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Universität Gesamthochschule
Kassel
Fachbereich Wirtschaftswissenschaften

Asset Price Channel and Financial Markets

von

Reinhold Kosfeld

Nr. 16/00

Volkswirtschaftliche Diskussionsbeiträge

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Vermögenstheoretischer Transmissionsmechanismus und Finanzmärkte

By Reinhold Kosfeld, Kassel

JEL E4, E5, G1

Financial markets, risk-adjusted yields, asset price channel

Finanzmärkte, risikoadjustierte Ertragssätze, vermögenstheoretischer Transmissionsmechanismus

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Summary

The asset price channel focusses on the relative prices of a wide range of assets in the transmission of monetary impulses on the financial and real capital markets. If monetary impulses are already fading on the financial markets, then their effectiveness in terms of economic policy targets has to be questioned. A missing tendency towards a long-run equilibrium relationship in the observable yield rates on the financial markets is often attributed to non-stationary risk premiums underlying the financial assets. In this paper a cointegration model for the risk-adjusted yields of the money market, market for bank credit and the capital market is developed for the monetary policy regime of a money supply target in the Federal Republic of Germany for the period 1980 – 1998. Furthermore, it is also shown that on the basis of the transmission model we consider, the stock market does not integrate consistently into the cointegration system of the other of the financial markets.

Zusammenfassung

Der Asset-Price-Kanal stellt die relativen Preise eines breiten Spektrums von Vermögenswerten bei der Fortpflanzung monetärer Impulse auf den Finanz- und Realkapitalmärkten in den Fokus des Interesses. Wenn die monetären Impulse bereits auf den Finanzmärkten zu versickern drohen, ist ihre Wirksamkeit auf wirtschaftspolitische Zielgrößen gänzlich in Frage zu stellen. Eine fehlende Tendenz zu einer langfristigen Gleichgewichtsbeziehung beobachtbarer Ertragssätze auf den Finanzmärkten wird häufig auf nichtstationäre Risikoprämien der zugrunde liegenden Finanztitel zurückgeführt. In dieser Arbeit wird für den Zeitraum 1980-1998 des geldpolitischen Regimes eines Geldmengenziels in der Bundesrepublik Deutschland ein Kointegrationsmodell für die risikoadjustierten Ertragssätze des Geldmarktes, Marktes für Bankkredite und des Kapitalmarkts entwickelt. Außerdem wird herausgearbeitet, dass sich der Aktienmarkt auf der Basis des von uns betrachteten Transmissionsmodells nicht konsistent in das Kointegrationssystem der übrigen Finanzmärkte integrieren lässt.

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* I would like to thank Christian Dreger and Martin Bohl for their helpful comments.

1. Introduction

It is common in macroeconomic theory to proceed from a single rate of interest representative of the economy, which can be influenced by monetary policy as an argument of the investment function. Even if the central bank is, however, able to steer the money market[1], this does not necessarily mean that there will be clearly predictable consequences for the interest rates for bank loans or the capital market, upon which capital costs decisively depend. The lack of a tendency towards a long-run equilibrium relationship between the interest rates is often traced back to non-stationary factors in the risk premiums[2]. As far as interest on bank loans is concerned, the lending view[3] stresses that market imperfections can emerge due to asymmetrical information, which could equally hinder the establishment of a financial market equilibrium. However, the transmission theory underlying the asset price channel[4] in no way supposes the existence of an equilibrium relationship between the raw yields of assets. The starting point is rather a comprehensive definition of yield rates, especially the various risks the assets include. The bank credit market, which calls for special attention in the lending view and is of particular importance in continental Europe[5] insofar as its special place in the financing of enterprises, is always explicitly considered in monetarist transmissions theory[6]. Even the Neo-Keynesian transmissions theory always acknowledges the relevance of this market[7]. Differences of opinion between the representatives of the lending view and supporters of the monetarist transmissions mechanism of relative prices are, however, merely due to the effects of imperfections[8].

If one expands the system of financial markets consisting of the money market, the market for bank credit and the capital market, explicitly to include the stock market, the interface between the financial and goods spheres of the economy comes to be the focus of interest. If monetary impulses reach the stock market, they affect the real sphere of the economy insofar as they can bring about changes in the price of existing real capital. In macroeconomic theories of monetary effects this is often seen as a signal for changes in the economy in terms of economic activity, since this results in a shift in the relative prices for real capital and the

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[1] Due to the institutional framework in the Federal Republic of Germany, the ability to control the money market through the *Bundesbank* is, to a large degree, taken as given for our period of research. See e.g. Köhler (1982), p. 96; Jander (1986), pp. 53; Gleske (1994), pp. 293; Nautz (2000), pp. 45. Despite a few differences in the configuration of monetary policy instruments, the brief period of responsibility for monetary policy so far enjoyed by the European Central Bank (ECB) in the European Union has shown that the ability to control the money market has remained. See Nautz (2000), pp. 32.

[2] See Evans and Lewis (1994); Tzavalis and Wickens (1997); Wolters (1998); Nautz and Wolters (1999)

[3] In the new literature on the monetary transmission mechanism different "channels" or "views" are compared. In his introductory contribution to a symposium on the monetary transmission mechanism, Mishkin (1995) distinguishes between an interest channel, exchange rate channel, other asset price effects and a credit channel (lending channel and balance sheet channel).

