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The Quality of Eligible Collateral and Monetary Stability: An Empirical Analysis

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Abstract

The central banking literature regards central bank independence and a transparent monetary policy as best suited to achieve and safeguard monetary stability. The existing empirical literature, however, failed in establishing a solid ground for this consensus. This paper sheds some new light on the empirical evidence on determinants of monetary stability. In addition, it expands the current research agenda by considering a neglected factor: The quality of eligible collateral (QEC).

Recently, the U. S. subprime crisis has shown that a weak collateralization of credits may have massive economic implications, entailing severe perturbations of the international financial system. This paper focuses on central bank lending and investigates to what extent the quality of eligible collateral is able to explain inflation employing the first comprehensive dataset to assess the significance of QEC for monetary stability. Data have been collected using an online questionnaire that was answered by central bank officials.

For the period 1990 to 2003 and a sample of 62 countries a robust negative and statistically significant correlation between QEC and average inflation is found. This result is robust to the use of control variables from the literature on institutional determinants of monetary stability. These findings have to be regarded as establishing QEC as one pivotal element of a theory of central banking. Collateralisation of the issuance of money and the elimination of financing the government deficit directly via the central bank can be seen as necessary conditions for achieving monetary stability. Good central bank money should be backed by the liable property of creditors to safeguard monetary stability. This finding can be utilized by policy makers especially in less developed and transition countries on their way towards a more stable economic development.

JEL-Classification: E58, E42, B59, P14

Keywords: Monetary economics, monetary theory, inflation, collateral, central banks, property, property economics, central bank independence

1 Introduction

Monetary stability is the overriding goal of central banks and represents a condition for continuous economic growth.[1] Based on the works of Nobel laureates Kydland and Prescott, the central banking literature regards central bank independence and a transparent monetary policy as best suited to achieve and safeguard monetary stability. The empirical literature, however, failed in establishing a solid ground for this consensus.[2] This paper sheds new light on the empirical evidence on determinants of monetary stability. Moreover, this paper expands the current research agenda by considering a factor that has so far been neglected in the central banking literature: The quality of eligible collateral.

The use of collateral is pervasive: More than two thirds of all credit contracts in developed countries are secured by collateral.[3] Yet, only in exceptional times does collateral make the headlines.[4] However, if it does – as in the recent crisis in the international banking system – even central banks need to act vigorously to prevent the whole system from collapsing. In recent years collateral has also become a subject of mainstream economic analysis.[5] But collateral also plays a vital role in the theory of Property Economics developed by Heinsohn & Steiger (2002; 2006 and 2007b). In the literature on the theory of the central bank, however, collateral has received only very little attention.[6] This paper aims at joining the theory of the central bank and Property Economics by investigating to what extent the quality of eligible collateral is able to explain inflation. In doing so, hypotheses derived from the theory of Property Economics are tested drawing on the first comprehensive dataset suitable to assess the significance of the quality of eligible collateral for monetary stability.[7] Moreover, the explanatory power of central bank independence and other potential determinants of inflation are assessed against the one of the quality of eligible collateral.

The paper proceeds as follows: Part two gives an overview of the literature on central banking and those issues in mainstream economic analysis related to this paper's research question: Central banks and collateral. In part three hypotheses on the effects of the quality of eligible collateral on inflation are generated based on the theory of Property Economics. Results of econometric analyses are presented in part four and part five discusses the implications of this study. Part six concludes.

2 Review of the literature

This paper investigates to what extent the quality of eligible collateral is able to explain cross-country differences in average inflation. An evaluation of this potential explanation

1 Cf. Levine (1997).
2 See the overview of the literature on central banking provided in section 2.1.
3 Cf. Bigus *et al*. (2004).
4 See, for instance, the Economist issue of August 18th 2007, Economist (2007a).
5 See the overview of the literature on collateral in economic analyses provided in section 2.3.
6 Cf. BIS (2001) p. i.
7 Cf. Lehmbecker & Missong (2008).

of inflation calls for an overview of how these are explained in the literature. Monetary policy has witnessed major developments during the last thirty years. The discourse on the characteristics of an optimal monetary policy was strongly influenced by the debate on *rules versus discretion*.[8] During the 1980s the paradigm of an independent central bank was developed. Central banks' monetary policy should be free from political pressures to be able to achieve the goal of price stability. The early 1990s saw just another innovation in monetary policy as inflation targeting was introduced in a number of countries. When more and more central banks were granted independence from their respective governments it became evident that the traditionally highly opaque monetary policy of many central banks would have to be adjusted to allow for greater central bank accountability.[9] Section 2.1 reviews the literature on monetary policy frameworks.

The subject of another ongoing debate in the field of central banking relates to the question if a central bank is required to guarantee an efficient functioning of markets. In the nineteenth century a similar debate on central banks' raison d'être took place. At that time a central bank was a new and rather unknown institution. Before that time – in the era of the so called free banking – one did not have any public supervision of the issuance of money. Thus, the question was whether a central bank would represent an indispensable or only an unnecessary public interference with economic processes.[10] Section 2.2 traces the debate's main arguments and appraises the significance of insights gained over the last decades. A short review of the macro- and microeconomic literature on collateral is offered in section 2.3.

2.1 The 'rules versus discretion' debate and its proposals

The debate on rules versus discretion led to major changes of monetary policy frameworks: During the 1980s many central banks were regarded as mere divisions of the treasury and central bank's communication with the public was considered as somewhat undesirable.[11] Nowadays this picture has changed completely as the following statement on the European Central Bank's (ECB) homepage reveals:

> "The independence of the ECB is conducive to maintaining price stability. Theoretical analysis and empirical evidence show this."[12] "Today, most central banks, including the ECB, consider transparency as crucial. This is true especially for their monetary policy framework. The ECB gives a high priority to communicating effectively with the public."[13]

8 Cf. Bofinger *et al*. (1996) p. 137 f.
9 See van der Cruisen & Demertzis (2005) p. 2, who argue that greater central bank transparency is justified by "[r]easons of democratic legitimacy […]".
10 Hayek and Friedman have revived this debate in the last decades. See Goodhart (1985) p. 1- 12.
11 Cf. Cukierman & Meltzer (1986) as well as data on central bank independence provided in Cukierman *et al.* (1992a).
12 See the ECB homepage under http://www.ecb.de/ecb/orga/independence/html/index.en.html.
13 See the ECB homepage under http://www.ecb.de/ecb/orga/transparency/html/index.en.html.

Geraats (2002), summarising these developments, regards central bank independence and transparency as the new paradigm in monetary policy.

The theory behind this paradigm is based on Kydland & Prescott's (1977) "Rules Rather than Discretion: The Inconsistency of Optimal Plans". A monetary policy bound by a fixed rule is justified on the grounds of a general dynamic time inconsistency of monetary policy. Monetary policy is assumed to have no effect on unemployment in the long run.[14] In the short run, however, a certain negative (positive) interrelation between the level of unemployment (economic activity) and the rate of inflation prevails. A level of inflation above the one expected by economic agents would cause unemployment to decrease. The microeconomic explanation is that producers interpret the rise in the price of 'their' good as a real increase in demand for 'their' good – being unable to distinguish whether all prices rise or only 'their' good's price – and raise production accordingly.

In Kydland & Prescott's model the central bank is always tempted to boost the economy in the short run by unexpected – surprise – inflation. The resulting decrease of unemployment is welcomed by both private agents and central bankers. However, economic agents know the goals and conditions under which the central bank takes its decisions. Under rational expectations economic agents, therefore, adjust their expectations of future inflation accordingly and expected inflation turns out to be always higher than it would be if the central bank were able to commit credibly to a policy of zero inflation. The reason for this finding is that a credibly rule bound monetary policy allows policy makers to keep inflation at low levels whereas a discretionary monetary policy allows for a reduction of unemployment below its natural rate but at the cost of potentially excessive inflation rates.[15] The problem of time-inconsistency of monetary policy triggered a broad discussion on how to solve it.

