $\partial C / \partial A_i \ge 0$ and $\partial C / \partial D_j \ge 0$

Equation (1) is the general form of the objective function to be maximized by the bank. In Equation (2) the multi-period valuation problem is described. Equation (3) defines the profit per unit of capital invested by the owners of the firm or their management representatives. Starting with the overall view of a banking firm's optimization problem several types of models can be distinguished, depending on what they focus on. (Santomero 1984, pp. 580-584) As will be shown later in the context of currency competition the idea of the "banking firm" becomes of particular relevance, when banks are permitted to issue their own money.

2.3. Central Banks

The special characteristics of banks as financial intermediaries derive more from regulations (restrictions on returns paid on deposits, reserve requirements), than from any role played by banks with respect to money. (Fama 1980, p. 40) Because these regulations often are imposed by central banks it is beneficial to examine the nature of such a central institution, and, due to its functions, to question whether governmental intervention is obligatory for its creation or not.

2.3.1. Role of Central Banks[16]

The most important factor which transforms a certain institution into a central bank is the legal monopoly of currency issue i.e. a certain bank is permitted to print the money. It was such a situation of uncontrolled currency issue, which inspired Hayek to his idea of currency competition. He does not reject the idea of central banking itself, but the concept of a government-sponsored central bank. In such an institution government would take

[16] The description follows in general White (1999, pp. 70-80), other sources will be marked.

advantage of several central bank's functions and thus interfere with the economic process. (Hayek 2007 pp. 100-102) In Hayek's view, only money which is exposed to the process of competition can be good money, otherwise the government has incentives to use the printing press and create inflation.[17]

The functions of central banking could be distinguished into following major roles: (1) serving as a bankers' bank (2) having a monopoly of note issue (3) acting as a lender of last resort (4) regulation commercial banks and (5) conducting monetary policy)

To be a **bankers' bank** is the minimal sense which qualifies an institution as a central bank. Central banks would be banks whose liabilities are held by commercial banks as part of their reserves. This function is not a prerogative of a government-sponsored institution, but also evolves in an environment of currency competition. Because of Clearing Arrangements between different issuing banks, an interbank clearinghouse system would emerge. Such systems are a multilateral result of the economization of transactions costs.[18]

Together with the operation of the discount window, the function as a **lender of the last resort** forms the discount policy in today's central banking (Mishkin 2007, pp. 380-381). The main difference between both is that the operation of the discount window would also work between single banks, whereas the need for a last resort comes into existence, when banks are not willing to lend money to each other any more. In a fractional banking system this could cause liquidity shortages and consequently "bank runs". What constitutes a central bank is the ability of a certain bank to act as a lender of the last resort and again, it is not written down anywhere that such an institution should be government-sponsored.

The legal **monopoly of currency issue** contributes importantly to turning the institution possessing it into a central bank. It originates from the era of coinage, when the process of standardization[19] needed credibility which only the governments could provide.

[17] The public choice approach assumes an opportunistic behaviour of the central banks i.e. central banks orient their policy towards election dates. There is some evidence that before elections central banks try to reduce unemployment through a less restrictive monetary policy. (see notes to professor Weigel's lecture "Ein wenig Politische Ökonomie der Zentralbanken")

[18] This assumption can be verified by historical cases in the United States during the period of free banking.

[19] In the sense of a signal of the quantity and purity of the metal

(Ritter 1995, p. 134) So the monopoly of note issue is not a natural monopoly, but rather a product of legislation.

As mentioned above **regulations of commercial banks** are often imposed by central banks, but the regulation of the banking industry need not come from an external source. Like the case of the lender of the last resort role, each member bank desires to eliminate the danger of others defaulting and would therefore agree on certain regulations. Moreover a member-controlled institution would introduce regulations which the banks themselves consider beneficial.

The last function of an official central bank is the **conduction of (an official) monetary policy**. This policy is aimed at providing (1) price stability (2) high employment (3) economic growth (4) stability of financial markets (5) interest rate stability and (6) foreign exchange market stability. Together with the monopoly of currency issue both functions are the only one which can be played by a government-sponsored institution. Among the functions of central banking this one is the most controversial one, because it assumes that central bank pursues the government's macroeconomic goals which can, when improperly defined, disturb the economic process and harm the economy. As governments seek to gain support from more voters they would regularly have incentives to implement political inspired policies (promoting high employment) than economic inspired ones (price stability). (Hayek 2007, p. 103)

2.3.2. Establishment of Central Banks

Central banks are not a natural development of the banking system, in the sense that they are not a spontaneous and evolutionary result arising from the market. Contrary, they are imposed from outside the market as a result of governmental action (Soto 1995; pp. 25-28) Their establishment follows not a unique path, but rather the above described functions form the framework under which it is possible to understand the origins. In the United States the Federal Reserve System was created after the bank panic of 1907, which was the most severe one in the history of nationwide bank panics. Widespread failures and substantial losses to depositors convinced the public to establish an institution which should act as lender of the last resort to prevent future panics. (Mishkin 2007, p. 312) In a system with competing financial intermediaries, banks always bear the risk of default, which

then, through a process aggravated by contagion, puts the functioning of the monetary system at risk. Therefore the role as lender of the last resort is often regarded as the main cause of the establishment of central banks. (Goodhart 1987, pp. 75-76) In most of the industrial countries the development of central banks additionally goes along with the monopoly of currency issue. (Hayek 2007, pp. 28-30) The existence of central banks around the world did not materialize by accident, but rather there are political and historical reasons why they run the bankers' bank, monopolize the production of currency and reserve money, and regulate the provision of bank-issued money. (White 1999, p. 88)

2.3.3. Monetary Policy

From the standpoint of the evolution of payment system, monetary policy is regarded separated from the evolution of central banks (Goodfriend 1991). This might be true in the sense that monetary policy did exist even before central banks come into existence, but fundamental is that in all times governments were involved into monetary policy (White 1999, p 88) and just the form of its intervention changed. In the current financial system monetary policy is executed through (national) central banks'[20] control over money supply. Hence this work seeks to examine an environment of privatized money supply it would be helpful to look first into an environment where a central instance has the power over money supply.

Concerning the central bank's role of conducting monetary policy a central discussion arises from the question whether central banks have a hierarchical or a dual mandate. Given the above mentioned targets of monetary policy, the hierarchical mandate sets the goal of price stability as the main objective for central banks. Only as long this goal is achieved other goals, like employment or economic growth can be pursued. Contrary, when the central bank is charged with a dual mandate it tries to achieve two co-equal objectives, respectively price stability and maximum employment. (Mishkin 2007, p. 397) To put it in other words: Should there be a distinction between the monetary and fiscal activities of the government? (Schwartz/Todd 2008 p. 167)

The supporters of the **dual mandate** claim that the monetary policy does not only affect prices, but also output, employment and other important aspects of non-financial ac-

[20] Considered as a government agent

tivity. If now any objectives are left completely unspecified, the policy makers would not take them into account and the central bank could depress economic activity by making the prices of other goods decline whenever food and energy prices experience large increases. Therefore the hierarchical mandate is in their view a kind of unspoken dual mandate. More explicit articulation of ends would clearly facilitate greater accountability and reduce uncertainty. (Friedman 2008)

By contrast the advocates of the **hierarchical mandate** start their thoughts at the only thing central banks can do: the creation and destruction of the monetary base through the instruments that are feasible to them.[21] With this starting point one can proceed to list the lessons that central banks have learned about what can be done. First of all, the knowledge of current and prospective developments of the economy is incomplete and they are not able to know what they would need to know to operate a perfect, an economy's large-scale model of all time. Pursuing more than one mandate would not produce the desired outcome. An expansionist policy, implemented to boost employment and economic growth, will only add zeros to the money supply and prices. A central bank's policy may affect real variables like productivity, economic growth and employment, but does not control them. Any policy action directed to do so would only contribute to unnecessary volatility of these variables. What a central bank can do is to promote price-stability in which the real variables are embedded. (Friedman 1968, p. 11, Schwartz/Todd 2008, pp. 167-180)

2.3.4. The Evolution of Monetary Policy Rules

Thus monetary policies are strongly linked to money supply, this poses the question up, what is the optimal behaviour of the money issuing institution. There are three basic schools of thought on the question of the monetary constitution: (1) the **discretionary central banking school**, which favours discretion or activism (like Keynesians) (2) the **constitutional central banking school**, which advises that the central bank should follow a specific formula (like Monetarism), and (3) the **free market money school**. (White 1999, p. 218) The third school, which favours decentralized and competitive money supply over central banking, will be examined in chapter 4. Following analysis concentrates on the first two which competing proposals form the framework for the evolution of practical mone-

[21] That are (1) open market operations (2) discount policy and (3) reserve requirements (Mishkin 2007, pp. 378 - 386

tary policy.[22] The discretionary central banking school and the constitutional central banking school have in common, that they consider the money supply as the central banks' answer to money demand. Therefore the focus lies on the question whether or to what extent the quantity of money demanded is affected by changes in interest rates.

The classical quantity theory of money started with the observation $V = \frac{P \times Y}{M}$, where P is the price level, Y is aggregate output (income) and M is the total quantity of money. The variable V is called velocity of money and describes the average number of times per year that a monetary unit is spent in buying the total amount of goods and services in the economy. Through rearranging one yield $M = \frac{1}{V} \times PY$ and as the velocity of money was considered to be constant, the Classical Economists were able to provide a formula how the central bank should set the money supply: $M^s = M^d = k \times PY$ [23]. In this equation the demand for money is purely a function of income, and interest rates have no effect on the demand for money. (Mishkin 2007; pp. 493-494)

The Quantity Theory of Money was refined by Keynes who emphasized the importance of interest rates and introduced the liquidity preference theory in the demand for money. Due to transactions motives, precautionary motives and speculative motives, people want to hold a certain amount of real money balances. In his liquidity preference function $\frac{M^d}{P} = f(\underset{-}{i}, \underset{+}{Y})$ the demand for real money balances is negatively related to the interest rate i and positively related to income Y. After solving the function for velocity, we yield

[22] "Practical" relates to the fact, that the ideas of the free market money school were never part of monetary policy practice. The only historical evidence the adherents of this school derive from the Free Banking era in Scotland (1716-1845), Switzerland (1823-1850) and the United States of America (1837 – 1863) (Boller 1992, pp. 38 – 44)

[23] This formula became generally known as the Quantity Theory of Money Demand.

the equation $V = \frac{Y}{f(i,Y)}$.[24] Velocity of money, and consequently the demand for money is not constant anymore, but instead affected by interest rates. (Miskin 2007, pp. 497-505)

The next development in the Quantity theory of money demand was offered by Milton Friedman and his "k percent rule"[25]. His proposal contained that some monetary aggregate (either $M1$ or $M2$) should grow at the rate of k percent per year where k is constant. In Friedman's view changes in interest rates have little effects on the demand for money, (Mishkin 2007, p. 509) and Central banks will choose M, which has the most stable velocity V, so that nominal income, at best equal to MV, is relatively stable. Putting these features in a formula one can write $g_m M + g_V V = g_P P + g_Y Y$, where g times the variable denotes the growth rate of every single variable. Given the values of $g_V V$ and $g_Y Y$ from historical data, central banks are able to stabilize the price level i.e. $g_P P = 0$ simply through growth of the monetary aggregate. The simple model was later extended by slightly more complicated rules but still focused on the growth of the monetary aggregate. (White 1999, p. 219-225) All strategies which suggest that the chosen monetary aggregate should be targeted to grow at a constant rate became known as monetary targeting (Mishkin 2007, pp. 398-399)