[4] Under asset price channel, following on Mishkin's (Mishkin, 1995, p.3) "other asset price effects" we understand a monetary transmission mechanism of the asset yield rates that includes a wide spectrum of assets. Especially subsumed here are the monetarist and Neo-Keynesian transmission mechanisms, to which this paper refers. The designation "asset theoretical transmission approach" is used by Duwendag et al. (1999, pp. 195) explicitly for these transmission channel of monetary impulses, whilst Bofinger, Reischle and Schächer (1996, pp. 554) use the not unproblematic designation "interest structure theoretical transmission process".

[5] See Bofinger, Reischle and Schächer (1996) pp. 560.

[6] Brunner and Metzler (1972a); Brunner and Metzler (1972b, 1974).

[7] Tobin (1969, 1974); Tobin (1978).

[8] Metzler (1995), pp. 64: Neumann (1995), pp. 138. Jarchow (1998, pp. 233) subsumed the credit channel under the transmission mechanism of relative prices, insofar as it was allotted the role of amplifier.

production of new (investment) goods[9]. A propagation of the impulses, however, requires a sufficiently stable equilibrium between the financial markets; otherwise there would be the danger that it would peter out in the financial sector of the economy. Short-run disequilibria, however, do not lead to an inefficient monetary policy if the tendencies toward a state of equilibrium are effective. A prerequisite in this case is a cointegration of the financial markets, through which such a steady state can be established[10]. Due to the various risks, however, such an equilibrium cannot refer to the raw yields of the financial assets. As a result an econometric analysis of the effectiveness of the asset price channel has to be connected to a suitable concept of risk adjustment.

The first step in the econometric study of monetary policy transmission mechanisms was to attempt to verify liquidity, income and price effects, where necessary, according to Irving Fisher's price expectation effect and in this respect to quantify their length[11]. This was followed by intensive causality tests using the national product and the money supply according to the Granger approach. These tests lead to different results depending on money supplydefinition, adjustment procedures and the time period of the study. A striking feature here were the frequent feedback-relations that can be seen in the case of a Granger causality of the money supply[12]. Indeed, it emerged that the vector autoregressive model of the Granger causality test is falsely specified if there is a long-run equilibrium between the variables analysed, which they tend back to after short-run disturbances[13]. Within a study whether the process of the transmission of monetary impulses has changed in selected countries of the European Union (EU) as a result of deregulation, Juselius (1999) applied the cointegration technique in an econometric analysis. Juselius' study is attributable to the money view (interest channel), in that the author analyses the monetary transmission in an expanded IS-LM model, in which a difference is made between money market and capital market interest rates[14]. Furthermore, Gottschalk (1999) conducted research into the transmission mechanism in the first member states of the European Monetary Union (EMU) on the basis of a money demand system, with the aid of cointegration techniques.

The aim of this paper is to confront the asset price channel with the reality on the financial markets during the timeframe of a *Bundesbank* money supply target, using cointegrations techniques. The existence of a long-run equilibrium and the short-run dynamics of the financial markets will be analysed using a financial market model consisting of the money market, market for bank credit and the capital market. In addition, the extent to which the stock market can be integrated as a market for real capital will be examined, too. Insofar as the financial market equilibrium is established through the risk-adjusted yield rates, it is necessary to extract the specific risks of the assets beforehand. The theoretical basis of the cointegration analysis, with which the asset price channel, up to the interface between the financial and real spheres of the economy, can be traced, is outlined out in section two. In section three the risk adjustment of the financial yields is shown by means of time series

[9] Tobin's q hypothesis draws special attention to this connection, in that it takes the q relation from the relation of the market value of existing real capital to the cost of replacement as an actuator for expansive (q>1) and contractive (q<1) effects.

[10] The concept of cointegration refers to work by Granger (1986) and Engle and Granger (1987), which is closely connected to the problems of "spurious regression" (Granger and Newbold, 1974). An operational framework of a multivariate cointegration analysis based on the Likelihood principle, has been developed by Johansen (1988, 1995).

[11] An outline of the test results can be found in Hillmer (1993), pp. 230.

[12] See Hillmer, (1993), pp. 238.

[13] See Wolters, (1995), p. 151.

[14] Juselius (1999), pp. 192. Bofinger, Reischle and Schächer (1996, pp. 558) define the money view, relating to Kashyap and Stein (1994), as a transmission process without any credit theoretical basis.

econometrically based GARCH models, which connect with the verification of stationary properties. The cointegration of the financial markets will be examined in sections four and five, both with and without the inclusion of the stock market. Finally, the paper concludes with a summary of the main findings of the study.

2. A macroeconomic model of the asset price channel

The asset price channel allows for an interpretation of the theory of relative prices from a monetarist as well as Neo-Keynesian perspective. Both variations of the asset theoretical transmission mechanism draw on substitution relationships between financial and real stocks that can convey monetary impulses to the goods sector of an economy[15]. Substitution effects occur through changes in the relative yields of assets, through which the structure of an optimal portfolio can be destroyed. Monetary policy measures generally bring about additional wealth effects, which can equally cause the economic agents to restructure their portfolios. Since our study is not concerned with the problematic of the ability to differentiate between the two variations of the considered transmission mechanism, but rather the effectiveness of the process of relative prices on the financial markets in general, it is suitable to start from a general model that can subsequently be illuminated regarding its testability.