Barro & Gordon (1983b) were among the first to propose remedies for the presumed time-inconsistency of a discretionary policy. A central bank's reputation or credibility is supposed to make up for a rule bound monetary policy. A central bank's reputation is said to have an effect on economic agents' formation of inflation expectations: The stronger the public's confidence in a central bank that promises to fight inflation effectively, the smaller expectations of inflation and therefore actual inflation would turn out to be. A central bank creating surprise inflation with the aim of pushing unemployment below its natural rate would thus jeopardise such reputation. If economic agents become aware of the game the central bank is playing, agents will – assuming rational expectations – presume that the central bank will always induce agents to increase employment. The corollary of such monetary policy would be rising inflation expectations, resulting in higher actual inflation and a loss of reputation for the central bank. The following two subsections illustrate the main proposals to create and maintain such credibility.

14 Empirical work by Lucas (1973) established the idea that a natural rate of unemployment exists, which in the long run is only affected by structural factors.

15 A discretionary policy is defined as taking the decision concerning the optimal policy in each period anew while in a rule bound setting this decision is only taken once and for all future periods. Cf. Kydland & Prescott (1977) p. 477-480.

2.1.1 Transparency as means to build reputation

Cukierman & Meltzer (1986) advanced the reputation approach of Barro & Gordon (1983b). In their model the central bank has private information regarding its goals. This entails that economic agents are unable to infer reliably the central bank's goals from policy results. The greater the central bank's control of inflation, however, the faster and more reliable economic agents' conclusions regarding central bank's goals would be. It follows that central banks might deliberately choose rather rough monetary policy instruments, since the resulting imprecise control of inflation offers the advantage – from the central bank's point of view – of obscuring surprise inflation. The use of suboptimal monetary policy instruments might therefore avoid any damages to a central bank's reputation that would otherwise result from surprise inflation. Studying the Federal Reserve Board Goodfriend (1986) came across such behaviour: Neither the precise goals of monetary policy nor the Board's decision process were transparently communicated to the public. The papers by Barro & Gordon, Cukierman & Meltzer and Goodfriend mark the beginning of a debate on transparency in monetary policy.

At the beginning of the 1990s the idea that an improved reputation could be achieved by a more transparent form of monetary policy was taken up by a couple of central banks, which introduced a new framework for monetary policy – inflation targeting.[16] The concept of inflation targeting comprises publicly announced targets for future inflation and a commitment to low and stable inflation as primary and overriding goal. Furthermore, inflation targeting entails an increased communication with the public: Targets for future inflation are not only announced but the central bank explains in publications and official speeches why the announced target was chosen. Precisely this form of public relations in connection with an inflation target renders it virtually impossible for a central bank to shirk itself from the responsibility for actual inflation. Thus, inflation targeting offers the advantage of an increased credibility.[17] In addition theoretical foundations of inflation targeting are supported by empirical work: Mishkin & Schmidt-Hebbel (2001) review the literature on inflation targeting and conclude that it is a success story.[18]

The main empirical study on central bank transparency's effect on inflation was conducted by Chortareas *et al*. (2002b). Their results support the thesis that the more detailed the explanations of central bank's forecasts are the lower the inflation rate will be. Posen (2002) regards central bank transparency as determinant of inflation but criticises Chortareas *et al.*'s paper for employing average inflation as dependent variable. According to Posen the theoretical literature on central bank transparency focuses on inflation expectations and thus on the persistence of inflation.

Posen (2003) finds no evidence that an increased central bank transparency implies a stronger accountability on the side of the central bank. Most notably, the newly gained independence of many central banks did not increase central banks' accountability al-

16 Cf. Bernanke & Mishkin (1997).
17 Cf. Woodford (2005).
18 See also Svensson (1999).

though these central banks became significantly more transparent. A review of the literature on central bank transparency by Geraats (2002) reaches a similar conclusion. Though it is often argued that an independent central bank necessitates – for reasons of democratic legitimacy – an increased transparency to guarantee the central bank's accountability vis-à-vis the public, this argumentation is not supported by empirical findings. Geraats concludes that despite a lot of progress in the theoretical literature a consensus on the economic desirability of a transparent monetary policy is still missing.

Little remains to be added to Geraats' conclusion. More transparency is generally a good thing for central banks' monetary policy. But transparency of monetary policy alone does not imply central bank accountability in the sense that a well informed public controls an independent central bank. Unsurprisingly, a central bank that acts as announced and successfully fights inflation is generally considered the best method to build and preserve credibility while central bank independence is seen as second best solution to achieve higher credibility.[19] This raises the question whether central bank independence is able to limit central banks' alleged inflation bias.

2.1.2 Central bank independence: Safeguard against political pressure

The two papers by Barro & Gordon (1983a; 1983b) represent the origin of the discussion on central bank independence. Their central thesis is that governments tend to force central banks to issue as much currency as possible. The thus increased central bank profits would help government to finance a good portion of its budget. Due to higher inflation the value of government debt would shrink and a decrease of unemployment levels could be beneficial for government's chances in the next elections. As an increased issuance of money causes inflation, governments are generally to be regarded as possessing an inflationary tendency. Accordingly inflation rates should be lower in those countries where central banks are able to conduct monetary policy independently from governments.[20]

Forder (2000) offers a review of the literature that challenges the typical rationalisation of central bank independence. He believes that "[…] much of the advocacy of central bank independence is attributable to cynicism about democracy."[21] Forder argues that Barro & Gordon's thesis has at its centre simply a central bank governor, not an elected governor. Thus, elections have no role in the time-inconsistency problem, and hence establishing politically independent central banks should hardly solve the problem. Therefore, Forder rejects proposed remedies to the problem of time inconsistency, like central bank independence, 'conservative' central bank governors and contracts between central bank governors and the government.[22] Blinder (1998) vigorously rejects Barro & Gordon's

19 Cf. Blinder (2000).
20 Cf. Berger *et al.* (2001).
21 See Forder (2000) p. 183.
22 Cf. Forder (2000). On the issues of 'conservative' central bank governors and contracts between central bank governors and the government see the papers by Rogoff (1985) and Walsh (1995).

credibility justification: "Much fascinating theory to the contrary, I do not know a shred of evidence that supports it."[23] This verdict calls for a closer look at the empirical findings.

Cukierman *et al*. (1992a) were among the first to empirically test whether central bank independence has any effect on inflation. They construct a central bank independence index. This index is based on the formal legal dimension of central bank independence and possesses a statistically significant negative correlation with the level of average inflation among developed countries. This legal independence index possesses, however, no effect on inflation among developing countries. In view of the empirical observation that more independent central banks tend to be in politically more stable countries the survey by Cukierman *et al*. (1992b) supports these results: Political instability promotes a government practice that relies considerably on central bank seigniorage income to finance the government's budget. Their argument is based on the idea that an inefficient tax system constrains government's collection of revenues and that such inefficiency is welcomed by political opponents, particularly in politically more instable countries. This constraint on their finances would thus force governments to rely more heavily on seigniorage revenues, which should affect inflation.

Another very influential paper stems from Alesina & Summers (1993) who investigate the effect of central bank independence on the level and variability of several macroeconomic variables. They find cross-country evidence for 16 developed countries and the period 1955 to 1988 that the level of inflation and its variability are both negatively correlated with central bank independence indices while central bank independence has no effect on real variables. This suggests, they argue, that money is neutral and central bank independence reduces inflation without causing costs in terms of real macroeconomic performance. Posen (1998) examines the thesis that a central bank's independence enhances its credibility at such a rate that inflation expectations sink fast enough to allow for disinflations with relatively small output losses. His results suggest rather the contrary: Independent central banks cause higher costs of disinflation than relatively dependent central banks. Romer (1993) investigates the effect of a country's openness to trade on inflation in a monetary policy framework like the one proposed by Barro & Gordon. His model predicts that a country's degree of openness positively affects the costs of high inflation, due to depreciation of exchange rates. Thus, more open countries should tend to have lower inflation. Romer finds a robust and statistically significant negative relationship between openness and inflation among developing countries.

There are several studies questioning the robustness of the presented results on the effects of central bank independence.[24] Fujiki (1996) argues that results presented by, for instance, Cukierman *et al*. (1992a) and Alesina & Summers (1993) do not provide a reliable foundation for policy proposals. Their results are found to be not robust to the inclusion of control variables and depend on the periods covered and the samples employed – in particular there is no significant correlation between central bank independence and

23 See Blinder (1998) p. 45. See also McCallum (1997).
24 Cf. Fujiki (1996), Fuhrer (1997) and Campillo & Miron (1997).

inflation in the period 1980 to 1989. Fujiki thus challenges the robustness of Alesina & Summers' results.