As the choice of a policy rule determines the variances of output and inflation, an optimal rule is naturally one that minimizes a weighted sum of these variances, where the weights are determined by policymakers' tastes. In this context emerge the Taylor rules which are policy rules for setting the interest rate r through the equation $r = \left(\frac{\lambda + \alpha q}{\beta}\right) y + \frac{q}{\beta}\pi$ where y is the gap between output and potential out (output gap), r is the difference between the real interest rate and its equilibrium level, π is the difference between inflation and its average level (inflation gap), α, β and λ are constants and q is a function of the model's parameters and the weights that policymakers put on infla-

[24] Starting with $\frac{M^d}{P} = f(i,Y)$ first the formula is rewritten as $\frac{P}{M^d} = \frac{1}{f(i,Y)}$. Afterwards both sides are multiplied with Y and, as in money market equilibrium demand equals supply, M^d is replaced by M: $\frac{P \times Y}{M} = \frac{Y}{f(i,Y)}$. The left-hand-side is nothing else than the velocity of money, so $V = \frac{Y}{f(i,Y)}$

[25] His proposal made inroads into the economic literature as the Modern Quantity Theory of Money.

tion and output variances. (Bell 1997, pp. 5-9) The Taylor rules have one special characteristic that make them favourable to money central banks: They do not only keep inflation under control but also minimize business-cycle fluctuations of output around its potential (Romer 2006, p. 526; Mishkin 2007, p. 415)

The last presented policy rule is the so called inflation targeting, where policies attempt to achieve a target level of inflation. Such inflation targets can be distinguished between (1) strict inflation targets and (2) inflation targets with gradual adjustment. In both cases the targeting will be carried out through setting of an "optimal interest rate". While a strict inflation target is optimal only for extreme tastes of the policy makers (expressed through q) the inflation target with partial adjustment in contrast is a better description of central banks' policies in several countries. (Bell 1997, pp. 9-12)

Two further dimensions in the discussion about monetary policy are questions dealing with (1) the **independence** of central banks and (2) the **credibility** of central banks. The first one stems from the observation that the behaviour of central banks coincides with the so-called political cycle. Monetary policy enables policymakers quickly (but temporarily) to achieve higher employment, financing the budget deficit and low interest rates. In times of elections politicians can exert pressure on the central bank executives to conduct a more expansionary policy, because its temporary consequences may affect the election result to the politicians' favour. A more independent central bank could therefore pursue the price-stability goal and is not subject to an inflationary bias (Alesina 1993 pp. 151-152, Cuckierman 1994 p.1437-1439) Even if this thread in the scientific literature is very absorbing the problem of independence is an effectual condition, which always arises when a central instance issues money. Due to the deficiency in experience or data[26], there is a lack of scientific literature about cases concerning the independence of decentralized money issuing authorities. Ex ante it is not possible to predict the behaviour of the CEO of a decentralized money issuing bank. On the one hand they might shun conflicts with the government, but on the other hand they could also have an eye on their reputation, as people will prefer to use a more trustworthy currency. The dimension of CEO's reputation is closely related to the problem of credibility. Contrary to the independence problem credibility is not an

[26]In the time when free banking took place in the United States, Scotland, Switzerland and Canada data collecting was not that developed like today.

effectual condition of a central instance, but a necessary one.[27] Although the discussion about this dimension might be of interest for the topic of currency competition[28], a detailed examination would go beyond the scope of the work.

[27] The ability to issue money does not assume credibility.
[28] What makes the credibility of a central instance issuing money, like central bank, different from that of a decentralized bank, like a commercial bank?

3. INFLATION

> "All Inflation is so very dangerous precisely because many people, including many economists, regard a mild inflation as harmless and even beneficial."
>
> F. A. Hayek

The reason why the previous chapter paid so much attention on central banks and monetary policy lies in the fact that controlled monetary policy is often the main source of high inflation over extended periods. These inflation rates appear in many cases to be higher than is social optimal (Romer 2006, p. 496) and, due uncertainty and difficulties in planning for the future, lower economic growth. (Boller 1992, pp. 5-17) Understanding inflation is also central for the issue of currency competition, because it was also the idea of promoting price-stability which inspired Hayek to his proposal. (Hayek 2007, pp. 48-51)

3.1. Definition of Inflation and how it emerges

Inflation is a permanent increase in the average price of goods and services in terms of money. Keynes' liquidity preference theory $\frac{M}{P} = f(i,Y)$ [29] offers a good starting point to a better understanding of inflation. By rearranging the formula to $P = \frac{M}{f(i,Y)}$ one will get a simple model how inflation can emerge: It could be the result of increases in the money supply, increases in interest rates, decreases in output and decreases in money demand for a given i and Y. Among these factors money growth plays the most important role, because money growth varies more than other determinants of inflation. Some enhancements of

[29] As in money market equilibrium demand equals supply, money demand M^d was already replaced by the monetary aggregate M. All other variables have again the same denotation: P is the price level, i is the interest rate and Y is real income.

the simple model were achieved by incorporating (1) assumptions about the interest rate, like the Fisher identity[30] and the expectations theory of the term structure[31], (2) the introduction of the time inconsistency problem[32], (3) the creation of interest-rate rules, like the Taylor rules, or (4) analysis of the government's need for seignorage. (White 1999, pp. 163-164; Romer 2006, pp. 496-547)

3.2. Costs of Inflation

The reason why so many authors dedicated their works to the analysis of linkages between monetary policy and inflation is the assumption that inflation is costly. However, apart from the models' predictions, inflation's costs are not well understood and yet economists have difficulty in identifying substantial costs of inflation. Therefore it makes more sense to follow the classification proposed by Romer (2006) than the proposal of Boller (1992)[33]. The costs of inflation could be divided into (1) easily identifiable ones, (2) other costs of steady inflation and (3) cost of variable inflation

3.2.1. Easily identifiable costs

The most obvious costs that occur in the presence of inflation are the **shoe leather costs**. Through the increased gap between the rates of return on money and on other assets, people will reduce their holdings of high powered money. They will try to deposit cash inflows in their bank accounts as soon as possible and make therefore smaller and more frequent conversions of other assets into currency. Even if they are small for almost all

[30] The Fisher identity defines the real interest rate r as the difference between the nominal interest rate i and expected inflation π^e i.e. $r \equiv i - \pi^e$ or equivalently $i \equiv r + \pi^e$

[31] This Theory deals with the relationship among interest rates over different horizons. It suggests that the expectations concerning future short-term rates of bonds (plus the term premium to holding a long-term bond) are equal: $i_t^n = \frac{i_t^1 + E_t i_{t+1}^n + ... + E_t i_{t+n-1}^n}{n} + \theta_{nt}$

[32] The simple time inconsistency problem could be described as follows: Through the control of money growth, the policymaker chooses inflation directly, subject to the constraint that inflation and output are related by the aggregate supply curve. The policymakers choice of π is a function of the expected inflation $\pi^e = \pi^* + \frac{b}{a}(y^* - \bar{y})$. In this formula for "optimal inflation rate", the policymaker's discretion does increase inflation without affecting output. However, the public forms its expectations accordingly to what the policymaker announces and therefore the policymaker has an incentive to produce in the next period an inflation that is higher than π^*.

[33] Boller (1992) distinguishes between (1) the cost and consequences of anticipated inflation and (2) the cost and consequences of inflation uncertainty, but his classification coincide throughout most with that one of Romer (2006) if his first two distinctions would be combined.

inflation rates, because of opportunity costs they represent a cost of inflation. (Boller 1992, p. 9-10; Romer 2006).

Another easily identifiable cost of inflation arises due to the costs of changing nominal prices and wages. If price adjustments were costless, one would expect no problems from a rising price level. But in reality exist positive transaction and information costs and prices are adjusted only when costs of not changing prices are higher than the so-called **menu costs**. Prices lose their main function as a signal of scarcity of a specific good at any point of time. As a consequence people and companies have to put more efforts to gather information and misallocation of resources will happen. (Boller 1992, p. 8, p.15; Romer 2006, p. 548)

Inflation also can affect incentives for investment and saving, because it distorts the tax system. In most countries incomes and deductions are computed in nominal terms. If the tax system of a country is inflexible i.e. thresholds of tax brackets in a progressive income-tax system are not adjusted, then economic agents have to bear a higher tax burden. Inflation can therefore significantly alter the relative attractiveness of different kinds of investment, and represents a redistribution of resources from private households to the public sector. Contrary to the shoe leather and the menu costs, the cost of inflation through **tax distortion** or **fiscal drag** may be large. (Boller 1992, pp. 11-12; Romer 2006, p. 548)

3.2.2. Other costs of steady inflation

The first type of costs of steady inflation is closely linked to the menu costs and the misallocation of resources. A steady inflation causes variations in relative prices as different firms adjust their prices at different times. Such **relative-price variability** disrupts markets as it makes long-term relationship between different parties harder. (Romer 2006, p. 549)

Another problem appears in the **households' and firms' perceptions**. The fact that a 3 % inflation rate will triple the price level within 40 years is not totally recognized by the economic agents. Rather, they tend to do their financial planning in nominal terms, which

causes systematically errors in saving for their retirement, in assessing the real burdens of mortgages, or in making long-term investment.[34] (Romer 2006, p. 549)

The next cost of steady inflation refers more to a **psychological phenomenon** than to "real" costs of inflation. As people relate their economic environment in terms of dollar, they have the behaviour to dislike it. Even if the changes in price level have no consequences for their real income, they may find large changes in dollar prices and wages disturbing. They intrinsically dislike inflation and often blame the policy maker for it.[35] (Romer 2006, pp. 449-450)

The last cost of steady inflation is not covered in Romer (2006) and deals with the **welfare losses**. The welfare costs of inflation can be distinguished into (1) short-run welfare costs and (2) long run welfare costs. Whereas the short run costs are partly unanticipated, the long run costs become fully anticipated as agents adjust their expectations about inflation. The most common example of this adjustment process is that agents want to hold less real money balances, because inflation acts as an implicit tax on money balances. The consumer substitutes away from cash until the marginal costs of avoiding inflation (like the use of credits) are equal to the marginal inflation rate tax on cash use. (Gilman 1993, pp. 97-98) The welfare cost of inflation is a controversial concept in economic theory and works through income transfers and the net loss of valuable services which society has to bear. (Tatom 1976, p. 9)

3.2.3. Costs of variable inflation[36]

This point is probably the most important one because greater inflation variability increases uncertainty and lowers welfare. A greater uncertainty about inflation impedes firms and individuals to undertake long-term investment (Romer 2006, pp. 550-551) but also has a negative impact on capital accumulation as lenders are not willing to lend their money anymore. The adjacent figure makes the cost of variable inflation more clear: The solid line,