The macroeconomic transmission model from Thieme and Vollmer[16] provides a good basic framework for the asset price channel. The short outline of the transmission model in a slightly modified form, shows the economic foundation of our econometrically based financial market analysis. In order to make the supply and demand relations transparent, the economy is divided in m sectors, which, with m=4, can be identified with commercial banks, the central bank, the public (households and enterprises) and the government. The assets of sector j are comprised of money M_j, bonds B_j and stocks (existing real capital) A_j, which stand against liabilities in the form of credits K_j[17]. If we relate the money supply, the value of bonds and credits to the output price level P, and stock capital to the price level of existing real capital, P_k, we get, with $q = P_k/P$[18], the real wealth of sector j:

$$w_j = \frac{G_j}{P} + \frac{K_j}{P} + \frac{B_j}{P} + q \cdot A_j .$$

Under the objective of utility maximisation of total wealth the demand for a financial asset depends, given at least partially substitutable components, on the yield rates r_G , r_K , r_B and r_A, the wealth w_j and the preferences u_j. Herein the wealth w_j embodies the budget restriction of

[15] Differences between the two asset theoretical transmission mechanisms lie, amongst other, in that Tobin's portfolio theory supports a complimentary relationship between financial and real capital (Tobin, 1978, pp.), whereas the imperfect substitution relationships between the asset in the monetarist theory are seen as extremely differentiated. So e.g. Brunner (1970, 1971) conjectures that at a low level of interest rates money and bonds are close substitutes, although at a high interest rate level the substitution relationship between bonds and real capital has a larger weight (see Neuman, 1995, p. 138).

[16] Thieme and Vollmer (1987), pp. 82. See also Brunner (1970); Brunner and Meltzer (1976); Tobin (1980, 1982).

[17] We consider credits in accordance to the other financial assets from the view of the lender. Deposits of the public in the banking sector are not explicitly quoted; they are subsumed under the financial asset money in the form of demand deposits.

[18] The ratio of the price level of the existing and newly produced real capital can be interpreted as Tobin's q, insofar as it fits with the relation from the market price of the available capital equipment and its reproduction costs. See Jarchow (1995) pp. 253; Kath (1999), p. 208 and pp. 217. Here it should be pointed out that this relation is not only to be found in the Neo-Keynesian transmission theory, but plays an equally decisive role in the monetarist transmission mechanism. See Brunner and Meltzer (1974), pp. 242; Mishkin (1995), p. 4; Neumann (1995), p. 140.

the jth sector. It is important to ensure that the yields of the asset are comprehensively defined. Whilst they include transaction and information costs, according to the monetarist view, the Neo-Keynesian portfolio theory sees specific risk premiums involved[19]. Using the excess demand functions

$$m_j^d = m_j^d (r_G, r_K, r_B, r_A, w_j),\ k_j^d = k_j^d (r_G, r_K, r_B, r_A, w_j)$$
$$b_j^d = b_j^d (r_G, r_K, r_B, r_A, w_j), \text{und}\ a_A^d = a_A^d (r_G, r_K, r_B, r_A, w_j)$$
$$\text{mit}\ m_j = \frac{M_j}{P}, k_j = \frac{K_j}{P}, b_j = \frac{B_j}{P}\ \text{und}\ a_j = q \cdot A_j,$$

in which the preference variable is taken as given and, therefore, eliminated, allows the portfolio equilibrium conditions to be expressed in the following form:

$$(2.1)\quad \sum_{j=1}^{m} m_j^d = 0,\ \sum_{j=1}^{m} k_j^d = 0,\ \sum_{j=1}^{m} b_j^d = 0\ \text{und}\ \sum_{j=1}^{m} a_j^d = 0.$$

According to (2.1) the equilibrium of financial markets is established if the excess demands for the considered assets disappear.[20] Whether the state of equilibrium is stable or unstable depends crucially on the constellation of the model variables.[21]

Substitution and wealth effects can be made transparent through the partial derivatives of the excess demand functions to yield rates r_i, I=M,K,B,A. The substitution effect manifests itself in a restructuring of the portfolio due to a change in the yield rates r_M, r_K, r_B and/or r_A of the considered financial assets money, bank loans, bonds and stocks. Seen as a whole the sum of the changes in demand due to changes in the yield rates must be zero for the economy as a whole,

$$(2.2)\quad \sum_{j=1}^{m} \left(\frac{\partial m_j^d}{\partial r_i} + \frac{\partial k_j^d}{\partial r_i} + \frac{\partial b_j^d}{\partial r_i} + \frac{\partial a_j^d}{\partial r_i}\right) = 0,$$

insofar as the total wealth remains unchanged. In contrast, the wealth effect can be presented in the form

$$(2.3)\quad \sum_{j=1}^{m} \left(\frac{\partial m_j^d}{\partial w_j} + \frac{\partial k_j^d}{\partial w_j} + \frac{\partial b_j^d}{\partial w_j} + \frac{\partial a_j^d}{\partial w_j}\right) = 1,$$

which simply means that the assets and liabilities collectively have to absorb all changes in the wealth.

In a stable state of equilibrium all stocks have to remain constant, which has the consequence that for the given price relations

[19] Brunner und Meltzer (1974), pp. 237; Tobin (1978), pp. 50; Thieme und Vollmer (1987), p. 84; Duwendag et al. (1999), pp. 192., pp. 197. and pp. 210.

[20] Here it is important to note that according to the Walras' law, an equilibrium in three financial markets implies an equilibrium in the fourth market.

[21] See Thieme and Vollmer (1987), p. 86. A state of equilibrium is unstable if it occurs in an unbalanced government's budget. See e.g. Ott and Ott (1965) and Christ (1968).