The evidence on determinants of average inflation delivered by – among others – Cukierman *et al*. (1992a) and Romer (1993) is reconsidered in the study by Campillo & Miron (1997). Their methodology is largely analogous to Cukierman *et al*.'s. Yet, Campillo & Miron include additional control variables like GDP per capita in the same model. Thus, for the first time in the literature on determinants of average inflation competing concepts are compared directly. Campillo & Miron find that central bank independence possesses no effect on average inflation while political stability and a country's openness to trade both possess a statistically significant negative effect on average inflation. Their contribution is of utmost importance as it sheds light on the robustness of previous survey's results leading them to the "inescapable" conclusion that central bank independence possesses no effect on inflation.[25] Berger *et al*. (2001) review the empirical literature that investigates central bank independence's influence on inflation. The results of those 35 studies covered are rather ambiguous: Less than every second study finds a robust negative correlation in the spirit of Barro & Gordon. Most of these studies (30 of 35) use Cukierman *et al*.'s legal-index. Overall the results of Cukierman *et al*. are confirmed by these studies.[26]

The literature on central banking following Kydland & Prescott (1977) can be summarised as follows: There is a consensus on the optimal characteristics of the institutional framework. A central bank should be independent and implement a transparent monetary policy in order to best suit the goals of monetary stability and a stable financial system.[27] This consensus, however, is not unequivocally supported by empirical evidence:

i) Greater transparency can generally be considered as beneficial even in light of the scant empirical evidence. However, central bank transparency does not help to strengthen a central bank's accountability in the sense that a well informed public could control a central bank unrestrained by democratic checks and balances.

ii) The correlation between central bank independence and inflation is not robust to the inclusion of control variables and periods covered: While the most influential surveys – suggesting that central bank independence possesses an effect on inflation – did not test the robustness of these results,[28] the evidence on the missing robustness is substantial.[29]

iii) There is no empirical evidence to support Barro & Gordon's thesis that central bank independence increases central bank credibility. To the contrary, Posen (1998) finds that independent central banks cause higher costs of disinflation than dependent central banks.

Therefore, the current consensus on central banks' institutional framework, central bank independence and transparency, has to be regarded as standing on shaky ground. Advocates of the theory of central banking following Kydland and Prescott must be criticised

25 Cf. Campillo & Miron (1997) p. 356.
26 A more recent review of this literature reaching the same conclusion is provided by Arnone *et al.* (2006a).
27 Cf. Cukierman (2002) p. 15, Berger *et al.* (2001) p. 3 f. and Mishkin (1999) p. 580.
28 Cf. Alesina & Summers (1993) and Cukierman *et al*. (1992a).
29 Cf. inter alia Fujiki (1996), Fuhrer (1997) and Campillo & Miron (1997).

for holding on to an incomplete theory. The third part of this paper presents an alternative to a central banking theory à la Barro & Gordon, the theory of Property Economics by Heinsohn and Steiger. They regard the quality of eligible collateral as crucial for monetary stability – an issue not addressed in the covered literature.

2.2 A central bank's raison d'être

A major debate in the theory of central banking is the question if a central bank is required to guarantee an efficient functioning of markets. Goodhart (1985) gives an account of the evolution of central banks in Europe. The first public banks were established to achieve a standardisation of banknote issue. These banks were the banker of government, held large parts of a country's gold reserves and thus occupied an outstanding position. For these reasons other commercial banks began to hold reserves at these banks. Such bank was usually chosen to act as banker's clearing house and served as a source of additional liquidity by discounting bills. These banks were thus virtually growing into their role as central bank and finally became the banker's bank – the lender of last resort (LOLR).[30] It should be stressed that early central banks neither possessed a monopoly on banknote issue nor were they conducting monetary policy.

Later, according to Goodhart, the opinion gained prominence that a banker's bank not only has to guarantee a stable banking system but also has to provide for stability on the macroeconomic level. One had been conscious about the fact that a LOLR implies a kind of insurance for commercial banks. To meet the moral hazard problem, which accompanies the establishment of a LOLR, the banker's bank was given the right to control its counterparties, i.e. commercial banks.[31] Thus, central banks ultimately assumed the function of banking supervision to prevent unduly risky behaviour on the part of commercial banks. Since then controlling commercial banks for the sake of payment system's stability is regarded as central banks' primary and most important function. These developments also account for a major change in central bank forerunners' status from private banks to public institutions since the profit-maximising behaviour of private-sector banks causes conflicts of interest inconsistent with the goals of a regulatory authority for the banking system. Goodhart thus concludes that a central bank's raison d'être lies in guaranteeing a stable payment system by providing a LOLR.

Friedman & Schwartz (1986) justify the necessity for a LOLR as follows: In case a commercial bank exhibits liabilities that exceed its assets the bank's solvency is in danger. If the bank's equity is sufficient to offset this difference between liabilities and assets, the bank can continue its operations. Problems arise if the bank's depositors doubt the sol-

30 Freixas *et al*. (2002) define LOLR as discretionary provision of liquidity by the central bank to financial institutions. Such provision of liquidity has to represent a response to a shock, which entails a rising demand for liquidity that cannot be provided by private participants in the money market.

31 Cf. Goodhart (1985). The moral hazard problem consists here in the possibility of commercial banks signing very risky contracts without creating sufficient reserves for potential losses. If such losses materialised the bank could be sure to be provided with the needed liquidity by the LOLR in order to safeguard the banking system's stability.

vency of the bank and cancel their deposits. A commercial bank's liabilities are predominantly short term callable, i.e. they can be withdrawn very quickly.[32] In case deposits are withdrawn a commercial bank might therefore experience a liquidity problem that could easily exceed the magnitude of the described solvency problem. To be able to solve such liquidity problem the commercial bank has to liquidate its assets, i.e. to turn them into cash. The underlying assumption is that the considered commercial bank is solvent and should thus be able to liquidate its assets with the help of other commercial banks. For Friedman & Schwartz a liquidation of assets implies that a commercial bank grants a collateralised credit to the bank with a liquidity shortage, i.e. a credit secured by the debtor bank's assets. The bank should thus be able to calm its depositors' fears about financial losses. Frequently, however, the following happens: An uninformed public assumes, when being informed about a commercial bank's solvency problem, that other – often similar – banks face the same problem. If agents act accordingly and withdraw deposits the respective banks have to liquidate assets. If too many commercial banks are affected in this vein, unaffected commercial banks are normally unable to provide the required liquidity. In such case the banking system has to rely on an external source of liquidity, which can only be provided by a central bank.[33]

Goodhart (1999) elucidates the importance of Bagehot's three rules in case of a banking crisis, which he summarises as:"1. Lend freely. 2. At a high rate of interest. 3. On good banking securities."[34] According to Goodhart the concept of a LOLR is obscured by several myths: The identification of illiquidity and insolvency as well as a differentiation between the two were always possible. Goodhart argues that Bagehot's principles are still valid as an evaluation of assets of a commercial bank that asks for extra-liquidity is, as a general rule, not possible. This opinion is justified with reference to the short time horizon, in which decisions have to be taken by the central bank in such cases. Moreover, a crisis on the asset market, which usually triggers commercial banks' illiquidity, complicates any sound evaluation of asset values as such crises generally cause high market volatility. Thus, the decision over the granting of LOLR credit is to be based primarily on the quality of the 'good banking securities' to be pledged, i.e. on the offered collateral's quality. A bank's financial power is to be regarded as merely subordinate in this respect.

A second myth according to Goodhart (1999) is that the LOLR is regarded as some kind of insurance and that accordingly moral hazard represents a prevalent problem tempting many to abolish a LOLR altogether. He assumes that in case of a financial crisis doing without a LOLR would cause a total breakdown of the financial system, which the electorate would not condone. Hence, an announcement on the part of government to do without a LOLR would not be credible and thus suffer from time inconsistency.