[34] A controversial feature of this argument is the fact that economic agents have myopia concerning the evolution of the future inflation rate otherwise they would not miscalculate their financial planning.
[35] The most popular case was the successful 1992 presidential campaign of Bill Clinton against Georg H. W. Bush. Due to foreign policy developments such as the end of the Cold Ward and the Persian Gulf War, Bush was considered unbeatable. In the campaign Clinton's strategist came up with the slogan "(It's) the economy, stupid" to point out, that Bush was not able fix the economy during the recession at that time. The slogan showed its effect and Bush plummeted from 90 % approval to 69 % disapproval with his job performance.
[36] variable in the sense, that future pace cannot be extrapolated

the dotted line and the dashed line represent possible future range of inflation-rate developments. The first one describes a situation where economic agents expect the inflation rate to remain on a low level. The second one is a case with low uncertainty and the last one is the case of high uncertainty about the future policy of monetary authorities. The higher the uncertainty about the future path of the inflation rate gets, the riskier it becomes for market participants to commit themselves by long-term contracts. (Boller 1992, p.12-14)

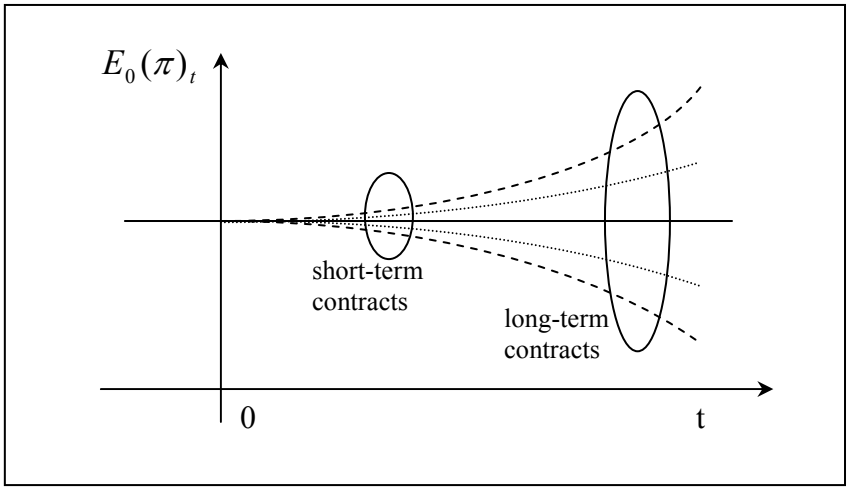


Figure 2: The cost of variable inflation

To avoid inflation, or to put it in another way to respond to real disturbances, the literature recommends an optimal monetary policy of the central bank. For example, a durable monetary policy rule (like the Taylor rules or the inflation targeting) will help to reduce inflation uncertainty and, reduce the resource costs devoted to misallocation (White 1999, p. 226; Woodford 2001, p. 236). A discussion about an alternative approach to avoid inflation and to reduce uncertainty was triggered by Hayek in his book "Denationalisation of money", in which he proposed the possibility of privately issued money.

4. CURRENCY COMPETITION

> "The past instability of the market economy is the consequence of the exclusion of the most important regulator of the market mechanism, money, from itself being regulated by the market process."
>
> F. A. Hayek

Essential efforts have been spent in the previous chapters to sketch the monetary framework in which a possible competition between currencies would take place. This chapter now tries to examine, whether and to what extend a system of competing currencies is possible. The first distinction in such a system can be drawn between (1) competition between currencies issued by (national) central banks and (2) competition between privately issued currencies.[37] Another possible typology is to classify the type of money into (1) (commodity) backed money and (2) unbacked (fiat) money. As both classifications do not exclude each other it is possible to display them in following raster:

		Type of money	
		backed/commodity	unbacked/fiat
Issuing instance	Central bank	1	2
	Commercial bank	3	4

Table 1: Typology of currency competition

[37] According to Hayek (2001) the first one is only a stage on the way to privately

Field (1) describes a system in which a (national) central bank issues money that is redeemable in gold, silver or any other commodity. A historical example would be the time span when the monopoly of currency issue was nationalized until the end of the gold standard with the collapse of the Bretton-Woods system. This work will refer to that type of competition as a system of **Commodity Standard (Competition).**

The next field (2) is system in which unredeemable national currencies compete with each other. This may be a good approximation for the current financial system, where at the moment three dominant currencies (Dollar, Euro & Yen) exist and a fourth (Renminbi or Yuan) seems to be emerging. The competition in this type is limited to some few international currencies; therefore the work will follow Hartmann (1998) and denote this system as **International Currency Competition**.

Field (3) coincides partially with field (1) as all issued money is redeemable into a certain commodity, but the difference lies in the agent that issues the currency. In this system commercial banks are allowed to bring their own money into circulation. (Selgin/White 1994 p. 1721) Like the two examples above also this field has a real counterpart in History. The already often mentioned era of Free Banking in the United States of America and Scotland is a typical example for this kind of competition, but also Switzerland, France, Australia, Italy, Canada, New Zealand and Sweden witnessed periods of Free Banking (Mafi 2003, p. 480). Following the existing literature this work refers to that type as **Free Banking (Competition)**.

Contrary to all other types of competition the last field (4) was, up until now, never brought into existence and represents the most challenging type to examine. In this environment commercial banks can introduce their own money, which is not (or only partial) redeemable into any commodity. Writing his book "Denationalisation of Money" Hayek had this type of currency competition in mind, and the work will use the expression **Private Currency Competition** for it.

4.1. Commodity Standard Competition

A monetary standard can be defined as a fixed relation between a currency and a commodity (or group of commodities) in physical form or of titles to designated physical quantities of a commodity (or group of commodities). A standard can be divided into (1) a

strict commodity standard, and (2) a **partial commodity standard**. In the first case, currency represents a real claim on the commodity. Both, the supply of currency and the prices of other goods in terms of the currency commodity, are determined entirely by market forces. The demand for monetary commodity stock and non-monetary commodity flow and the supply of the commodity are the crucial determinants. The second type arises, when total output grows, but the velocity of circulation is constant. In such a situation the commodity will be "economized" through the use of fractional reserves for mediums of circulation or the creation of additional currency which is only partially redeemable. (Friedman 1951, pp. 203-213) The further analysis here will deal with the first type, because a partial commodity standard coincides mainly with the current system and will be examined in the chapter about International Currency Competition.

4.1.1. A simple model of a Strict Commodity Standard[38]

The analysis assumes a closed economy in which a monopolistic central bank issues one currency which is redeemable into a commodity at a fixed price. Private Banks provide the public with various forms of deposits and hold commodity reserves[39] to redeem these deposits into the commodity on demand. The productive resources are exogenously given and employed in the commodity-producing and the consumer-good industries, and the relative price of the commodity and consumer goods equals the rate of transformation. Therefore the two production functions are:

(1.1) $c = c(p)$ with $c'(p) < 0$ and

(1.2) $g = g(p)$ with $g'(p) > 0$

(1.3) $$p \equiv \frac{p_G}{p_C}$$

Where c denotes the physical production of consumer goods, g the physical production of the commodity, and the relative price p is defined as the commodity price p_G divided by the price of consumer goods p_C. In this model the central bank commits itself

[38] The presented model follows the proposal of Boller (1992)
[39] The last subchapter of this section offers a discussion whether banks should hold 100 % reserves or only a fraction of these deposits.

to buy and sell the commodity at the fixed price p_G. The nominal stock money supplied M^S can be expressed as:

$$M^S = \frac{p_G G_m}{\alpha} \tag{1.4}$$

In this equation G_M is the commodity stock used for monetary purposes and α is the fraction of the circulation banknotes and deposits backed by the commodity[40]. On the other hand money demand M^D is given by following equation:

$$M^D = \frac{y}{(1+\pi)} \text{ with} \tag{1.5}$$

$$\pi = E(\dot{p}/p) \text{ and} \tag{1.6}$$

$$y = p_C c(p) + p_G g_{NM}(p) \text{ with } g'_{NM}(p) \tag{1.7}$$

y is called the transaction variable and $(1+\pi)$ is the opportunity cost of holding money, π the expected inflation rate and g_{NM} the non-monetary flow demand for the commodity. By combining (1.4) and (1.5), the equilibrium of the money market is given by

$$\pi = \alpha \frac{y}{p_G G_M} - 1 \tag{1.8}$$

Changes in the commodity stock $\dot{G}_M$ used for monetary purposes are defined as

$$\dot{G}_M = g(p) - g_{NM}(p) - \delta G_M \tag{1.9}$$

The formula predicts that changes in G_M are fuelled by new production of the commodity $g(p)$, minus non-monetary uses of the commodity $g_{NM}(p)$ and, due to deprecia-

[40] In the case of strict commodity standard α is assumed to be equal to 1

tion, minus losses on the existing monetary commodity stock δG_M. The price-level dynamics are given through[41]

$$\dot{p} = \alpha \frac{c(p) + p g_{NM}(p)}{G_M} - p \tag{1.10}$$

The qualitative analysis via phase-diagram shows following pattern[42]

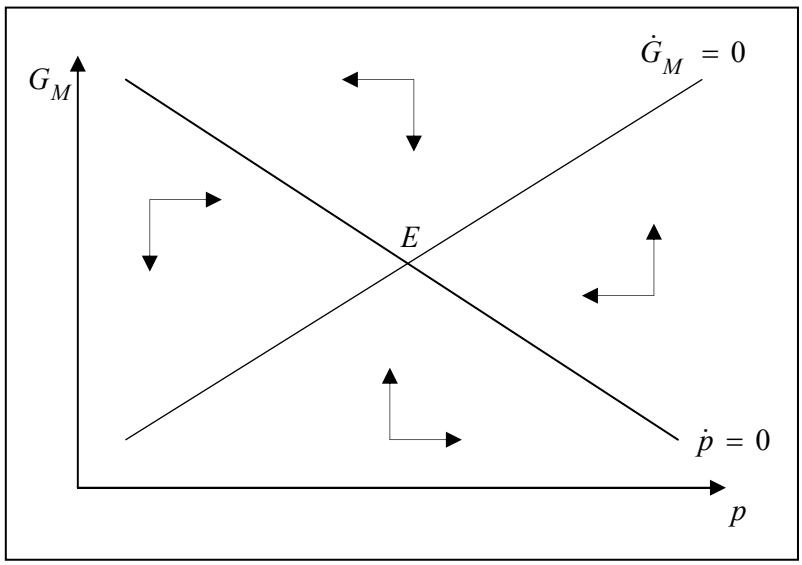


Figure 3: Equilibrium path in a phase diagram

Given the direction of the arrows, the equilibrium path is a cycle, either leading away from or leading to the equilibrium point E. In this model stability depends on the relative slopes and is ensured in all cases when the absolute slope of $\dot{G}_M = 0$-curve must be smaller than the absolute slope of the $\dot{p}_M = 0$-curve. The model has a unique stable equi-

[41] Putting the assumption of perfect foresight $\pi = \frac{\dot{p}}{p}$ into (1.8) gives

$\frac{\dot{p}}{p} = \alpha \frac{y}{p_G G_M} - 1 \Rightarrow \dot{p} = \alpha \frac{y}{p_G G_M} p - p$. Afterwards y and p are substituted by the definitions from (1.3) and (1.7) which yields

$$\dot{p} = \alpha \frac{p_C c(p) + p_G g_{NM}(p)}{p_G G_M} p - p \Rightarrow \dot{p} = \alpha \left(\frac{p_G}{p_C} \times \frac{p_C c(p)}{p_G G_M} + \frac{p_G}{p_C} \times \frac{p_G g_{NM}(p)}{p_G G_M} \right) - p$$

$$\Rightarrow \dot{p} = \alpha \frac{c(p) + p g_{NM}(p)}{G_M} - p$$

[42] The derivation of the demarcation curves and their slopes can be found in the Appendix A

librium at point E whenever the condition $\left|\frac{\partial G_M}{\partial p}\right|_{G_M = 0} < \left|\frac{\partial G_M}{\partial p}\right|_{\dot{p} = 0}$ is satisfied. One of the models features is, that in equilibrium the monetary commodity stock and the relative price of the commodity are simultaneously determined and the stylized economy exhibits stability.