(2.4) $r_G = r_K = r_B = r_A$

the markets are cleared in the long run.[22] A sound economic interpretation of the equilibrium relationship concerning the asset's prices is only possible if one bears in mind that the yield rates r_G, r_K, r_B and r_A are not directly observable variables. On the contrary, observed yield rates will be affected by asset specific transaction costs (information and change costs) or risks (e.g. uncertainties regarding expected yield flows)[23]. An econometric test of the asset price channel, therefore, requires an operationalisation of the yield rates underlying it. If we can assume that the information costs have a positive correlation with the degree of risk of an asset[24], and costs of change always include the price risks[25], the focus on the risk aspect is justified from the perspective of both asset theoretical transmission mechanisms. It therefore follows, that the equilibrium relationship (2.4) can only be valid for the risk-adjusted yield rates of the financial assets. The risk premiums in the observed yield rates will have to be captured by object specific and time-varying risk models.

3. Risk adjustment and stationary properties of the yield rates

Whether a long-run equilibrium can exist on the financial markets depends decisively on the degree of integration of the variables that determine the equilibrium relationship. The markets can be cointegrated if the representative variables possess the same degree of integration. Even in the case of differing degrees of integration cointegration is nevertheless possible, provided certain conditions are met.[26] A study of a financial market equilibrium has to start by determining the degrees of integration, for which the expanded Dickey-Fuller test (ADF test)[27] can be applied. In order to provide a more reliable judgement in cases of doubt we supplement with the Phillips-Perron test (PP test)[28].

An econometric test of the efficiency of the asset price channel could take place immediately on the basis of the observed yield rates if the assumption that their risk premiums are constant would be justified. Evidence of the existence of non-stationary risk premiums in long-run interest rates is, however, provided by e.g. Wolters (1998) and Wolters and Nautz (1999). Distinctive patterns of time-varying risk premiums on the stock market have been worked out by e.g. Kosfeld and Robé (2001). We have to reckon with the fact that alternative assets can embody different time-varying risks, which means that the equilibrium relationship (2.4) of the asset theoretical transmission mechanism is only valid for the risk-adjusted yield rates. For a cointegration analysis, therefore, it is important to determine the risk premiums of the financial assets that have to be eliminated from the observed yield rates. If we can assume a multiplicative connection between the risk and expected yield of an asset[29] the yield

[22] See Thieme and Vollmer (1987), pp. 86. Generally speaking the steady state could be established if all the stocks grew at the same rate (Thieme and Vollmer, 1987, p. 86). Duwendag et al. (1999, pp. 201) develop in a verbal-argumentative manner an equilibrium relationship of the asset theoretical transmission mechanism that is comparable with equation (2.4).

[23] Thieme and Vollmer (1987), p. 84.

[24] The connection between information costs and the degree of uncertainty is emphasised by e.g. Meltzer (1995, p. 50) in the propagation of a rule-based monetary policy.

[25] Duwendag et al. (1999), p. 206.

[26] In particular at least two variables must possess the maximum degree of integration. See e.g. Charemza and Deadman (1992), pp. 147; Eckey, Kosfeld and Dreger (1995), pp. 212.

[27] Dickey and fuller (1979, 1981).

[28] Phillips and Perron (1988).

[29] For a differentiation between multiplicative and additive risks in assets see e.g. Kosfeld and Robé (2001).

generating process can be approximated by an ARIMA-GARCH model within a time series econometric scheme[30]. Whilst the ARIMA(p,d,q) model

$$(3.1)\ r_{jt} = \delta + \sum_{h=1}^{p} \phi_h r_{t-h} + \sum_{k=0}^{q} \theta_k u_{t-k}, \theta_0 = 1$$

portrays the conditional average process, the conditional variance is provided by the GARCH (p,q) model

$$(3.2)\ \sigma_{jt}^2 = \alpha_0 + \sum_{h=1}^{q} \alpha_h u_{j,t-h} + \sum_{k=1}^{p} \beta_k \sigma_{j,t-k}^2$$

Insofar as the conditional variances embody the time-varying risks of the financial assets, it is possible to undertake a risk adjustment in the imputed yield-risk connection of the observed yield rates by relating them to the roots of the conditional variances σ_{jt}^2:

$$(3.3)\ r_{jt}^{adj} = \frac{r_{jt}}{\sqrt{\sigma_{jt}^2}}.$$

The quantities r_{jt}^{adj} can be interpreted as risk adjusted yield rates which establish a long-run financial market equilibrium in the sense of the asset price channel if a cointegration relationship exists.

The financial markets included in the econometric analysis are represented through the yields in the money, credit, capital and stock market. The money market is, in this case, a narrowly defined market in which commercial banks as actors supply and demand short-term liquidity. This allows for the use of the FIBOR (Franfurt interbank offered rate) as a proxy for the money market interest rate[31]. The yields on government bonds serves to represent the capital market interest rate,[32] whilst the interest on credit can be operationalised[33] through the interest rate on current account credit with a medium volume (DM 1 – 5 million). Finally, stock market returns in the form of yield on the shares in existing real capital, are taken from the DAFOX (German stock index for research purposes), the properties of which provide advantages compared to other stock indices[34].

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[30] Engle (1982); Bollerslev (1986). See also e.g. Franses (1998), pp. 115; Kosfeld and Robé (2001).

[31] See Gutthoff (1993), p. 318. The inclusion of the money market in this limited form is justified from two perspectives. For one thing, the interbank interest rate could serve as a proxy variable for the non-pecuniary yields of money holding. For another, the money market rate, through the central bank control of the short-term interest rate, could be used as the first link in the chain of the transmission mechanism.