Begg *et al*. (1998) examine the ECB's capability to accomplish the tasks conferred to it, i.e. to safeguard a stable currency and a stable financial system. They criticise that a

32 On bank runs see also Freixas *et al.* (2002).

33 Cf. Friedman & Schwartz (1986) p. 52-55. This argument can already be found en detail in Walter Bagehot's Lombard Street, cf. Bagehot (1873) chapter XII, p. 79-101.

34 Cf. Goodhart (1999) p. 340.

LOLR is missing just like a common banking supervision.[35] They note that national central banks in the Eurosystem possess a certain freedom to accept rather dubious assets as eligible collateral and that it is not clear, which institution would have to cover potential losses from such operations.

Overall findings of the literature on central banks' raison d'être can be summarised as follows: A broad consensus exists on LOLR representing a necessary condition for a banking system's capability to withstand financial crises and thus representing a central banks' primary raison d'être.[36] This consensus, however, is not yet accounted for in an international context: Despite increasing internationalisation in the banking sector there is neither an international LOLR nor does the Eurosystem possess a Eurozone wide LOLR. The issuance of currency and with it monetary policy has nowadays become the defining characteristic of a modern central bank but does not – at least in this strand of literature – represent its raison d'être.[37] Collateral enters considerations only insofar as it is understood that all central bank credit – including LOLR credits – must be collateralised.[38] Potential central bank losses due to its role as LOLR must be covered by government, emphasising that a strong central bank must be backed by a strong treasury. Bagehot's notion of 'good collateral' is generally not discussed with regard to the qualities good collateral must possess to be regarded as such.[39]

2.3 Collateral in the economic literature

One of the first economic analysis that assigns collateral a role in economic analysis stems from Stiglitz & Weiss (1981). The macroeconomic strand of this literature searches an explanation for the magnitude of changes in investment due to business cycle movements. Proposed explanations include the financial accelerator as well as a balance sheet and a bank lending channel.[40] A review of the macroeconomic literature referring to Stiglitz & Weiss is offered by Reichlin (2004). This literature regards collateral as a key factor in explaining the business cycle. In these analyses, however, the central bank represents merely the exogenous source of interest rate shocks triggering the transmission mechanism. An analysis of central banks with regard to changes in collateral values is thus lacking.

Hubbard (1998) describes the microeconomic literature on collateral as concerned with informational imperfections in credit markets. A review of the theoretical literature on the collateralisation of credit is offered by Bigus *et al*. (2005). They note that the existence of collateral in credit contracts is due to a lack of information on the part of creditors since collateral is irrelevant in a perfect neoclassical world. There are two main reasons identi-

35 Cf. Begg *et al*. (1998) p. 41. See also Spethmann & Steiger (2005).
36 For an exemplary statement of this thesis see Buiter (2004) p. 42 f.
37 This view is reinforced by those authors who prefer monetary laissez faire. Cf. White (1984), Selgin & White (1994), Ritter (1995), Selgin & White (2005).
38 Cf. Bagehot (1873), Begg *et al.* (1998) and Goodhart (1999). See Freixas *et al.* (2002) for an overview on the LOLR-literature.
39 Exceptions are the papers by Begg *et al.* (1998) and Spethmann & Steiger (2005).
40 Cf. Bernanke & Blinder (1992), Bernanke & Gertler (1995) and Bernanke *et al*. (1996).

fied in the literature why collateral is beneficial for creditors and debtors: The first rests on the assumption that creditors cannot identify the riskiness of a potential borrower – resulting in adverse selection, the second is based on the idea that borrowers might default strategically – referred to as moral hazard. Summarising the predictions of theoretical models Bigus *et al.* note that to avoid adverse selection it should be the safer borrowers pledging collateral whereas to avoid moral hazard on the part of borrowers the more risky borrowers should pledge collateral. If adverse selection and moral hazard problems are analysed combined in one model the results are less clear and depend heavily on model specifications.

Furthermore, Bigus *et al.* highlight a rather neglected issue in the literature on collateral: Most papers do not differentiate between internal and external collateral.[41] Internal collateral represents assets of the firm, which – if the credit defaults – the creditor can sell in any case to satisfy his claims irrespective of whether assets have been pledged as collateral or not. Contrary to internal collateral, the pledging of external collateral implies an incentive on the part of the debtor to repay since external collateral represents claims on the debtor's private assets. This differentiation is crucial since theoretical models are predominantly concerned with the effects of external collateral without, however, mentioning this explicitly.[42] Only in cases where a defaulting debtor has several creditors and the firm's assets are insufficient to satisfy all claims internal collateral might serve to rank claims in the sense that collateralised claims are satisfied before uncollateralised ones.

Bigus *et al.* (2004) review the empirical literature on the collateralisation of credit. Their findings can be summarised as follows: The probability of collateral being pledged is higher the smaller and younger potential debtor firms are, the longer the credit period and the larger credit volumes are, the weaker the competition among banks is and the worse overall economic conditions are.[43] In general, the results of empirical studies do not support the thesis that collateral helps to mitigate adverse selection. Somewhat little empirical support receives the thesis that collateral limits moral hazard. The thesis that creditors demand collateral consisting in firm assets if they expect conflicts of interest with other creditors receives the broadest empirical support. Finally, 70% to 90% of all credits are found to be collateralised establishing the importance of collateral for credit markets.

Overall, the microeconomic literature on collateral has to be regarded as rather inconsistent. The literature focuses on the effects of external collateral but fails in most empirical surveys to differentiate between internal and external collateral.[44] This somewhat invalidates many empirical findings as internal collateral is found to be used considerably more frequently than external collateral.[45] Moreover, collateral is not discussed in connection with central banks' monetary policy.[46]

41 An exception is the paper by Manove & Padilla (1999). See also the survey by Pozzolo (2004).
42 Rudolph (1982) for instance regards Stiglitz & Weiss (1981) paper as dealing with external collateral.
43 See for instance Jiménez *et al*. (2004) who provide evidence for the Spanish credit market.
44 An exception is the paper by Pozzolo (2004).
45 See Bigus *et al.* (2004) and Pozzolo (2004).
46 Cf. for instance Coco (2000).

3 Hypotheses of the Theory of Property Economics

The following argumentation shows how the quality of assets eligible for the issue of money by a central bank affects the long-term level of inflation. The quality of an eligible asset generally depends on the creditworthiness of its issuer and on the liquidity or marketability of the asset.[47] Two hypotheses are developed, in which collateralisation and the quality of eligible assets affect inflation: i) The collateralisation of a central bank's issuance of money as a general protection against an unlimited issuance of money and ii) Eligible assets of a quality sufficient to prevent a financing of public debt by 'printing money'. These hypotheses are based on the Theory of Property Economics by Heinsohn and Steiger (1996; 2000a; 2005; 2006; 2007a and 2008).

3.1 Property Economics' theory of money and central banking

For Heinsohn & Steiger (2005), property's most important feature is its role in the emergence of money. According to Heinsohn and Steiger, good money represents a claim to the property of the issuer of money. Money is created in a credit contract. Such a contract is signed by two proprietors. The creditor issues money by handing out documents to a debtor. Each of these documents (notes) represents a claim to a part of the creditor's property. Therefore, money is backed by the property of the issuer. The debtor receives the issued money if he pledges a part of his property to collateralise the loan. He is furthermore obliged to repay the loan plus interest. Why is money created exactly in this way? First of all, such money represents claims to property, i.e. an asset, even though the money itself, for instance a banknote, might be without any intrinsic value. Secondly, the issuer has to insure herself against the risk that her money could be presented for redemption out of her property if the debtor does not repay the loan. Insurance against this risk is achieved by demanding collateral from the debtor: In case the debtor defaults, the pledged property of the debtor becomes the property of the creditor.[48] Issuers of money are thus forced not to endanger their property by permitting claims on their property to become reality without adequate collateral. How to achieve that redeemable money is not presented for redemption will be the subject of the next paragraphs.

Nowadays, money is issued in a two-tiered banking system by a central bank that holds a monopoly on the issuance of money. In such a system the central bank is not obliged to redeem its notes vis-à-vis the non-bank public, but only vis-à-vis its counterparties, i.e. the commercial banks.[49] The obligation to redeem can only be satisfied if the central bank permanently holds property respectively equity, immediately available. Commercial banks presenting banknotes for redemption surely represents no everyday occurrence. This, however, does not affect the fact, that the central bank has to be able to absorb surplus

47 Cf. Bank of Japan (2003) p. 1-3. See also ECB (2007) p. 93-109.

48 This is the reason why both parties entering into a credit contract have to be proprietors. If the debtor does not pledge his property explicitly, the creditor usually has the right to execute her claims against the debtor into his property.