As we have seen above, by an exogenous fixing of the price of a commodity[43] market forces provide a stable price level and, thus, lowers the risk of long term contracts. The big advantage of a commodity standard is its ability to adjust the money supply automatically, by setting price signals to commodity producers. Nevertheless, this model also identifies two possible main sources of price-level fluctuations: (1) changes in the reserve ratio, and (2) changes in the production functions of the commodity and consumer goods. Whereas the first one is subject to central bank decision, the second one depends on the production of the commodity. Changes in its production[44] relative to the production function of consumer goods leads to changes in the supply of the commodity and additionally to changes in the price level. (Boller 1992, 32-33, Friedman 1951, pp. 204-205)

How would it look like to implement a system of competition between national commodity standard. If central banks have the same commodity, the exchange rate risk is almost eliminated. The currency represents a claim on a certain amount of the same commodity and the exchange rate will be defined through the ratios of these claims. The most striking problem is that, due to the scarcity of natural resources, it is not possible that all currencies are backed by the same commodity. Different commodity standard (mainly metallic minerals like gold, silver or copper) would emerge and their exchange rate risk is determined through the markets of the different commodities. Another idea is to define the currency as an international standardized market basket of commodities, which contains so many units of commodity X, so many units of commodity Y, etc. The only requirement of such commodities is their physical and economic suitability for storage. (Friedman 1951, p 213-215) Adopting the same standardized commodity bundle eliminates again the exchange rate risk and different currencies, when they represent also the same nominal claim

[43] Traditionally gold or silver
[44] Triggered by technological progress; One example is the invention of the cyanide process for extraction pure gold from ore; (White 1999 p. 38)

on the commodity bundle, would be perfect substitutes.[45] The only costs of exchange will emerge along the transportation costs of the commodity bundles and subsequently lead to bilateral agreements and further to multilateral clearing arrangements (Goodfriend 1991, p. 14). A certain bank in country Y will collect notes issued in country X and vice versa, a certain bank in country X will collect notes issued in country Y. In a first step both will exchange the notes into the domestic currency at their central banks. Each central bank would want to redeem the collected notes, rather than to pay them back out again or to accumulate them indefinitely. Thus, to minimize the cost of unilateral or irregular redemption[46], a regular meeting for bilateral redemption will emerge, where X-notes are traded for Y-notes. The gains from unilateral to bilateral note-exchange are further extended and will end in the constitution of a multi-lateral exchange system or international clearinghouse system. (Selgin 1987, p. 453-454) This international clearinghouse system would be a spontaneous institution[47] and would link all reputable central banks and, hence, will function as an international control agency that domestic banks will meet the requirements of the standardized commodity bundle, especially the redeem ability of their currencies. Even if these considerations are theoretically, there is some historical evidence like the Suffolk bank clearing system during the Free Banking era in the United States, that such an evolution will take place. (White 1999, pp. 16-19)

It is essential to note, that the described system would only work, when central banks hold 100 % reserves. The reason why they have to hold 100 % of the commodity bundle is quite obvious: When the issued currency is not entirely redeemable the currency system will be a partial commodity standard and end in the issue of fiat money (Friedman 1951, p. 211). How currency competition in a partial commodity standard system with fiat money works, will be examined in the following chapter.

4.2. International Currency Competition

In the period after World War II the world witnessed an intensification of relationships regarding political, economic and sociologic spheres. Especially in the economic field

[45] When two currencies represent 1/8 of a standardized commodity bundle, there is no reason to reject one currency as a media of exchange.
[46] Costs of transport and time
[47] Selgin/White argued that in a competive environment clearinghouses will always emerge and meet the functions of certification, regulation and lender of the last resort (Selgin/White 1994, pp. 1732-1733)

that evolution leads to a broader international view in which traditional concepts seemed not be adequate any more. A result of this "internationalization" was the advent of new phenomena like international currencies. An international currency fulfils one or several of the classical money functions[48] expended by the claim that also non-nationals or non-residents of the issuing country, whether they be private or public agents, can take advantage of these functions. In this context international currency competition describes the process, to what extend several national currencies are employed by non-residents. In the decades after World War II the dollar was the dominant international currency. It was the preferred Unit of Account in most of the international markets and the driving force behind political and/or economic leadership, (Hartmann 1998, p. 1) but in the last decade its position was eroded by the introduction of a single European Currency – the Euro. Hence, it makes sense to consider the possibility of competing international currencies and in which manner this can happen.

International Currency Competition among foreign central banks can be restricted in several ways: (1) economic agents can be enforced to use the currency issued by the domestic central bank as a Unit of Account (2) it might be prohibited by law to denote contracts in foreign currencies (3) the holding of foreign currencies by residents can be restricted, and (4) governments do not accept any other currency than the one issued by the domestic central bank. (Vaubel 1986 p. 927) First of all, these restrictions have to be removed to guarantee a choice in currency and an upcoming evolution of international money. Only when an individual agent or institution residing in a country other than that of this currency is permitted to accept or to use it as a Unit of Account, a Medium of Exchange or a Store of Value the internationalization of a currency can start. The table below shows, that during the process of internationalization also the traditional functions of money are subject to changes.

[48] See chapter 2

Money Function	Private use	Official Use
(1) Medium of Exchange	Vehicle currency (i) in goods exchange: - foreign trade vehicle - domestic trade vehicle (ii) in currency exchange: - forex vehicle	Intervention currency
(2) Unit of account	Quotation currency	Pegging currency
(3) Store of value	Investment currency	Reserve currency

Table 2: Money functions of an international currency

In the system of competing international currencies central banks still have a crucial role. They can try to influence their country's exchange rates by intervening in the foreign exchange market so that their currency will serve as an **intervention currency**. Because central banks are only able to intervene in those currencies in which they hold some reserves, currency will work additionally as a **reserve currency**. Finally, when the exchange rate to another currency is fixed at some level, currency performs as a **pegging currency**[49]. The functions of private use of an international currency coincide mainly with the functions of money already described in Chapter 2. The main difference occurs when an international currency function as a **vehicle currency.** In this situation the currency is the accepted Medium of Exchange in domestic or foreign trading. Similar it works on the foreign exchange (forex) market: If a currency is primarily used as the Medium of Exchange into other currencies, then the currency serves as a forex vehicle. **Quotation currency** is a currency in which unit prices of goods or assets are expressed when it (the currency) is different from the currency of the respective supplier of the goods. To finish the private use functions, an **investment currency** is a currency in which asset contracts are settled. (Hartmann 1994, pp. 14-19).

[49] "*Pegging currencies are those currencies against which some country's exchange rate has to be maintained at some fixed level (or within some interval) as specified in an exchange rate arrangement*" (Hartmann 1994, p. 15)

International currency competition would affect the inflation in several ways, because currencies are assets to be held, and their demand depends on the price of holding them. The higher the expected inflation rate, the larger will be the yield foregone by holding currencies which bear no interest. Thereby, competition among central banks reduces inflation in at least three ways: (1) Through the **exit effect** the world demand for currencies shifts from the currencies that are expected to depreciate and to be risky to currencies that are expected to appreciate and to be more stable. (2) The **voice effect** describes a situation in which the public opinion blames the policy maker for high inflation rates. Often the effect is triggered, when countries with higher inflation are impressed by the example of countries with low inflation.[50] (3) Finally, the **acceleration affect** occurs in a situation, where an inflationary monetary impulse in one country affects the price level faster than a simultaneous monetary expansion of equal size that is common to all countries. (Vaubel 1986, pp. 928-929).

Mafi (2003) showed empirically, that the index of freedom to use alternative currencies is negative[51] related to the level of inflation. (Mafi 2003, p. 487) Thus, a system of competing international currencies would be a benefit for private money holders whereas for central banks it would be a challenging task. In their role as a competitive producer they must care not only about changes in total money demand but also about changes in its composition, which makes new rules for monetary expansion necessary (Vaubel 1986, p. 930). International currency competition is just possible if one neglects money's role as a vehicle currency and differences in volumes and volatilities in the numerous bilateral currency markets. A strictly market based emergence of the Medium of Exchange will result in the formation of currency unions (Alesina/Barro/Tenreyro 2002, pp. 307-311) and possibly, into the emergence of one single currency[52] The reason lies in the minimization of transaction costs, which is in the forex market determined through high (predictable) trading volumes and low (predictable) trading short-term exchange rate volatilities. Hence, the currencies of countries, which maintain a dominant role in international trade and investment, will be adapted as a general accepted Medium of Exchange and only shocks hitting the international monetary system can trigger a shift from one dominant international currency to

[50] For the exit and voice effect Vaubel follows the terminology of Hirschman, who introduced them in his book "Exit, Voice and Loyalty" (1970)
[51] And significant at the 5 % level
[52] See subchapter „Evolution of money"

another. (Hartmann 1998, pp. 40-66) Additionally, the abandonment of the national currency implies the loss of national monetary policy. When monetary policy had contributed to business-cycle stabilization, its loss leads to higher costs in the form of wider cyclical fluctuations of output. (Alesina/Barro/Tenreyro 2002, p. 309) It is more likely that international currency competition will produce several currency unions which membership is determined by trade, geography and co-movements of outputs and prices.

4.3. Free Banking Competition

The existence of a natural monopoly does maximize the profit of the industry[53], but it reduces the benefits to consumers. In this view, the best regulation can do, is to force the monopoly industry to the level of competition. As Hayek questions the existence of a (natural) monopoly in money issue, the question is, when competition promotes economic efficiency, because it delivers greater benefits to consumers; why not apply it on the issue of money. In a system of a strict commodity standard, there is no need for government action, because the supply of currency is determined by market forces. The only situation where government can come into play is to provide services[54], or to impose regulations concerning the type of commodity which is used, or to standardize a commodity bundle. (Friedman 1951, p. 204) With such base money why not allow banks to issue currency and to compete for shares in the currency market.

4.3.1. A simple model of Free Banking[55]

In a system of Free Banking Competition banks act like a firm[56] and face an optimization problem which is given through the structure of its balance sheet shown in following table:

[53] In the case of the "money industry", the government benefits from the monopoly of money issue.
[54] Like certifying the quality and quantity of the currency commodity or issuing or certifying warehouse receipts (when the commodity is stored in a warehouse)
[55] The presented model follows Selgin/White (1994) and White (1999)
[56] See Chapter "The Banking firm" where the profit maximization function is similar to that one in this chapter.