[32] Alternatively, the returns on bonds could be ascertained on the basis of the German bond index (REX). Here it is assumed that for an actor on the capital market the yields of governments bonds outstanding is the main point of interest. It is calculated for bearer debt securities with a minimum residual maturity of more than three years. See Deutsche Bundesbank (1988), p. 226.

[33] The data basis for the interest rate series is the "Statistische Teile" of diverse issues of the periodical "Monatsberichte der Deutschen Bundesbank".

[34] See Göppl and Schütz (1992), pp. 7. The DAFOX series is taken from the Financial Market Databank of the Institute of Decision Theory and Operations Research of the University of Karlsruhe.

The period of research is limited to 1980 – 1998 in consideration of monetary policy target setting. The *Bundesbank* has provided an orientation framework in the form of a money supply target since the middle of the 1970's.[35] Although in the beginning stages a particular point value was targeted, since the end of the 1970's the target formulation has been in the form of a "target funnel". At the beginning of 1999, responsibility for monetary policy passed from the EU countries to the European Central Bank (ECB), which is the reason for the termination of the research. Using monthly data it is possible to calculate the prerequisites for stochastic convergence criteria. Furthermore, this also allows for an adequate inclusion of the short-run dynamics of the adjustment process.

Table 3.1 shows that the observed interest rates in the money, credit and capital markets are non-stationary. Both unit root tests (ADF and PP tests) indicate that the yields of the assets traded on these markets follow a I(1) process. Against this, the stationary properties of the stock market returns are more difficult to judge. In this case the residuals of the ADF test model display the white noise properties only from a lag of 12 up. The null hypothesis of a unit root must then be rejected at a significance level of 10%. Although the significance is more clearly shown on the basis of the PP test, considering the magnitude of the test statistics, on the whole the stationarity of the stock market returns proves to be statistically weak.

Table 3.1: ADF and PP tests of the observed yield rates

	ADF test[a]				PP test[a]	
Variables	ADF stat. for r_{jt}	Max. lag k^b	ADF stat. for Δr_{jt}	Max. lag k^b	PP stat. for r_{jt}^c	PP stat. for Δr_{jt}^c
r_M	-1.588	3	-6.021**	2	-1.288	-12.252**
r_K	-1.572	3	-5.907**	2	-1.445	-11.279**
r_B	-1.059	2	-10.084**	1	-0.945	-9.179**
r_A	-2.784(*)	12	-6.315**	11	-3.440*	-15.651**

Explanation:

a The unit root tests for yield rates were carried out using a model with a constant and no trends, whereas for differences a model without constant and without trends was used.

b Included lags of temporally delayed endogenous variables in the test equation (3.2), for which none of the calculated Q-statistics are significant; Godfrey's LM test is used as a control instrument here.

c The PP statistics result with a truncation lag of 4 of the Newey-West-correction.

** 1% significance level, * 5% significance level, (*) 10% significance level.

The mean process of the first differences of the interest rates can be approximated on the basis of the portmanteau test from Ljung and Box, in connection with the LM test from Godfrey and the Bayesian information criterion through ARIMA(4,1,3) and ARIMA(4,1,4) models, respectively. In contrast, the first order autoregressive parameter of an ARIMA(12,1,12) model for the stock market returns would lie close to one. In this way the ARMA(12, 12) model empirically crystallises as a data generating process of the stock market returns. In order to do justice to the principle of parsimony, with the exception of the intercept only the significant lag variables are taken into consideration in the model estimation (see Table 3.2). The validity of the yield rates in all four financial markets can be ascertained using GARCH(1,1) models, whereby the influence of the lagged conditional variance is, in the latter case, without significance and hence suppressed.

[35] See e.g. Issing (1992), pp. 255.

The risk-adjusted yield rates can be determined on the basis of volatility estimates provided by the data generating models. These take the function of proxy variables of the quantities which establish a steady state within the asset theoretical transmission mechanism.

Tab. 3.2: ARIMA-GARCH models of the yield rates on the financial markets

Vari-ables	ARIMA model[a]	GARCH model	Overall statistics[b]
Money market rate	ARIMA(4,1,3) δ = -0,03985 ϕ_1 = 0,24951** ϕ_4 = 0,20723** θ_1 = 0,20104**	GARCH(1,1) α_0 = 0,00235 α_1 = 0,15026* β_1 = 0,80319**	R^2 = 0,1003 DW = 2,1276 BIC = -2,4309 F = 4,0140**
Lending rate	ARIMA(4,1,4) δ = -0,00771 ϕ_3 = 0,18361** ϕ_4 = 0,66879** θ_1 = 0,27009** θ_4 = -0,54320**	GARCH(1,1) α_0 = 0,00103 α_1 = 0,05973** β_1 = 0,91575**	R^2 = 0,1914 DW = 1,6950 BIC = -3,0209 F = 7,2708**
Yields on bonds	ARIMA(4,1,4) δ = -0,02406 ϕ_1 = 0,37836** ϕ_4 = -0,24879* θ_4 = 0,32358	GARCH(1,1) α_0 = 0,00846 α_1 = 0,05366 β_1 = 0,74848*	R^2 = 0,2076 DW = 1,8271 BIC = -2,9874 F = 9,4312**
Stock market returns	ARIMA(12,1,12) δ = 0,29861** ϕ_5 = 0,23650** ϕ_6 = -0,18536** ϕ_8 = 0,39014** ϕ_{12} = -0,24838** θ_5 = -0,32912** θ_6 = -0,12312* θ_8 = -0,43250** θ_{12} = -0,49488**	ARCH(1) α_0 = 19,62805** α_1 = 0,52794**	R^2 = 0,3803 DW = 2,1017 BIC = 3,9814 F = 12,5179**

Explanation:

a For the purpose of defining the parameters parsimonically, the ARIMA(p,d,q) models are always estimated using significant lag variables

b The quality measures relate to the respective filtered variables (eliminating the stochastic trends through formation of first differences).