49 Cf. Steiger (2005).

money if it deems this necessary. The absorption of surplus money is feasible only if the central bank holds assets that can be sold against such surplus money.[50]

Commercial banks can only obtain money if they pledge good securities to the central bank to collateralise the credit and if they promise to repay the loan plus interest.[51] Since every good security represents property, such banking system can only exist in countries where an effective legal system is present that protects property rights. Furthermore, central banks are not permitted to accept assets from counterparties that issued or guaranteed those assets. The same rule applies to counterparties that have close ties with the issuers of assets.[52] It is these rules that constitute the difference between monies that are easily accepted as medium of exchange and others, which represent nothing else than IOU notes, that have to be expected to be presented for redemption. For some banknote to be accepted as money, that is not hastily presented for redemption, two conditions must be met: i) The intrinsically worthless piece of paper has to represent something of value, i.e. the banknote must be backed by assets; and ii) it must be guaranteed that the ratio of the backing asset's value and its representations remains more or less constant. That is, an over-issue of banknotes relative to their property base must be excluded. The mechanisms that guarantee that, for instance, the Swiss franc meets these conditions will be sketched next.

A central bank's counterparties, i.e. commercial banks, have to assume liability for defaulting collateral. This implies that commercial banks have to cover the losses in case their pledged assets, which are debt instruments of other institutions, default. In this way good money is always backed by the property of at least three proprietors: The central bank's property (creditor to a commercial bank), the commercial bank's property (debtor to the central bank but at the same time creditor to its debtors), and the property of the commercial bank's debtors. In other words, good money is "creditor's money", i.e. it is backed by the property of creditors.[53] Thereby the first condition is satisfied, since an issue of money on the basis of good collateral guarantees that the issued banknotes represent assets. This, however, is only the obvious condition, since everyone issuing an IOU note can likewise claim to have his notes backed triply by property. The mechanism, ensuring that an over-issue of banknotes relative to their property base is excluded, is elaborated in the following.

The demand for central bank credit is generally limited by the commercial bank's willingness to accept liability with their property vis-à-vis the central bank for debt instruments of the commercial bank's debtors. If this basic principle of creditor liability is disregarded, an arbitrarily growing money base with an inherent tendency towards worthless paper money, i.e. debtor's money, will be the result. A debtor's money becomes reality as

50 Cf. Stadermann (1994) p. 63-80, in particular p. 79.

51 It has to be considered that repo operations, i.e. operations with repurchase agreements, make up the bulk of today's liquidity providing operations. These repo operations are in essence nothing else than collateralised credits. Cf. Bank of Japan (2003) p. 1.

52 In the Guidelines of the Swiss National Bank (SNB) on Monetary Policy Instruments (2004) p. 7 (http://www.snb.ch/d/download/geldpol_instr_e.pdf) this rule reads as follows: "The SNB does not accept counterparties' own securities or those issued by persons or companies that form an economic entity with the counterparty."

53 See Heinsohn & Steiger (2002) p. 5.

soon as the government decides that its own debt instruments will be directly eligible collateral at the central bank. In such a case, the debtor government uses its self-issued assets as collateral to obtain a credit. It is therefore already a matter of bad money if the central bank's debtors do not have to pledge assets as creditors but are permitted to pledge assets issued by themselves, i.e. as debtors, since IOU notes can generally be issued infinitely.[54] This would be nothing else than financing the government's deficit by 'printing money'. If, however, public debt instruments first have to take what seems to be a 'loop way' across the asset market to become proper eligible collateral, this loop way will be the best safeguard against an inflationary currency.[55]

What is the reason that good collateral has to take the loop way across the asset market? A debtor is only liable for his own debt instruments, while a creditor, as a central bank's debtor, is liable vis-à-vis the central bank for the pledged collateral even if the pledged debt instrument defaults. Accordingly, a creditor will scrutinise the creditworthiness of her debtors to protect her property. Debt instruments that are traded on the asset market are by definition marketable and usually represent eligible collateral. Contrary to marketable debt instruments, nonmarketable debt instruments, are usually not eligible as collateral at a central bank. The marketability of a debt instrument has to be proven on the market, i.e. the combination of risk and price has to be seen as acceptable for purchase by market participants. Thus, it can be stated that the creation of good money, i.e. creditor's money, is influenced by operations on the asset market. An over-issue of money seems impossible under these circumstances, while an avoidance of the asset market will almost inevitably lead to the creation of a worthless debtor's money.[56]

Some remarks on Property Economics are in order here. It should be noted that Property Economics as an alternative to the neoclassical theory of a general equilibrium is not limited to the notions presented above. In fact, Property Economics sets out to explain the emergence of markets and other real world phenomena that cannot be explained, for instance, in classical or neoclassical economics as these theories simply postulate their existence. Property Economics is not a theory supposed to be valid for all times and places – like neoclassical economics – but only for those societies that are characterised by an effective legal system protecting property.[57]

54 Cf. Heinsohn & Steiger (2002) p. 5 and Heinsohn & Steiger (2000b) p. 6-12. Bad money is also referred to as debtor's money, cf. Steiger (2006).

55 Only government is treated here as a potential originator of a debtor's money, since only government is able to enforce the circulation of a money that tends to be worthless. Cf. Steiger (2006).

56 For the differences of creditor's and debtor's money see Heinsohn & Steiger (2000a; 2005b; 2006; 2007a, and 2008).

57 Cf. Heinsohn & Steiger (2005) p. 9-28. Similarly, Bailey (1998) analyses "property rights in aboriginal societies".

3.2 Hypotheses derived from the theory of Property Economics

Central banks are usually obliged by law to grant credits only if these are sufficiently collateralised.[58] The issuance of money by central banks is commonly administrated by granting credits to commercial banks.[59] This implies that a central bank's issuance of money is not independent from the demand for credit by commercial banks.[60] In the light of a generally limited stock of assets, which always represents scarce property, a requirement to collateralise central bank credit means that the issuance of money is strictly finite.[61] After all, a good is not scarce because it can be found only in relatively small quantities but because someone is the proprietor of that good.[62]

What happens if the collateralisation of the issuance of money is missing and instead faith is put only in the power of interest due? The experiences of some transition countries feature the best object-lesson. The normal case is runaway and speedily further accelerating inflation.[63] The collateralisation of the issuance of money can therefore be expected to act upon the latter as a restriction, and hence also as a check against inflation. The first hypothesis reads accordingly:

> [H1] *The collateralisation of a central bank's issuance of money directly limits inflation through the scarceness of eligible assets.*

Of greater relevance for monetary stability, however, is the principle of creditor's money or rather the principle of creditor's liability. As illustrated above, the banking system's liquidity is strictly limited by the commercial banks' willingness to accept liability vis-à-vis the central bank with their property for debt instruments that serve as collateral. In essence, the argument boils down to a comparison of different qualities of eligible collateral: Eligible collateral represents debt certificates, mostly government bonds.[64] The crucial feature of 'good' collateral is, however, neither directly linked to the quality of the debt certificate itself nor to the creditworthiness of the issuer. Since claims against oneself can in principle be issued infinitely and debt certificates represent in this regard nothing else than IOUs, the scarceness of debt certificates cannot be secured by the issuers of such ti-

58 There exists no comprehensive study on the collateralisation of central banks' credit. Cf. Kopcke (2002), BIS (2001), Blenck *et al*. (2001), Borio (2001) and ECB (2007) for the practices of some industrialised countries. See also the surveys conducted by Lehmbecker (2005; 2008).

59 Cf. Bofinger *et al*. (2001).

60 Martínez-Resano (2004) notes that issuance of banknotes is initiated by commercial banks and that this demand for currency can be quite volatile. The accuracy of this thesis can be substantiated with reference to Japan: Interest rates were at an extremely low level after the crisis of the early 1990s but even so the Bank of Japan was not able to issue money in dimensions that would have freed the economy from fears of deflation. See also Koo (2001).