Assets	Liabilities & Equity
Reserves R	Equity capital K
Loans and securities L	Deposits D
	Notes or currency-card balances in circulation N

Table 3: Simplified balance sheet of a bank

This balance sheet imposes the constraint

(3.1) $$R + L = N + D + K$$

and the objective function to be maximized is the profit function, given by

(3.2) $$\pi = i_L L - i_D D - C - Q$$

where π denotes the expected profit, i_L the interest yield on loans and securities, i_D the interest rate on deposits, C the operating costs, and Q the liquidity cost. Both interest rates, i_L and i_D are not choice variables but determined by the loan and deposit market. The operating costs are a continuous function of each of the balance sheet items:

(3.3) $$f(R, L, N, D) \text{ where } C_R > 0,\ C_L > 0,\ C_N > 0,\ C_D > 0$$

In this model the liquidity cost Q is the expected value of costs which a bank incurs, when it runs out of reserves. The function may be written as

(3.4) $$Q = p(X - R)\phi(X \mid N, D)dx$$

where X is the outflow of reserves, $\phi(X \mid N, D)$ is the probability density function over X, conditional on N and D, and p is the penalty cost as a percentage of realized illiq-

uidity. The penalty cost p is always larger than 0, as long as $X - R$ is larger than 0[57]. The static profit maximization yields a set of six equi-marginal conditions:[58]

$$i_L - C_L = -C_R - Q_R \tag{3.5}$$

The first marginal condition claims that the marginal net revenue form making loans or holding securities (left-hand side term) is equal to the marginal net benefit from holding reserves (right-hand side term). In this situation the profit-maximizing bank is indifferent between holding extra loans or securities and holding extra reserves of the same market value.

$$i_L - C_L = C_N + Q_N \tag{3.6}$$

A growing volume of currency outstanding will be reflected in rising marginal costs (right-hand side) and thus sets an economic limit to the amount of loans and securities expressed through the marginal net revenue from making loans or holding securities.

$$i_L - C_L = i_D + C_D + Q_D \tag{3.7}$$

This equation can be understood intuitively: The amount of loans is limited to the rising marginal cost (interest payment, marginal operating costs and marginal liquidity costs) of acquiring funds via deposits. When the marginal net revenues from making loans equals the total marginal cost of maintaining and servicing deposits, then no more loans will be made.

$$-C_R - Q_R = C_N + Q_N \tag{3.8}$$

This equation is implied by (3.5) and (3.6) and states that the bank's marginal net benefit from holding reserves is equal to the total marginal cost of maintaining currency in circulation. Intuitively it imposes a restriction on the issue of currency to buy reserves, because it has to keep the currency in circulation.

[57] The assumption that the outflow of reserves is bigger than the reserves is at the first sight somehow unrealistic: It is not possible to withdraw more money, than the bank has stored. But the historical case gives evidence for the contrary: During the free banking era in Scotland banks often were not able to meet people's desire to withdraw money. Therefore banks had to break off the payment and guaranteed higher interest rate until the next possible withdrawal. This compensation plus the loss of reputation form the main parts of the penalty cost p, which occur when the outflow is higher than the reserves.

[58] The derivation of the first order conditions for profit maximization can be found in the Appendix.

$$(3.9) \qquad -C_R - Q_R = i_D + C_D + Q_D$$

Something similar says equation (3.9), which is implied by equations (3.5) and (3.7). Here the marginal net benefit from holding reserves is equal to the marginal cost of maintaining deposits i.e. the profitability of acquiring reserves by attracting additional deposits is limited through the rising marginal costs of deposits.

$$(3.10) \qquad C_N + Q_N = i_D + C_D + Q_D$$

The last equation describes the constraint, that the marginal cost of expanding the currency circulation must equal the marginal cost of expanding the bank's deposits. In the profit-maximizing equilibrium both sources are equally costly.

The general prediction of the equi-marginal conditions is that a bank can use currency issue to expand its assets only if the currency[59] stays in circulation. Hence, in a competitive environment the currency issuing bank must have customers which will hold that currency, rather than (1) redeem it for reserves, or (2) exchange it for deposits or the currency of another bank. As banks are price-takers in the loan and deposit market i.e. i_L and i_D are determined by the market, competition will take place along non-price dimensions. Pivotal factors in the choice which currency to hold are (1) the spend ability of the currency (2) easy redemption of the currency (3) public awareness and confidence in the currency (4) anti-counterfeiting measures and (5) higher physical attractiveness of the currency.

The model above and the six equi-marginal conditions enable any particular bank i to calculate the equilibrium size of its currency circulation N_P^i *, where subscript P denotes the public for whom the currency is an asset and superscript i denotes the issuing bank. In this model there will be no over-issue by one single bank, because any over-issue will be reflected in the loss of reserves. The reason lies in the reflux process i.e. how the public respond to a currency excess of one single bank: People can (1) direct redeem the currency for reserves, or (2) deposit the excess currency in another bank[60], or (3) deposit the excess

[59] Which is clearly distinguishable from the currencies of other banks (Klein 1974, p. 424)
[60] In a clearinghouse system this would create adverse clearings for the over-issuer, as the recipient bank presents the deposited currency for redemption.

currency into the bank itself[61]. In all three cases the bank i finds its reserves lower than it desires, thus the bank will have to sell securities in order to increase reserves. Also an over-issue by a currency monopolist or by plural issuers will be corrected, but in such events by external drain i.e. outflow of currency reserves from all banks and not just the over-issuer. The last case left when all the banks in the world over-issue, only increases a representative bank's probability of illiquidity. Each bank will feel its risk of running out of reserves too great and, thereby will contract deposits D or Notes or currency-card balances in circulation N. (White 1999, pp. 60-64) Similar to the commodity standard competition, also this model assumes implicitly the emergence of clearinghouse as a higher instance to ease the exchange of different currencies. Such clearinghouse associations would also solve the uniformity problem[62] of different currencies, as membership in a certain clearinghouse system signals trustworthiness of the currency (Goodfriend 1991, pp. 13-14). In general, when a currency (1) is backed by a commodity or bundle of commodities and (2) when it is clearly distinguishable, it is quite probable that individuals will accept them as a Medium of Exchange. (Boller 1992, p. 146) The appearance of sticky behaviour and switching between alternative Media of Exchange will be discussed in the last chapter

4.4. Private Currency Competition

Together with Free Banking this type of competition constitutes a so-called Laissez-Faire Monetary System. Both have in common, that (1) the quantity of exchange media is not controlled by the government, (2) nor exists a central bank as result of government intervention[63]. There is also an absence of legal restrictions concerning (3) the entry, branching and exit of commercial banks and (4) the drafting of contracts between banks and their costumers, as well as no limitations of (5) the issued quantities, types or mix of debt and equity claims. Additionally, (6) interest rates are not controlled and (6) government does not impose any deposit guarantees. (Selgin/White 1994, pp. 1718-1719, Mafi 2003 p. 478) What makes this competition different is the competitive supply of currency

[61] In this case the marginal equi condition (3.10) $C_N + Q_N = i_D + C_D + Q_D$ is not valid, because the marginal cost of an additional deposit (higher cost of liquidity, higher cost of liability) is higher than the marginal cost of expanding currency in circulation.

[62] The uniformity problem occurs when several currencies are in circulation and, because of the uncertainty about counterfeiting, a bank or a shop rejects to accept, or only accept at various discounts from par, a certain currency. (Selgin/White 1994)

[63] This does not exclude generally the existence of central bank. Even in a laissez-faire monetary system can a central bank come spontaneously into existence.

with parallel private fiat-type currency. Currency on a non- or partial commodity base is issued by private banks and can be clearly distinguished from other issued currencies.

4.4.1. Klein's model of Fiat Money[64]

The first formal treatment of the economics of private money and the introduction of the idea of "brand-name" currency[65] was done by Benjamin Klein (1974). In his model the competitive supply of fiat money is examined under the assumptions of perfect and imperfect foresight. In the case of **perfect foresight** all changes in the purchasing power of a "brand-money j"[66] are anticipated. The profit-maximizing quantity of real balances of such a currency j, $\left(M/P\right)_j$, is limited by the rising marginal cost of producing real balances of brand-j money. The equilibrium condition is

$$i_j - i_{M_j} = MC_j \tag{4.1}$$

where i_j denotes the nominal interest rate on bonds denominated in currency j[67], i_{M_j} is the nominal interest rate paid on balances of currency j, and MC_j corresponds to the marginal cost of producing real balances of currency -j. The left-hand side is the "rental price" of currency j i.e. the opportunity costs when consumers hold brand-j currency balances rather than bonds.[68] Because Klein distinguishes between the stock of money and flow of "monetary services", the production of real money balances are not

[64] Following Klein (1974) and White (1999)

[65] Klein introduced this definition as a description for clearly distinguishable private issued currencies or banknotes. Otherwise competition would drive the quality of private fiat-type monies to zero. (Klein 1974, pp. 424). In the following analysis, the expressions currency and money assume indirectly brand-name currency or brand-name money, even it is not explicitly written.

[66] In Klein's argumentation the term brand-money / brand currency serves to distinguish clearly between several competing currencies.

[67] The whole model of Klein focuses on the institutional settings of the United States. This becomes especially obvious through the use of bonds in the model which are an institutional tribute to the United States.

[68] This is a simplified notation of the one Klein introduced. He formulated it as $(i - r_M) = \frac{dC_j}{d\left(M/P\right)_j}$ where r_M is the interest payment of money, i is the interest payment of bonds in terms of the j^{th} currency, C_j the real costs of producing monetary services, and $\left(M/P\right)_j$ is the real balance of currency j. (Klein 1974, pp.425-426).

costless as the issuer has to endow the currency with the capacity to render transactions-facilitating services. (Klein 1974, p. 424; White 1999, p. 229). Klein's condition is very similar to the marginal equi-condition (3.7) from the previous section:

$$(4.2) \qquad i_L - C_L = i_D + C_D + Q_D \Leftrightarrow i_L - i_D = C_L + C_D + Q_D$$

In this case the term $(C_L + C_D)$ denotes the marginal cost of channelling loans into deposits and is equivalent to MC_j. Contrary to the chapter about free banking, in this model do not exist any marginal liquidity cost of bank liabilities, because currency is not redeemable into any commodity, thus $Q_D = 0$. Under the assumption of perfect foresight, the impact of any anticipated inflation would be neutralized by an explicit interest yield in i_{M_j} which compensates for future depreciation of currency j's purchasing power. This allows rearranging equation (4.1) to

$$(4.3) \qquad i_{M_J} = i_j - MC_j$$

Combined with the Fisher effect[69] the nominal interest rate on bonds denominated in terms of currency j equals the real rate of interest r and the actual (which is, due to the Fisher identity, equal to the anticipated) inflation rate π^e or equivalently gP_j, the change in the price level of currency j

$$(4.4) \qquad i_j = r + gP_j$$

When the quantity of real balances of currency j, $\left(M/P\right)_j$, does not change, the inflation rate equals the growth rate of currency j.

$$(4.5) \qquad gP_j = gM_j$$

Substituting (4.5) into (4.4) and further into (4.3) yields following final equation for the situation of perfect foresight:

[69] Remembering footnote (26) the Fisher identity defines the real interest rate r as the difference between the nominal interest rate i and expected inflation π^e i.e. $r \equiv i - \pi^e$ or equivalently $i \equiv r + \pi^e$

(4.6) $$i_{M_J} = r - MC_j + gM_j$$

The prediction of this condition is, that the explicit yield on currency j has to equal to the real interest rate r, minus the marginal cost of producing real money balances MC_j, plus full compensation for any loss of the purchasing power of currency j triggered by money growth gM_j. In this model only the determinacy of real balances matter and banks have no profit from expanding the nominal money stock i.e. no profit from hyperinflation.