** 1% significance level, * 5% significance level.

R^2: Determinations coefficient, DW: Durbin-Watson statistic, BIC: Bayesian information criterion, F: F statistic (test of the overall relationship)

Since the proxy variables are to be analysed in terms of a cointegration relationship, it is their degree of integration which is of primary relevance. The test results (see Tab. 3.3) show that a stochastic trend can be assumed for the three risk-adjusted interest rates. Following the elimination of the risk premium, however, stock market returns exhibit the properties of an I(0) variable. It is by no means possible, though, to draw any conclusions from this as to how far monetary impulses could encounter restraints in the transfer from the financial to the real sphere of an economy, before the market for new to be produced goods has been taken into account. Despite the different characteristics of the risk-adjusted yield rates, it depends entirely upon the connections between the risk-adjusted yield rates of the first three macromarkets, as to whether a cointegration of only these financial markets can exist, or in all four considered macromarkets.

Table 3.3: ADF and PP tests of the risk-adjusted yield rates

	ADF test[a]				PP test[a]	
Variables	ADF stat. for r_{jt}	Max. lag k^b	AD stat. for Δr_{jt}	Max. lag k^b	PP stat. for r_{jt}^c	PP stat. for Δr_{jt}^c
r_M	-2.409	0	-13.643**	0	-2.294	-13.799**
r_K	-2.158	4	-4.633**	3	-2.357	-10.984**
r_B	-1.006	2	-12.860**	1	-1.095	-16.232**
r_A	-3.108*	6	-6.820**	5	-4.223**	-17.911**

Explanation:

a The unit root tests for yield rates were carried out using a model with a constant and no trend, whereas for differences a model without constant and without trend was used.

b Included lags of temporally delayed endogenous variables in the test equation (3.2), for which none of the calculated Q-statistics are significant; Godfrey's LM test is used as a control instrument here.

c The PP statistics results with a truncation lag of 4 of the Newey-West correction.

** 1% significance level, * 5% significance level, (*) 10% significance level.

4. Cointegration in the financial market model without the stock market

A state of equilibrium of the financial markets is a fiction that provides an appropriate reference in a theoretical analysis. In reality, however, one state of equilibrium in the assets market passes constantly to another without a steady state ever being reached. Nevertheless, an econometric analysis can investigate whether a stable relationship of the yields on the financial markets exists beyond all adjustment processes, which could be interpreted as a long-run equilibrium. Knowledge of the existence of a steady state is not alone the relevant point for monetary and debt policy, rather the efficiency depends on whether there are forces that drive the system towards equilibrium in the case of short-run deviations. In the instance of a divergence, the empirical foundation of the asset price channel has to be brought into question.

Traditional econometric methods are not adequate to cope with this problem. With non-stationary variables, the problem of spurious regression arises, which makes it appear questionable as to whether a "true" relationship between the risk-adjusted yield rates can be concluded from a least-squares estimation. Moreover, the short-run dynamics would be fully neglected. In the ad hoc use of a vector autoregressive model, however, the relationship between the long-run state of equilibrium and the short-run dynamic is not considered. The cointegration technique aims to methodically connect both aspects with one another, so that valuable information regarding the effects of monetary impulses on the financial markets can be ascertained.

Although the asset price channel on account of expected feedback effects is ultimately analysed in a multivariate cointegration model, our financial market model allows for the bivariate examination of the previously determined theoretical implications. In order to provide both analysis forms with a unified methodical basis, we use the Johansen Method.[36]

[36] Johansen (1988); Johansen (1995).

Due to the equilibrium relationship (2.4) in financial market model I (transmission model without the stock market), two independent cointegration vectors must exist between the risk-adjusted interest rates for the asset price channel to be effective. If the cointegration relationship, for example, between the capital and money markets as well at the credit and capital markets, on account of equation (2.4) are given by[37]

(4.1) $r_B = r_G \Leftrightarrow r_B - r_G = 0$

and

(4.2) $r_K = r_B \Leftrightarrow r_K - r_B = 0,$

then the relation

(4.3) $r_K = r_G \Leftrightarrow r_K - r_G = 0$

has to hold, too. The equilibrium relationships (4.1) – (4.3) need, in this case, to be interpreted as special instances of the linear long-run relationships

$$r_j = \alpha + ß \cdot r_k,\ j,k=K,B,G;\ j \neq k,$$

Tab. 4.1: Bivariate cointegration in financial market model I

Max. lag	Risk-adj. capital and money market interest rates			Risk-adj. credit and money market interest rates			Risk-adj. credit and capital market interest rates		
	λ_{trace}	λ_{max}	Model defects	λ_{trace}	λ_{max}	Model defects	λ_{trace}	λ_{max}	Model defects
1	16,3 4,9	11,5 4,9	Q und BG, ARCH	21,5* 5,8	15,7* 5,8	Q und BG, ARCH	28,2** 2,3	25,8 2,3	Q and BG, ARCH
2	18,7(*) 5,0	13,7 5,0	Q und BG, ARCH	17,5 5,3	12,1 5,3	Q und BG	24,6* 2,7	21,9** 2,7	Q and BG, ARCH
3	17,6 6,4	11,2 6,4	Q und BG, ARCH	14,7 5,3	9,4 5,3	Q und BG	19,0(*) 2,2	16,8* 2,2	Q and BG, ARCH
4	19,5(*) 6,2	13,3 6,2	ARCH (hohe Lags)	13,7 5,0	8,7 5,0	Q und BG	18,4(*) 3,0	15,4(*) 3,0	ARCH (with r_K)
5	17,0 6,1	10,8 6,1	ARCH (high Lags)	14,5 5,4	9,1 5,4	Q und BG	14,3 2,5	11,8 2,5	ARCH (with r_K)
6	17,0 5,1	11,9 5,1	ARCH (high Lags)	14,6 4,8	9,8 4,8	-	13,6 2,9	10,8 2,9	ARCH (with r_K)