61 In industrialised countries the availability of eligible collateral represents usually no binding restriction. This, however, does not necessarily hold in exceptional circumstances and possibly even less so in developing countries. Cf. Borio (2001) p. 18.

62 Cf. Heinsohn & Steiger (1996) p. 259. See also Demsetz (1998) p. 151 f.

63 Cf. Ulf Heinsohn cited in Heinsohn & Steiger (1996) p. 278 f. on Vietnamese experiences. The average annual inflation rate in Vietnam for the period 1986-1995 amounted to approximately 100 percent.

64 Cf. Martínez-Resano (2004) p. 22.

tles. Rather, the scarceness of eligible collateral is secured by those who buy these titles on the asset market as this guarantees that titles possess an observable positive price, which – economically speaking – signifies scarceness. Therefore, good collateral must take the scarceness guaranteeing loop way across the asset market or, in other words, good collateral has to be marketable.

The standards for the quality of eligible collateral, however, are still unsatisfied as the marketability of an eligible asset alone is insufficient to guarantee a genuine anchor for the issuance of money.[65] The quality of an eligible asset consists in the buyer's readiness to accept liability for potential losses from an asset, the occurrence of which generally cannot be influenced by the buyer. Good central bank money, creditor's money, is thus based on the property of liable creditors. The crucial point to note is the fixation of the issuance of money to a base that is not arbitrarily augmentable and hence scarce, i.e. collateral representing scarce property. It is this anchor that would be eliminated if government had the option to directly pledge self-issued debt instruments to the central bank. Therefore, a second hypothesis reads as follows:

> [H2] *Ensuring the preservation of the principle of creditor's liability in the collateralisation of the issuance of money limits in particular government's demand for credit in such a way that a threat to monetary stability can be ruled out.*

Summarising, [H1] demands that issued money be backed by assets while [H2] requires that eligible collateral always proves its quality on the asset market.

4 Methodology and results of data analysis

Cross-country data are employed to test the prediction of property economics that inflation will be higher in countries whose central banks do not issue currency in compliance with the principle of creditor's money. As the literature on central bank independence and transparency attempts to explain average inflation with the help of institutional characteristics, this literature's modus operandi is taken as a blue print for this analysis.[66] Moreover, doing so allows for comparing the explanatory power of determinants proposed by Property Economics with those suggested in the literature on central banking and transparency. Hypotheses are tested using multivariate linear regressions and are based on the survey on the quality of eligible collateral conducted by Lehmbecker (2008). In 2006, 148 national central banks were asked to answer an online-questionnaire. 62 of them returned completed forms. Answers to the following items of the questionnaire were used to con-

65 It should be emphasized that this anchor for the issuance of money does neither consist in the accidental scarceness of a real good like gold, nor does it consist in the 'scarceness' of an ever so real basket of goods. Rather the anchor consists in the additional scarceness originating from the liability condition of by definition already scarce property.

66 Cf. Cukierman *et al*. (1992a; 1992b), Loungani & Sheets (1997), Berger *et al*. (2001) and Arnone *et al*. (2006a) regarding exemplary surveys on central banks' independence and Chortareas *et al*. (2002a) and Fry *et al*. (2000) for a survey on central banks' transparency.

struct an Index of the Quality of Eligible Collateral (IQEC): i) Whether central banks exceptionally dispense with collateral when providing liquidity (binary), ii) whether assets from institutions possessing close ties with the issuers of these assets are accepted as collateral (binary), iii) the minimum percentage of a credit that has to be collateralized (ordinal scale), iv) the minimum degree of creditworthiness that issuers of assets eligible as collateral have to satisfy (ordinal scale following the classification of international rating agencies), v) the percentage of central banks' bad debts (share) and vi) the amount of banknotes in circulation as a percentage of total assets (share).

Based on these items an index employing equal weights is constructed.[67] The higher the numerical index value, the poorer is the quality of eligible assets. Hence, a low index value stands for high standards concerning collateral. In multivariate regression analyses, it is checked whether the IQEC significantly affects monetary stability as measured by the consumer price inflation (CPI)[68]. The empirical analysis aims at determining whether the IQEC possesses explanatory power with respect to inflation when compared with "traditional" indicators used in empirical studies on institutional aspects of monetary policy. As numerous potential explanatory variables come into consideration, both manual specification of the estimation equations and an automated stepwise selection are used. However, both methods did not lead to diverging results.[69]

Model 1 (see table 1) comprises the dependent variable consumer price inflation (CPI)[70] as a measure of average inflation, the independent variable IQEC as a measure of the quality of eligible collateral as well as six other explanatory variables generally expected to possess an effect on average inflation. The variable PS is supposed to measure the degree of political stability or rather political violence in a country. Index averages are based on annual data collected by Kaufmann *et al*. (2006). According to Cukierman *et al*. (1992b) political stability possesses a negative influence on inflation. The variables RL, RQ and GE are supposed to measure respectively the degree of the rule of law, the degree of regulatory quality and the degree of government effectiveness prevalent in a country. Index averages are based as well on annual data collected by Kaufmann *et al*. These three variables are expected to possess a negative influence on inflation and are considered here, to find out whether the IQEC actually measures the quality of eligible collateral or if it represents merely a good instrument to detect different degrees of these three variables.[71]

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67 Details of the index construction are substantiated in Lehmbecker & Missong (2008). Moreover, index values for the sample of 62 central can be retrieved from this paper. For an in-depth evaluation of the questionnaire's items see Lehmbecker (2008).

68 Data are taken from the World Bank's (2006) development indicators.

69 Cf. Stier (1996) p. 248 f. for a discussion of advantages and disadvantages of the stepwise selection routine. Relying rigidly on significance levels, this routine helps to circumvent the problem of 'arbitrary' results in multivariate regressions as it provides small and readily interpretable models by incorporating the statistically most important explanatory variables. The problem of 'arbitrary' results is due to potentially strong reactions of explanatory variables' significance levels to changes in the model, depending on which group of independent variables is employed. See Campillo & Miron (1997) for an example of this effect concerning the variable GDP per capita.

70 Data are taken from the World Bank's (2006) development indicators.

71 For the idea for this robustness test the authors are indebted to participants of the Brown-Bag-Seminar in the Department of Economics at the University of Kiel in June 2005.

The variables LGDP and GDP are supposed to represent an overall measure of a country's stage of development.[72] More precisely, GDP measures average GDP per capita and LGDP is the average of the log of GDP per capita. GDP per capita was introduced by Campillo & Miron (1997) as a control variable to assess the explanatory power of central bank independence indices and is expected to possess a negative influence on inflation. The log of GDP per capita represents a frequently employed transformation to lessen the influence of extreme values.[73]

Table 1: OLS results

Model	Included variables	adjusted R^2	Coefficient	Standard Error	t-Value
Dependent variable: CPI, n = 62, period: 1998-2003, Method: Stepwise selection		Explanatory variables:	IQEC, PS, RL, RQ, GE, LGDP, GDP		
Model 1	IQEC	0.294	22.600***	8.085	2.796
	PS		-3.312**	1.316	-2.517
	Constant		0.601	2.837	0.212
Dependent variable: CPI, n = 61, period: 1998-2003		Explanatory variables:	IQEC, OPEN, LGDP		
Model 2	IQEC	0.216	25.724**	10.137	2.538
	OPEN		-0.019	0.046	-0.420
	LGDP		-0.939	0.966	-0.972
	Constant		7.251	11.033	0.657
Dependent variable: CPI, n = 59, period: 1998-2003, Method: Stepwise selection		Explanatory variables:	IQEC, PS, GDP		
Model 3[w]	IQEC	0.319	11.148**	4.458	2.501
	PS		-1.314**	0.534	-2.459
	Constant		1.652	1.344	1.229
Dependent variable: CPI, n = 46, period: 1995-1999, Method: Stepwise selection		Explanatory variables:	IQEC, PS, RL, RQ, GE, LGDP, GDP, CBI, CBT, CBDF		
Model 4[w]	IQEC	0.470	51.086***	13.330	3.832
	PS		-9.130	5.803	-1.573
	Constant		0.977	6.702	0.146

Note: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively.
[w] indicates heteroskedasticity consistent standard errors.