In the case of **imperfect foresight** the assumption of perfect predictable changes in prices gP_j is relaxed and consumers form expectations about these changes gP_j^*. To create confidence in privately issued money, commercial banks must compensate their clients for this higher anticipated inflation. Equation (4.1) has now two requirements: The marginal costs of producing real balances of currency j, $\left(M/P\right)_j$, have to meet (1) the cost of providing greater transaction services, and (2) the cost of increasing confidence. To analyse the behaviour of the bank one has to start with, the banks' real income net of interest payments $\frac{\psi}{P_j}$, which is given by

(4.7) $$\frac{\psi}{P_j} = (i_j - i_{M\,j})\left(\frac{M}{P}\right)_j$$

The determination of the equilibrium amount of privately issued money can be found in the Appendix. More interesting is to examine the behaviour of the inflation rate, because this objection is the force to be reckoned with in the environment of privately issued fiat currency. By incorporating imperfect foresight, equation (4.7) can be rewritten as

(4.8) $$\frac{\psi}{P_j} = (i_j - i_{M\,j})\left(\frac{M}{P}\right)_j + gM_j\left(\frac{M}{P}\right)_j - gP_j^*\left(\frac{M}{P}\right)_j$$

where $\frac{\psi}{P_j}$ denotes the real profit, $(i_j - i_{M\,j})\left(\frac{M}{P}\right)_j$ the net real interest income, $gM_j\left(\frac{M}{P}\right)_j$ the gross real revenue from issuing new money, before rebates and

$gP_j^*\left(\frac{M}{P}\right)_j$ is the portion of new money that must be rebated to holders of existing j-brand currency in order to compensate them fully for anticipated inflation. The question whether the profit-maximizing rate of monetary expansion is finite, or in other words, whether a bank has incentive to inflate its currency j, can be answered by calculating the first-order condition of (4.8):

$$\frac{d\left(\frac{\psi}{P_j}\right)}{dgM_j} = \left(\frac{M}{P}\right)_j \left[d\left(\frac{i_j - i_{Mj}}{dgM_j}\right) + 1 - \frac{dgP_j^*}{dgM_j} \right] \tag{4.9}$$

where $d\left(\frac{i_j - i_{Mj}}{dgM_j}\right)$ is the decrease in rental price triggered by unanticipated inflation and $\frac{dgP_j^*}{dgM_j}$ describes peoples adjustment of current inflation expectations to current money growth. For simplicity the first expression will be denoted by u and the second one by v.

$$\frac{d\left(\frac{\psi}{P_j}\right)}{dgM_j} = \left(\frac{M}{P}\right)_j (u + 1 - v) \tag{4.10}$$

In his model Klein regards the term v as constant with $0 \le v \le 1$, where $v = 1$ represents perfect foresight and $v < 1$ imperfect foresight. Under imperfect foresight and $u = 0$[70] the profit maximising rate of increase of money is infinite. A firm will always inflate its currency, because $(u + 1 - v) > 0$ and thus, the marginal profit form faster monetary expansion is always positive. A finite monetary expansion rate will only occur when the marginal profit of monetary expansion equals zero:

[70] $u = 0$ means that the issuing firm can hold $\left(i_j - i_{Mj}\right)$ constant as gM_j varies.

(4.11) $$\left(\frac{M}{P}\right)_j (u+1-v)=0$$

which implies $u=v-1$. As $v<1$[71], this requires $0<u<1$. To inquire whether this point is a local maximum or global maximum it is necessary to remember the profit function from (4.8) and rearrange it to

(4.10) $$\frac{\psi}{P_j}=(i_j-i_{Mj})\left(\frac{M}{P}\right)_j+\left(gM_j-gP_j^*\right)\left(\frac{M}{P}\right)_j$$

Because $\left(gM_j-gP_j^*\right)$ is directly proportional to gM_j[72] the second part of the equation grows without limit. In order to stop growing the firm's rental stream $\frac{\psi}{P_j}$, it is required that the rental price of money (i_j-i_{Mj}) becomes negative as money growths without limit. This situation represents a local equilibrium, but when the rental price of money is bounded below zero, maximum profit will only occur at an infinite rate of inflation.

[71] The case when $v=0$ would describe a situation, where people do not adjust their inflation rate expectations with respect to money growth. This is, more likely to be unrealistic than the assumption of perfect foresight.

[72] Klein assumes that expectations about inflation rates are formed by $gP_j^*=u+vgM_j$, hence also expectations are proportional to the growth rate of money.

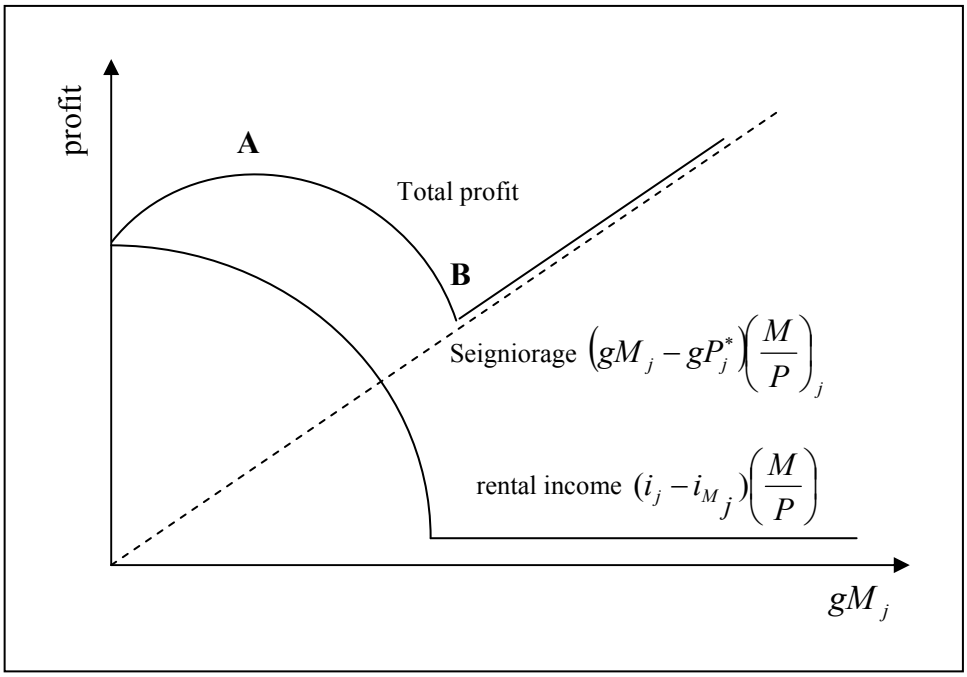


Figure 4: Unbounded monetary expansion

In order to gain a better understanding, the results are presented graphically in the figure above. Equation (4.10) implies that bank j's real profit $\frac{\psi}{P_j}$, or **total profit**, is the sum of two terms: (1) the net real interest or **rental income** $(i_j - i_{M_j})\left(\frac{M}{P}\right)_j$ and (2) **seignorage** $\left(gM_j - gP_j^*\right)\left(\frac{M}{P}\right)$, which is the amount of real purchasing power that bank j can extract from the public by printing money (Mafi 2003, p. 476). In this graph point **A** is a local equilibrium where $-u = 1 - v$. As u converges to zero, beyond point **B** $1 - v$ is always higher than u and profit can be increased with unbounded monetary expansion. Thus, in the global equilibrium of private currency competition the so-called **overissue problem** occurs: Monetary expansion and inflation are infinitely i.e. hyperinflation.

4.4.2. A partial vindication of Hayek

In recent years Hayek's idea witnessed a partial theoretical and empirical vindication. Martin and Schreft (2006) showed that in an overlapping generation (OG) model[73] and in a

[73] Economy exists at dates $t = 1,2,...,n$ and at each date, a mass 1 of two-period living agents is born into the economy

search model[74] exist also one equilibrium with competitively issued money. This is all the more notable as in earlier studies both frameworks served to prove the non-existence of a monetary equilibrium with competitive issuance. Indeed, there are two monetary equilibriums: In an environment of currency competition, money can have a value higher than the paper it is printed on or not, depending on the beliefs of the economic agents. To bring about the agent's optimal beliefs and to achieve an efficient money supply there is a need for a specific cost of becoming a money issuer. To impose such costs the authors hence propose the introduction of a licensing agency. (Martin/Shreft 2006 pp. 27-29) May such an agency not be in the spirit of Hayek when it is a governmental agency, but as described in the analysis of central banks, a regulatory function can also emerge as a spontaneous result.

By analysing the relationship between currency competition and inflation Mafi (2003) offered an empirical vindication of Hayek's proposal. He examined whether competition in issuing currency will result in lower inflation or not. As a first step Mafi calculated the annual average inflation rates during free banking eras which occurred in Australia, Canada, France, Italy, New-Zealand, Spain, Switzerland and the United States. Afterwards he compared his results to the average annual inflation rates after the creation of each country's national central bank. During the period of free banking the average inflation rate was for all countries significantly lower than inflation under central banking. As Hayek claimed, competition among currency suppliers provides consumers with choices that enhance their well being. (Mafi 2003, pp. 482-486)

4.5. Fractional versus 100 % Banking

One argument of the inherent instability of the banking system can be lead back to the discussion between 100 % banking and fractional banking. In the case of **100 % banking**, the banker acts strictly as a warehouseman and no intermediation between borrowers and lender will take place because the banker can make loans only out of his personal wealth. This does not mean that no intermediation at all will take place. Only the banks' functions (1) of managing demand deposits and (2) borrowing money for investment opportunities will be separated, and, due to these functions, two different types of institutions will

[74] Time is discrete and denoted by $t = 1,2,...,n$, and the Economy is populated by a mass 1 of agents who live forever.

emerge: Accounting banks, where 100 % of the deposits are always redeemable, and investment banks, where clients abandon the right to redeem their deposits for a certain period. This system might provide more stability, but as a consequence the cost of managing demand deposits will increase. On the other hand, the interest rate on deposits of investment banks will increase as well, as an investment bank has to compensate the abandoned right of deposit withdrawal. In the presence of **fractional banking** bankers lend out depositors' balances, while satisfying depositors' desire to withdraw their deposits on demand. This became possible because of two conditions: (1) money is fungible[75] and (2) withdrawals are random[76] (Selgin 1987, pp. 445-445) A striking feature of fractional banking is the multiple deposit creation. Consider a stylized balance sheet of the total banking system, when the required reserve ratio is 10 %

Assets		**Liabilities & Equity**	
Reserves *R*	+100 (**1**)	Deposits *D*	+ 100 (**1**)
	-90 (**2**)		+ 90 (**3**)
	+ 90 (**3**)		
	- 81 (**4**)		
Loans and securities *L*	+ 90 (**2**)	Equity capital *K*	
	+ 81 (**4**)		

Table 4: Multiple deposit creation

In the first stage (1) 100 € are deposited in a certain bank and constitute also this bank's reserve. As the required reserve ratio is 10 %, the bank will not want to hold excess reserves and will make loans of 90 € (2). The borrower to whom the bank lent the money will

[75] The coin and bullion which is repaid to the depositor is not identical to the coin and bullion she had originally brought in

[76] Compared to the large number deposits fractional reserves are sufficient to meet random withdrawal demands.