Explanation:
a Financial market model I: Money market, market for bank credit and capital market.
** 1% significance level, * 5% significance level, (*) 10% significance level

[37] Insofar as our cointegration analysis always uses the risk-adjusted yield rates, for the sake of convenience we omit the abbreviation "adj" from the following.

λ_{trace}: trace statistic, λ_{max}: maximum eigenvalue statistic
Q: Ljung-Box test, BG: Breusch-Godfrey test, ARCH: ARCH LM test.

with α=0 and ß=1. With this, both cointegration vectors of two bivariate cointegration relationships between the risk-adjusted interest rates are given as theoretically identical by (1, -1).

The test results of the bivariate cointegration models shown in Tab. 4.1 convey a first empirical evidence of the asset price channel in the money, bank credit and capital markets. As regards the relationship between the risk-adjusted yields on bonds and money market rates, allowing for lags up to four periods in the modelling of the short-run dynamics reveals a weak significance (10% level) for the existence of a cointegration relationship on the basis of the trace statistic. From this lag, the Ljung-Box and the Breusch-Godfrey tests are not able to refute the null hypothesis of missing autocorrelation of the residuals of the VEC and VAR models, respectively. Previously existing ARCH effects at lower lags disappear; they only show presence at lags of a higher order. In the estimated cointegration vector (1 -1,858 0,786), the second component $-\hat{\beta}$ possesses the theoretically expected sign, but is only significant at the 10% level. The missing significance of the estimate $\hat{\alpha}$ of the intercept corresponds with the expectations. The results, though, should not be overrated, as will be shown in the trivariate cointegration analysis. What could be seen as a problem is that the $\hat{\beta}$ deviates noticeably from the theoretical value of minus 1 of the cointegration parameter. However, it should be noticed that the yield rates were separately adjusted, which goes along with problems of scale.

A cointegration of the risk-adjusted lending and money market rates could only viewd as given if the VEC model has a lag order of one. Whereby the residuals contain a systematic that is not to be overlooked. With higher lags, by contrast, it does not succeed in ascertaining a statistically significant long-run relationship between both yield rates.[38] In comparison, a VEC model with a maximum lag of four shows a weak significance (10% level) for a cointegration of the interest rates in the credit and capital markets. From this point on, the residuals are free from autocorrelation. In the resulting cointegration vector (1 -2.794 4.861) the estimates $\hat{\beta}$ and $\hat{\alpha}$ possess exactly the same inference statistical properties as those ascertained in the long-run relationship between the yields on bonds and money market irates. ARCH effects arising at low lags in the VEC (4) model cannot be completely excluded.

With the bivariate cointegration analysis of the risk-adjusted interest rates feedback effects that could emanate from the excluded third market are left out of consideration. An interdependent adjustment process is exactly that which is emphasised in the asset theoretical transmission mechanism.[39] The fact is that the money market rate not only can influence the interest rates on the credit and capital markets, but can also itself be dependent on circumstances on the latter interest rates. Thereby, the higher the term, the greater the feedback effects that can be expected.[40] Similarly, the simultaneous influence of monetary policy and international capital flows on the credit market, is not to be negated a priori. The mutual dependence of the risk-adjusted yields of the observed financial assets can only be adequately analysed in a trivariate cointegration system.

[38] For this reason we choose not to present the relationship between the two yield rates with its significant slope, because in the case of absent cointegration we would be dealing with spurious regression.
[39] See Bofinger, Reischle and Schächter (1996), pp. 554; Duwendag et al. (1999), pp 195.
[40] With greater term capital market circumstances increasingly affect the money market rates. The central bank has more control of the make up of prices at the short end of the money market. See Deutsche Bundesbank (1994), p. 62

Tabelle 4.2: Trivariate cointegration in financial market model I[a]

Maxim. lag	λ_k	λ_{trace}	λ_{max}	LB stat.	BG stat.	ARCH
1	0,1120 0,0812 0,0111	47,44** 21,18* 2,46	26,26* 18,72* 2,46	r_K-eq.* r_B-eq.*	r_K-eq.* r_B-eq.**	r_K-eq.* r_B-eq.**
2	0,1069 0,0920 0,0133	49,04** 24,18* 2,95	24,87* 21,23** 2,95	r_K-eq.* r_B-eq.*	r_K-eq.* r_B-eq.*	r_K-eq.* r_B-eq.*[b]
3	0,0896 0,0746 0,0118	40,13* 19,57(*) 2,60	20,56(*) 16,97* 2,60	r_B-eq.*	r_K-eq.(*) r_B-eq.*	r_K-eq.* r_B-eq.(*)[b]
4	0,1038 0,0677 0,0154	42,57** 18,67(*) 3,39	23,90* 15,28(*) 3,39	no sign.	no sign.	r_K-eq.* r_B-eq.[b]
5	0,0991 0,0529 0,0131	37,30* 14,64 2,85	22,65* 11,79 2,85	no sign.	no sign.	r_K-eq.** r_B-eq.[b]
6	0,1043 0,0413 0,0129	35,72* 11,93 2,81	23,80* 9,11 2,81	no sign.	no sign.	r_K-eq.** r_B-eq.[b]
7	0,1230 0,0351 0,0123	38,57* 10,36 2,67	24,93* 7,69 2,67	no sign.	no sign.	r_K-eq.** r_B-eq.[b]
8	0,1312 0,0309 0,0093	38,81* 8,71 1,99	30,10** 6,72 1,99	no sign.	no sign.	r_K-eq.**