Using the stepwise selection routine to reduce the number of potential explanatory variables, IQEC and PS emerge as the sole independent variables to form model 1. Their coefficients are statistically significant while none of the other potential explanatory variables can significantly contribute to explain average inflation over and above that, which is 'explained' by IQEC and PS. These results correspond to the predictions made in part 3, namely that a low (high) standard of eligible collateral – equivalent to a high (low) value of the IQEC – tends to go with high (low) average inflation. A positive correlation between average inflation and the IQEC thus implies a negative correlation between average inflation and the quality of eligible collateral.

In model 2 the variables IQEC, OPEN and LGDP enter as explanatory variables. OPEN is supposed to measure the degree of a country's openness to trade and represents annual averages of imports of goods and services as percentage of GDP. OPEN could not be in-

72 Data are taken from the World Bank's (2006) development indicators.
73 See for example Berger *et al.* (2001) and Campillo & Miron (1997).

cluded in model 1 due to missing data for one country, the Bahamas. According to Romer (1993) this variable possesses a negative influence on inflation. Only IQEC possesses a significant negative effect on average inflation while OPEN and LGDP cannot significantly contribute to the explanation of inflation in this model.

The sample of 62 countries for the period 1998 to 2003 includes three high-inflation countries – Romania, Tajikistan and Turkey feature pronounced above average inflation – that might possess an inadmissibly strong effect on the results presented so far. These three outliers are therefore excluded from the sample. Model 3 contains CPI as dependent and IQEC, PS and GDP as independent variables to assess the explanatory power of IQEC after the exclusion of outliers and in the presence of its strongest explanatory variable rivals. For this task the stepwise selection routine is employed as exercised above. The estimated equations confirm the general result that the quality of eligible collateral and political stability both possess a statistically significant effect on average inflation. The size of coefficients, however, decreases distinctly as the maximum average inflation in the sample drops from more than 50% per year to roughly 15%.

Model 4 contains in addition to the variables included in model 1 the variables CBI, CBT and CBDF. These variables are supposed to measure the degree of a central bank's independence from government, the limits on a central bank's financing of the government deficit and the transparency of a central bank's monetary policy respectively. Index values are taken from the dataset on central bank monetary policy frameworks provided by Fry *et al*. (2000). According to Cukierman *et al*. (1992a) central bank independence possesses a negative influence on inflation. According to Fry (1998) and Chortareas *et al*. (2002a) CBDF's expected influence on inflation is negative. Finally, according to Geraats (2002) and Chortareas *et al*. (2002a) central bank transparency possesses a negative effect on inflation. The use of these three variables largely determined the period 1995 to 1999 and the sample size.[74] As before IQEC and PS emerge as the sole independent variables to form the model. Their coefficients reveal the expected relationships and are statistically significant[75] – while none of the other potential explanatory variables can significantly contribute to explain average inflation over and above that, which is explained by IQEC and PS – representing our main result. The following summarises our results. To assess the validity of this result, several alternative model specifications have been analysed, all of which support the robustness of our findings.[76]

i) The result is essentially unaffected by the vector of weights used for the IQEC' elements. Neither employing the squared IQEC has a noteworthy effect on

74 The sample represents the intersection of the data provided by Fry *et al*. (2000) and Lehmbecker & Missong (2008).

75 All models are checked for heteroskedasticity using the White test and calculating heteroskedasticity consistent standard errors according to White (1980) if heteroskedasticity is detected. In model 4 this procedure leads to statistical insignificance of PS.

76 See Lehmbecker (2008) for the details of robustness analyses.

significance levels nor employing a version with weights derived from principal components analysis, using an alternative standardisation of the index components.[77]

ii) The dependent variable, average inflation, has been operationalised in a way that corresponds to this paper's research question as different ways of operationalising the dependent variable had no effect on results. The measure of average inflation matters only in the sample of high income countries for the period 1995 to 1999.

iii) The results are valid for the main samples as well as for subsamples of high income and developing countries respectively.

iv) The results depend not unduly on a few influential observations, i.e. there is no outlier problem except for the developing countries samples adjusted for outliers for the periods 1995 to 1999 and 1990-1997.

v) Additional explanatory variables, i.e. control variables, were incorporated to reveal the explanatory power of the IQEC relative to other potentially relevant independent variables. The IQEC' statistical significance is robust to the inclusion of all control variables except for the log of GDP per capita in some samples of the period 1990 to 1997.

vi) Finally, the result that the IQEC possesses a statistically significant effect on average inflation is robust to variations of examined periods as significant correlations are found in all three periods, i.e. 1998 to 2003, 1990 to 1997 and 1995 to 1999.

Therefore, a robust, clearly negative and statistically significant correlation between the quality of eligible collateral and average inflation has been established for the period 1990 to 2003. Variables that contribute to the explanation of average inflation over and above that, which is explained by the quality of eligible collateral, are political stability, GDP per capita and central bank transparency. However, political stability, GDP per capita and central bank transparency possess no sub-sample validity. Moreover, the correlations of these three variables are in numerous cases not robust to the inclusion of the IQEC and lack therefore robustness with regard to control variables. Variables that measured the degree of a country's openness to trade, the degree of the rule of law, the degree of government effectiveness, the degree of regulatory quality, the degree of a central bank's independence from government, the degree of a central bank's accountability and the degree to which the financing of the government deficit by the central bank is limited did all not contribute to the explanation of average inflation over and above that, which is explained by the quality of eligible collateral.

5 Discussion of results

This survey's results provide new evidence on the significance of institutional determinants of inflation. These results, however, have to be interpreted with regard to the usual problems of cross-section analyses.[78] The sizes of the samples employed are sufficiently large to be considered representative. To interpret the results in terms of a universal validity seems not indicated though. The sample might be biased in the sense that predomi-

77 See Lehmbecker & Missong (2008) for details on using weights calculated based on factor analysis.
78 Cf. Campillo & Miron (1997) p. 355.

nantly those central banks contributed to this survey that recently have had some success in fighting inflation. Moreover, it can generally not be ruled out that the control variables employed managed to deliver only crude measures of what was intended to be measured. These caveats, however, apply to all cross-section analyses – including the literature on institutional determinants of inflation. The following illustrates the results' significance with regard to the theory of Property Economics and the current theory of central banking.

5.1 Implications of results for the theory of Property Economics

According to the major result of part four, there is a robust negative and statistically significant correlation between the quality of eligible collateral and average inflation, which supports hypotheses [H1] and [H2] and therefore the theses of Property Economics. For hypothesis [H1] this indicates that a central bank that secures its issuance of money, limits its room for an expansionary monetary policy by the scarceness of assets needed for the collateralisation and thereby ultimately limits inflation. Evidence supporting the validity of this interpretation can also be found in the trend of transition countries' inflation rates from the early 1990s. The twelve transition countries in the sample experienced some years of extreme inflation at the beginning of the 1990s and all of these except for Romania and Tajikistan – feature single-digit inflation rates today.[79] These countries are – in this respect – representative of most high-inflation countries in the 1990s that managed to achieve disinflation. Transition countries inflation performance, however, is particularly indicative: Central bank officials in these countries conducted monetary policy for the first time in a capitalist environment at the beginning of the 1990s. Not surprisingly, central bank officials were rather inexperienced, resulting in ill-suited early monetary frameworks: The survey data reveal that often collateralisation of central bank credits was not required at the beginning of the 1990s. Moreover, inflation performances of these countries seem to reflect the trends of learning curves. Slovenia, for instance, adapted very quickly to the new rules of the game and features a low value in the IQEC, indicating a high quality of eligible collateral, whereas countries like Romania and Tajikistan show a low quality of eligible collateral and still suffer from high inflation.

Suboptimal inflation records, however, might also be due to a lack of developed markets for government bonds. This could explain the inadequate collateralisation of central bank credits observed in many transition countries during the 1990s. Moreover, the pervasive trend that central banks are to a certain extent involved in the development of government debt markets might also represent an attempt to secure an adequate collateralisation of the issuance of money since currency is usually backed by government bonds.[80]

Hypothesis [H2] puts the quality of eligible collateral at centre stage. The readiness of a central bank's counterparty to accept liability with its property for potential losses of a not self-issued debt instrument pledged to the central bank as collateral represents the pivotal

79 These transition countries comprise China, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Latvia, Macedonia, Mongolia, Romania, Slovenia, Tajikistan.