spend it[77], such that the whole amount is again in circulation. For simplicity it is assumed, that the circulating money will be again deposited as a whole (3). Because the bank still has to keep only 10 % reserves, 81 € will be used for additional credits (4). This process continues until the excess reserves converge to zero. The process of multiple deposit creation can be written as follows:

(5.1) $$\Delta D = \frac{1}{r} \times \Delta R$$ [78]

where ΔD denotes the change in total checkable deposits in the banking system, r the required reserve ratio and ΔR the change in reserves for the banking system. (Mishkin 2007, pp. 341-347)

Even if the assumption of 100 % reflux from credits to deposits is somehow unrealistic, fractional banking contributes to a more effective money supply than the existing stock of specie alone. But contrary it also does thereby create inside money. Consider following graph:

[77] Why making a loan when you keep all the money in your pocket? It is more likely to assume, that the money will be invested

[78] The formal derivation of the equation is $\Delta D = [[\Delta R \times 1]] + [\Delta R \times (1-r)] + [\Delta R \times (1-r)^2] + ...[\Delta R \times (1-r)^n]$ which can be rewritten as $\Delta D = \Delta R \times [1 + (1-r) + (1-r)^2 + ...(1-r)^n]$ Using the formula for the sum of an infinite series, it is possible to yield $\Delta D = \Delta R \times \frac{1}{1-(1-r)} \Rightarrow \frac{1}{r} \times \Delta R$

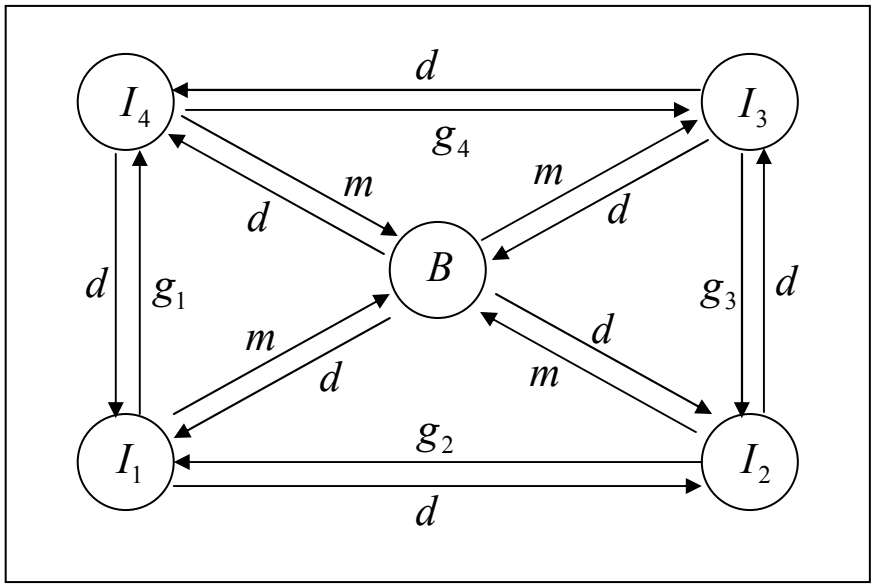


Figure 5: An economy with deposits as medium of exchange

In the sketched economy all individuals I_n go to the bank B and receive in exchange for their physical money m bank's deposits d. Subsequently, people do not use money to carry out their transactions but their deposit account in the bank. Deposits have become a Medium of Exchange which is denoted in physical money as the Unit of Account. In this view, deposits are nothing more than inside money, which represent a claim on physical currency, or to put it in other words: deposits are money which is redeemable in physical currency. Combined with the concept of multiple deposit creation, one can say that through fractional banking and technological enhancements deposits always become a type of privately issued fiat money.

5. CONCLUSION

„The question we have to consider is whether competition between the issuers of clearly distinguishable kinds of currency consisting of different units would not give us a better kind of money than we have ever had, far outweighing the inconvenience of encountering (but for most people not even having to handle) more than one kind."

F. A. Hayek

Reconsidering Hayek's proposal of currency competition was the main aim of this thesis and it tried to show, that his proposal is not a general but a specific idea how currencies can compete against each other. As presented in chapter 4, currency competition can be classified according to differences in the issuing instance and whether the currency is entirely or partially redeemable into a commodity or bundle of commodities. In doing so, four combinations are possible: (1) a central instance issues money which is completely backed by a commodity or bundle of commodity (**Commodity Standard Competition**), (2) a central instance issues partially redeemable money (**International Currency Competition**), (3) commercial banks issue a commodity backed money (**Free Banking Competition**), and finally (4) commercial banks bring their own fiat money into circulation (**Private Currency Competition**). The proposed denomination for each type does not lay claim to unique validity, but rather it tried to overcome the puzzling use of expressions in the existing literature.

One of the major claims in Hayek's idea is to avoid more government intervention than necessary. Therefore a great effort was spent to describe the evolution of existing institutional arrangements as a spontaneous result and apply this concept on the different types of currency competition. The thesis gives evidence that Money, Financial Intermediation and also Central Banking can emerge in different ways without being imposed from outside. Nevertheless, government comes into play to provide and design the legal framework

in which such processes will take place. However, its intervention should move along the line of regulation and not along the line of central institutional design.

The opponents of competitively produced fiat money make their argument on the inflationary bias i.e. a private issuing institution has always incentives to over-issue like in the Model of Klein with imperfect foresight. But Martin/Schreft (2006) showed that hyperinflation is just one of the possible equilibriums. There exists also a monetary equilibrium, in which money has a higher value than the paper it is printed on, depending on the beliefs economic agent form. To influence this believes positively it might be necessary to introduce costs of becoming a money issuer. In the authors' view a central instance could charge issuing banks. From Hayek's standpoint such an institution should be the spontaneous result, which is, due the thesis' discussion on regulatory functions of central banks, quite probable. An empirical rejection of the inflationary bias argument was presented by Mafi (2003). In his paper he compared inflation rates of several countries during their experience with free banking to inflation rates after imposing a central bank. In his argumentation inflation rates were significantly lower during free banking than in the periods of central banking.

Another objection against the idea of currency competition arises from the "sticky behaviour" of economic agents. The experiences with hyperinflation in Germany gave some evidence that people tend to stick with a depreciating Unit of Account for a very long time. Switching from one Unit of Account to another is not a costless procedure and depends mainly on the availability of an alternative Unit of Account that is widely used in the economy. Even if in a competitive environment exist more non-inflating numéraires, people do not consider only the costs of using a new numéraire (like changing the accounts), but also the costs of using a new means of payment.[79]

Apart of the behaviour objection, there is nothing to be said against a system of free banking where money is issued on the base of a single commodity or a standardized bundle of commodities. Quite the reverse, historical and theoretical evidence suggest that such a system is a viable alternative monetary regime which can, up to a certain degree, provide price-level stability. Beside the point of political feasibility such a system is not substantially

[79] In 2002, when the euro replaced the Schilling in Austria, people continued to calculate in Schilling as a numéraire for a long time. Even now, eight years later, the Schilling is still present when people make a rough guess on expected costs.

different to the current one. As shown in chapter 4, fractional banking, and in further consequence multiple deposit creation, is already creation of fiat money, where deposits serve as the Medium of Exchange and represent a claim on physical currency. The difference to a free banking or private currency system lies in the constraints: Whereas in a system of privately issued money banks are restricted by the costs of running out of liquidity, in the current system they are only constrained by legally required reserve. Due to this fact and additionally deposit insurance banks do not need to take costs into account. As issue of more money in the form of deposits is not possible, they tend to lend to riskier borrowers. Therefore, an environment of competitive money supply would strengthen the responsibility of banks.

The literature on currency competition is not only an intellectual glass bead game for monetary theorists and historians, but also has a practical value. As mentioned in the introduction it is the experience of a crisis which causes changes in current arrangements. In which direction such changes are towards, depends critically on the constraints of political feasibility and the options that have been explored. Hence, research in currency competition serves to widen the range of options and keeps them available.

6. BIBLIOGRAPHY

ALESINA, Alberto; SUMMERS, Lawrence H. (1993): Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence. Journal of Money, Credit, and Banking; Volume 25, Issue 2 (May 1993), pp. 151-162

ALESINA, Alberto, BARRO, Robert J.; TENREYRO, Silvana (2002): Optimal Currency areas. NBER Macroeconomics Annual, Vol. 17 (2002), pp. 301-345

ALLEN, Franklin; SANTOMERO, Anthony M. (1998): The Theory of Financial Intermediation. Journal of Banking & Finance, Vol. 21 (1998), pp. 1461-1485

BALL, Laurence (1997): Efficient Rules for Monetary Policy. National Bureau of Economic Research (Cambridge, MA), Working Paper No. 5952, March 1997

BOLLER, Guido (1992): On the Economics of Private Monies; St. Gallen: Dissertation

CUKIERMAN, Alex (1994): Central Bank Independence and Monetary Control. The Economic Journal, Volume 104, Issue 427 (Nov., 1994), pp. 1437-1448

FAMA, Eugene F. (1980): Banking in the Theory of Finance. Journal of Monetary Economics 6, (1980), pp. 39-57

FRIEDMAN, Benjamin M. (2008): Why a Dual Mandate is Right for Monetary Policy. International Finance 11:2, (2008), pp. 152-165

FRIEDMAN, Milton (1951): Commodity-reserve currency. The Journal of Political Economy, Vol. 59, No. 3 (Jun., 1951), pp. 203-232

FRIEDMAN, Milton (1968): The Role of Monetary Policy. The American Economic Review, Vol. 58, No. 1 (Mar., 1968), pp. 1-17

GERTLER, Mark (1988): Financial Structure and Aggregate Economic Activity: An Overview. Journal of Money, Credit, and Banking, Vol. 20, No. 3 (Aug., 1988, Part 2) pp. 559-588

GILLMAN, Max (1993): The welfare cost of inflation in a cash-in-advance economy with costly credit. Journal of Monetary Economics, Vol. 31 (1993), pp. 97-115

GOODFRIEND, Marvin (1991): Money, Credit, Banking, and Payment System Policy. Federal Reserve Bank of Richmond Economic Review, LXXVII (1991), pp. 7-23

GOODHART, C. A. E. (1987): Why do Banks need a Central Bank? Oxford Economic Papers, New Series, Vol. 39, No. 1, (Mar., 1987), pp. 75-89

GREENFIELD, Robert L.; YEAGER, Leland B. (1983): A Laissez-Faire approach to Monetary Stability. Journal of Money, Credit, and Banking, Vol. 15, No. 3 (Aug., 1983) pp. 302-315;

HART, Albert Gailord (1968): Money; In: SILLS, David L [Ed.]; International Encyclopaedia of the Social Sciences Vol. 10; New York: Macmillan, pp.