80 Cf. Martínez-Resano (2004).

quality of an eligible asset. If this quality is missing, i.e. government possesses the option of using its own self-issued debt instruments as collateral to acquire credit directly from the central bank, the scarceness of eligible assets existing under normal circumstances is eliminated. As highlighted by the corroboration of [H1] it is exactly the fixation of the issuance of money to a basis that is not arbitrarily augmentable and thus scarce, i.e. collateral representing scarce property, which would be eliminated if government had the option to directly pledge self-issued debt instruments to the central bank. This is due to the fact that debt instruments, i.e. the issuance of claims against oneself, are in principle infinitely augmentable. The scarceness of debt instruments cannot be secured by the issuers of such titles but only by those who buy these titles on the asset market. That is the reason why all collateral and especially the one originally issued by government must take the scarceness guaranteeing loop way across the asset market. However, the standards for the quality of eligible collateral go still one step further: The marketability of an eligible asset alone, i.e. the existence of a potential buyer for that asset, is not sufficient to guarantee a genuine anchor for the issuance of money. The quality of an eligible asset consists in the readiness of its buyer to accept liability for potential losses from an asset, the occurrence of which generally cannot be influenced by the buyer. Therefore, good central bank money, creditor's money, is based on the property of liable creditors. Given our results it has to be concluded that only Property Economics' creditor's money can guarantee monetary stability.

5.2 Implications of results for the theory of central banking

There exists a broad consensus in the central banking literature on the institutional framework that should be in place to ensure a stable financial system and monetary stability: Central banks ought to be independent and follow a transparent monetary policy. The empirical evidence supporting this latter consensus, however, is rather weak: The reported correlations between central bank independence and inflation are typically not robust to the inclusion of control variables and periods covered. The most influential surveys, e.g. by Cukierman *et al*. (1992a) and Alesina & Summers (1993), suggesting that central bank independence possesses an effect on inflation did not test for the robustness of their results. The evidence on the missing robustness of these surveys' results is substantial.[81] Surveys on the effects of central bank independence cover the period 1950 to 1995. More recent data to test for the effect of central bank independence on inflation exist, but are surprisingly either not used to test for effects on inflation or are ignored as in the case of the most comprehensive survey on monetary policy framework characteristics to date.[82] Therefore, the current consensus on the institutional framework of central banks' independence and transparency has to be regarded as not well-founded.

81 Cf. inter alia Fujiki (1996), Fuhrer (1997) and Campillo & Miron (1997).

82 Cf. Arnone *et al*. (2006b) as well as Fry *et al*. (2000). The two comprehensive reviews on central bank independence, Berger *et al.* (2001) and Arnone *et al.* (2006a) do not even mention the Bank of England's survey by Fry *et al*. (2000), which covers almost 100 central banks.

In this paper three variables have been found to contribute to the explanation of average inflation over and above that, which is explained by the IQEC: Political stability, GDP per capita and central bank transparency. The results of Cukierman *et al*. (1992b) concerning political stability's negative effect on inflation are thus confirmed.[83] This statement needs to be qualified, however, as political stability is neither significant in several of the sub-samples tested nor consistently robust to the inclusion of the IQEC. Nevertheless, political stability can be regarded as one of the determinants of inflation alongside the quality of eligible collateral. The effect of central bank transparency on average inflation could only be assessed for the period 1995 to 1999 due to data constraints. The results of Chortareas *et al*. (2002b) are largely confirmed, i.e. central bank transparency possesses a significant negative effect on average inflation. Again, however, this result is not very robust as central bank transparency possesses neither sub-sample validity nor is it consistently robust to the inclusion of the IQEC. Nonetheless, central bank transparency can be regarded as one of the determinants of inflation alongside the quality of eligible collateral. GDP per capita is found to possess a negative effect on average inflation, which largely confirms the results of Campillo & Miron (1997). This result is, however, not robust to the inclusion of the IQEC, lacks sub-sample validity and crucially depends on the log transformation.

Variables that measured the degree of the rule of law, the degree of government effectiveness, the degree of regulatory quality and the degree of a central bank's independence from government did not contribute to the explanation of average inflation over and above that, which is explained by the IQEC. The results strengthen the position of those who doubt that central bank independence is the key to monetary stability.[84] Furthermore, the findings of this survey challenge the result of Romer (1993) regarding the negative effect of openness on inflation. The variable measuring a country's openness to trade is, just like central bank independence, not robust to the inclusion of control variables like the IQEC, indices of political stability and GDP per capita. Based on the results of this survey the negative correlation between inflation and central bank independence as established by Alesina & Summers (1993) as well as Cukierman *et al*. (1992a) can therefore not be confirmed. Given the unambiguity of results it even seems prudent to regard the thesis that central bank independence possesses a negative effect on average inflation as refuted by the data for the years since 1990. Finally, it should be noted that apart from central bank transparency and the quality of eligible collateral no institutional variable remains that possesses a demonstrated effect on inflation and can be regarded as a potentially adjustable parameter.[85]

A last point to note is that the findings of the literature on collateral are somewhat inadequate with regard to the collateralisation of central bank credits. The microeconomic lit-

83 It has to be mentioned here that the index of political instability employed in this survey does not measure the same construct as the one used in Cukierman *et al*. (1992b). Notwithstanding, a strong correlation between the two indices of political instability can be assumed. See Kaufmann *et al*. (2006) and Goldstone *et al*. (2000).

84 See, for instance, Posen (1998) or Fuhrer (1997).

85 Arguably, political stability and the level of GDP per capita cannot be regarded as parameters adjustable for the purposes of monetary stability.

erature on collateral considers collateral only in some cases as an optimal ingredient of credit contracts and, if it does so, thinks of external collateral. By contrast, in this paper full collateralisation of all central bank credits is shown to represent best practice with regard to monetary stability. In addition, commercial banks pledge only internal collateral to the central bank. Central banks, however, do not demand internal collateral to be able to enforce their claims first in case of default since central banks credit contracts commonly rank the creditor central bank first in this respect.

6 Conclusions

The results of this paper enhance the evidence on the influence of the institutional framework of monetary policy on inflation. Our findings establish the quality of eligible collateral as one pivotal element of a theory of central banking. Collateralisation of the issuance of money and the elimination of financing the government deficit directly via the central bank can be seen as necessary conditions for achieving monetary stability. The crucial quality of eligible collateral consists in the readiness of a central bank's counterparty to accept liability with its property vis-à-vis the central bank for potential losses stemming from pledged assets. This quality of eligible collateral guarantees that money is fixed most tightly to its property base. Good central bank money should therefore be backed by the liable property of creditors to safeguard monetary stability.

Central bank independence and transparency represents the consensus in the literature following Kydland and Prescott. This consensus is shown to stand on shaky ground. Evidence on central bank independence relies primarily on data for the period 1960 to 1989. Monetary stability, however, represents a current challenge and thus deserves more up-to-date evidence. This paper uses such evidence and shows that the quality of eligible collateral 'trumps' all alternative explanations of average inflation.

This finding can be utilized by policy makers especially in less-developed and transition countries on their way towards a more stable economic development. In addition, adapting monetary policy frameworks accordingly would represent a rather minor reform compared to the time and effort necessary to make a central bank independent from government. Given the robustness of our results, further research on eligible collateral seems promising. In any case it can be stated that the theory of Property Economics has successfully passed the first comprehensive empirical test.

Finally, the recent crisis of the international banking system has shown that the quality of eligible collateral is a current and most eminent issue. In the course of this liquidity crisis central banks all over the world were forced to act as lender of last resort. The crisis had been triggered by the default of so called subprime mortgages, i.e. credits to low income individuals who have no capital. Alarmingly, the Fed felt forced to accept mortgage-backed securities as collateral for its emergency credits.[86] Thus, the Fed accepted assets as collateral that are based on those that had triggered the crisis. Whether such collaterali-

86 Cf. Economist (2007b).

sation still deserves its name seems questionable and shows that the quality of eligible collateral is still not fully understood even by central bankers.

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