HARTMANN, Philipp (1998): Currency Competition and Foreign Exchange Markets. Cambridge: University Press

HAYEK, Friedrich A. (2007 [1976]): Denationalisation of Money; London: The Institute of Economic Affairs

JACKSON, Mathew O.; WATTS, Alison (2002): On the Formation of Interaction Networks in Social Coordination Games. Games and Economic Behavior, 41, pp. 265-291

JONES, Robert A. (1976): The Origin and Development of Media of Exchange. The Journal of Political Economy, Vol. 84, No. 4, Part 1 (Aug., 1976) pp. 757-775

KIYOTAKI, Nobuhiro; WRIGHT, Randall (1989): On Money as a Medium of Exchange. The Journal of Political Economy, Vol. 97, No. 4 (Aug., 1989) pp. 927-954

KLEIN, Benjamin (1974): The Competitive Supply of Money. Journal of Money, Credit, and Banking, Vol. 6, No. 4 (Nov., 1974), pp. 423-453

KLEIN, Michael A. (1971): A Theory of the Banking Firm. Journal of Money, Credit, and Banking, Vol. 3, No. 2, Part 1 (May, 1971), pp. 205 – 218

MAFI, Elham (2003): The Relationship between Currency Competition and Inflation. Kyklos, Vol. 56, Issue 4 (Nov., 2003) pp. 475-490

MARTIN, Antoine; SCHREFT, Stacey L. (2006): Currency Competition: A partial vindication of Hayek. Journal of Monetary Economics, Vol. 53, Issue 8, (Nov., 2006) pp. 2085-2111

MISHKIN, Frederic S. (2007): The Economics of Money, Banking and Financial Markets. Boston: Pearson Education

RITTER, Joseph A. (1995): The Transition from Barter to Fiat Money. The American Economic Review, Vol. 85, No. 1 (Mar., 1995), pp. 134-149

ROMER, David (2006): Advanced Macroeconomics 3rd ed. New York: McGraw-Hill

SANTOMERO, Anthony M. (1984): Modeling the Banking Firm. Journal of Money, Credit and Banking, Vol. 16. No. 4, Part 2: Bank Market Studies (Nov., 1984), pp. 576-602

SCHWARTZ, Anna J.; TODD, Walker F. (2008): Why a Dual Mandate is Wrong for Monetary Policy. International Finance 11:2, (2008), pp. 167-183

SELGIN, Georg A (1987): The Evolution of a Free Banking System. Economic Inquiry, Vol. 25, Issue 3 (Jul., 1987), pp. 439-457

SELGIN, George A.; WHITE, Lawrence H. (1994): How would the Invisible Hand Handle Money? Journal of Economic Literature, Vol. XXXII (Dec., 1994), pp. 1718-1749

SOTO, Jesús Huerta de (1995): A Critical Analysis of Central Banks and Fractional-Reserve Banking form the Austrian School Perspective. The Review of Austrian Economics Vol. 8., No. 2 (1995): pp. 25-38

TATOM, John A. (1976): The welfare cost of Inflation. Research paper of the Federal Reserve of St. Louis; (Nov. 1976)

VAUBEL, Roland (1986): Currency Competition versus Governmental Money Monopolies. Cato Journal, Vol. 5, No. 3 (Winter 1986) pp. 927- 942

WHITE, Lawrence H. (1999): The Theory of Monetary Institutions; Oxford: Blackwell

WOODFORD, Michael (2001): The Taylor Rule and Optimal Monetary Policy. The American Economic Review, Vol. 91, No. 2, Papers and Proceedings of the Hundred Thirteenth Annual Meeting of the American Economic Association (May, 2001), pp. 232-237

7. APPENDIX A: MATHEMATICS

7.1. Derivation of Demarcation curves

The demarcation curves are given by setting

(A.1) $\dot{G}_M = g(p) - g_{NM}(p) - \delta G_M$ and

(A.2) $\dot{p} = \alpha \frac{c(p) + p g_{NM}(p)}{G_M} - p$

equal to zero i.e. $\dot{p} = 0$ and $\dot{G}_M = 0$. This yields

(A.3) $G_M = \frac{g(p) - g_{NM}(p)}{\delta}$, and

(A.4) $G_M = \alpha \frac{c(p) + p g_{NM}(p)}{p}$

The slope of (A.3) is given by

(A.5) $\frac{\partial G_M}{\partial p} = \frac{\overset{[>0]}{g'(p)} - \overset{[<0]}{g'_{NM}(p)}}{\delta} > 0$

Analogously, the slope of (A.4) is given by

(A.6) $\frac{\partial G_M}{\partial p} = \alpha \left[\frac{p \overset{[<0]}{c'(p)} - \overset{[>0]}{c(p)}}{p^2} + \overset{[<0]}{g'_{NM}(p)} \right] < 0$

To evaluate the dynamic properties of the model, the deviation of (A.1) and (A.2) with respect to G_M is formed:

(A.7) $$\frac{\partial \dot{G}_M}{\partial G_M} = -\delta < 0$$

(A.8) $$\frac{\partial \dot{p}}{\partial p} = \alpha\left[\frac{c'(p)}{G_M} + \frac{p' g_{NM}(p)}{G_M} + \frac{g_{NM}(p)}{G_M}\right] - 1$$

$$= \underset{<1}{\alpha}\left[\underset{<0}{\frac{c'(p)}{G_M}} + \underset{<1}{\frac{g_{NM}(p)}{G_M}}\left(\underset{<0}{\frac{p g'_{NM}(p)}{g_{NM}(p)}} + 1\right)\right] - 1 < 0$$

7.2. First-order conditions for profit maximization

(B.1) $$R + L = N + D + K \Leftrightarrow K - R - L + N + D = 0$$

(B.2) $$\pi = i_L L - i_D D - C - Q$$

From (B.1) and (B.2) one can write out the Lagrangean

(B.3) $$\pi(R, L, N, D) = i_L L - i_D D - C - Q + \lambda(K - R - L + N + D)$$

from which the following first order conditions are derived:

(B.4) $$\frac{\partial \pi(R, L, N, D)}{\partial R} = \pi_R = -C_R - Q_R - \lambda = 0$$

(B.5) $$\frac{\partial \pi(R, L, N, D)}{\partial L} = \pi_L = i_{:L} - C_L - Q_L - \lambda = 0 \text{ where } Q_L = 0$$

(B.6) $$\frac{\partial \pi(R, L, N, D)}{\partial N} = \pi_N = -C_N - Q_N + \lambda = 0$$

(B.7) $$\frac{\partial \pi(R, L, N, D)}{\partial D} = \pi_D = -i_D - C_D - Q_D - \lambda = 0$$

7.3. Profit maximizing quantity of fiat money

Starting point are banks' real income net of interest payments, which is

(C.1) $$\frac{\psi}{P_j} = (i_j - i_{M_j}) * \left(\frac{M}{P}\right)_j$$

Assuming, that the cost of providing services is zero, and that the cost to find people who hold money is the only cost of generating confidence, it is possible to rewrite equation (4.7) to

(C.2) $$\beta_j = \frac{(i_j - i_{M_j}) \times \left(\frac{M}{P}\right)_j}{r}$$

Here, the present value of banks' income on brand name capital β_j is a stream of returns to the brand-name-capital asset value. To put it into another way, the stream of real income $(i_j - i_{M_j}) \times \left(\frac{M}{P}\right)_j$ represents a normal rate of return. To get an intuitive understanding consider following extreme cases: (1) the production of confidence is costless, and (2) the real interest payments on money are zero.

The first case assumes a costless production of confidence i.e. the marginal cost of producing real balances of brand-j currency is zero: $MC_j = i_j - i_{M_j} = 0$ or $i_j = i_{M_j}$. The rate of return to bonds i_j is equal to i_{M_j}, the rate of return on currency j. Because the marginal cost of producing real balances is zero, also the opportunity cost of holding money is driven to zero, and by inserting into (C.2), the amount of bank j's brand name capital β_j is zero.

In the second case, the nominal interest on money just equals the inflation rate i.e the real interest payments on money are zero:

(C.3) $$i_{M_j} = gP_j$$

Remembering the Fisher equation, which defines the real interest rate r as the difference between the nominal interest rate i and expected inflation π^e i.e. $r \equiv i - \pi^e$ or in this case

(C.4) $$i_j \equiv r + gP$$

and substitute both, the results from (C.3) and (C.4), into (C.2), one yields

(C.5.) $$\beta_j = \frac{(r + gP_j - gP_j) \times \left(\frac{M}{P}\right)_j}{r} \Leftrightarrow \beta_j = \left(\frac{M}{P}\right)_j$$

In this case the amount of bank j's brand-name capital equals $\left(\frac{M}{P}\right)_j$,.the real balances of currency j. The stock of j-money is equal to the net wealth of its issuer.

8. APPENDIX B: ABSTRACT

English

The idea of currency competition is the most innovative and controversial proposal about an alteration of the current monetary system. However, the intellectual creator of this idea, Friedrich August Hayek, combined often an economic analysis and a more or less pamphlet-like description of the political process. Therefore the thesis tries to revisit Hayek's idea and focus on the economic implications and effects. The first part of the thesis examines the current financial system and stresses the relevance of its institutions money, financial intermediation and central banking. The next part is dedicated to a brief examination on inflation whose avoidance forms the starting point in Hayek's considerations. The main part develops a typology of currency competition and analyses their prospects in the current financial system. The thesis closes with perspectives on a possible future of monetary policy with currency competition which is a viable alternative.

Deutsch

Die Idee von Währungswettbewerb ist der innovativste und zugleich umstrittenste Vorschlag, wie das bestehende Finanzsystem verändert werden kann. Jedoch hat der geistige Vater dieser Idee, Friedrich August Hayek, sehr oft eine ökonomische Analyse mit einer mehr oder weniger pamphletartigen Beschreibung des politischen Systems verbunden. Diese Arbeit versucht daher Hayeks Idee zu überdenken und auf die ökonomische Bedeutung und Auswirkungen einzugehen. Der erste Teil der Diplomarbeit untersucht das aktuelle Finanzsystem und betont dabei die Bedeutung der Institutionen Geld, Finanzintermediäre und Zentralbanken. Der nächste Teil ist einer kurzen Untersuchung der Inflation gewidmet, deren Vermeidung den Ausgangspunkt von Hayeks Überlegungen darstellt. Der Hauptteil entwickelt eine Typologie des Währungswettbewerbes und analysiert deren Aussichten im aktuellen Finanzsystem. Die Arbeit schließt mit den Perspektiven einer möglichen Geldpolitik mit Währungswettbewerb als realisierbare Alternative.

9. APPENDIX C: CURRICULUM VITAE

Personal Information

Name:	Peter
Surname:	SCHNEIDER
Date of Birth:	02/17/1985
Place of Birth:	Friesach (Carinthia)

Education

October 2005 – August 2010	Volkswirtschaftslehre Universität Wien, Austria
October 2008 – June 2009	Ciencias Economicas y Empresariales (Erasmus exchange) Universidad de Alicante, Spain
September 1999 – June 2004	Commercial academy in Althofen (Carinthia) terminated with highest distinctions (GPA: 1,3) A-levels (in writing): German, English, Business Studies and Bookkeeping A-levels (oral): Italian, Marketing, History

Language Skills

German	mother tongue
English	first foreign language IELTS score: 7.5

	Cambridge FCE: grade B business-fluent in spoken and written
Italian	second foreign language A-levels in Italian with grade 1 near fluent in spoken and written
Spanish	third foreign language fluent in spoken and written

Other Information

- IT-skills: MS Office (++) Eviews (++) Stata (+) Photoshop (+)
- 8 month military service at the „Pionier Bataillon 1“ (pioneer battalion) in Villach (Carinthia) as well as 2 months border security deployment in Burgenland
- Excellent typing skills (up to 300 characters per minute)
- First Aid course
- Driving licence (classes A and B)
- 10 years in the management of a youth club