Explanation:
a Financial market model I: Money market, market for bank credit and capital market
** 1% significance level, * 5% significance level, (*) 10% significance level
λ_k: kth eigenvalue, k=1,2,3, λ_{trace}: Trace statistic, λ_{max}: Maximum eigenvalue statistic
Q: Ljung-Box test, BG: Breusch-Godfrey test, ARCH: ARCH LM test.

Assuming the validity of the equilibrium relationship (2.4), there have to be two independent cointegration vectors of the risk-adjusted interest rates in a trivariate cointegration system where the stock market is excluded. As shown in Tab. 4.2, a cointegration rank of two, based on an error correction model with maximum lags of one and two, proved to be well supported statistically. It must be noted that the residuals in the r_B and r_K equations of the VEC (1) and VEC (2) models contain considerable systematics. Here it is not only ARCH effects that are present, rather the LB and BG tests show in part considerable autocorrelations. The complete removal of the ARCH effects proves to be especially difficult with the residuals of the r_K equation. However, the residuals from all three short-run relationships are free from autocorrelation from a maximum lag of four up. It therefore stands for reason that the short-run dynamics of the financial markets should be portrayed through a VEC (4) model. Whilst the existence of a second independent cointegration vector is only weakly significant (10% level)[41], the first cointegration vector has a high significance on the basis of the trace statistic.

[41] The inclusion of a quite considerable number of non-significant interest rate differences in the estimation algorithm could be the reason why the existence of a second independent cointegration vector was not more clearly ascertained.

Both the ascertained cointegration vectors provide the long-run relationships[42]

(4.4) $$r_{K,t} = \underset{(2,272)}{2,099} + \underset{(4,946)}{1,518} \cdot r_{G,t}$$

and

(4.5) $$r_{B,t} = \underset{(4,410)}{2,787} + \underset{(2,166)}{0,454} \cdot r_{G,t}$$

between the adjusted yields of the financial assets. In both cases the slope is statistically significant. Furthermore, the sum of both slopes is close to the theoretically expected value of 2. Viewed separately, the risk-adjusted money market rate shows a considerably stronger influence on the lending rate than on the yields on bonds, which is understandable considering the latter is affected by international capital flows to a much greater extent. By comparison, the intercept should, theoretically, be non-applicable, whilst the estimates here prove to be significant. This problem is already known from cointegration analysis of non-adjusted interest rates.[43] An exclusive reduction of the significance on the scale factor would, therefore, be to great an interpretation.

The multivariate error correction model (vector error correction model, VEC(4) model) consists of the system of equations

(4.3) $$\Delta r_{K,t} = \underset{(-1.462)}{-0.008} \cdot ec_{1,t-1} + \underset{(2.424)}{0.024} \cdot ec_{2,t-1} + \underset{(2.427)}{0.171} \cdot \Delta r_{K,t-1} + \underset{(1.774)}{0.124} \cdot \Delta r_{K,t-4} + \underset{(2.837)}{0.087} \cdot \Delta r_{B,t-1}$$

$$+ \underset{(1.545)}{0.048} \cdot \Delta r_{B,t-1} + \underset{(1.625)}{0.049} \cdot \Delta r_{B,t-4},$$

$R^2 = 0,283$, SSE = 1,785, SE = 0,094, L* = 214,4,

(4.4) $$\Delta r_{B,t} = \underset{(3.727)}{0.050} \cdot ec_{1,t-1} + \underset{(0.878)}{0.021} \cdot ec_{2,t-1} + \underset{(1.366)}{0.231} \cdot \Delta r_{K,t-4} - \underset{(-4.004)}{0.299} \cdot \Delta r_{B,t-2}$$

$$- \underset{(-3.090)}{0,224} \cdot \Delta r_{B,t-4} + \underset{(2.397)}{0.117} \cdot \Delta r_{G,t-1},$$

$R^2 = 0,147$, SSE = 10,408, SE = 0,226, L* = 22,238

and

(4.5) $$\Delta r_{G,t} = \underset{(2.804)}{0.057} \cdot ec_{1,t-1} + \underset{(3.543)}{0.131} \cdot ec_{2,t-1} - \underset{(-2.364)}{0.620} \cdot \Delta r_{K,t-2} + \underset{(1.505)}{0,113} \cdot \Delta r_{G,t-1}$$

$R^2 = 0,131$, SSE = 24,199, SE = 0,344, L* = -69,724,

[42] The t-values are given in brackets
[43] See Wolters (1995), p. 151; Nautz (2000), pp. 117.

which provides the short-term dynamic of the financial markets in a numerically specified form.[44] It explains the interest rate differences of the assets, by means of the lagged differences, as well as the error correction terms $ec_{1,t-1}$ and $ec_{2,t-1}$, which embody the equilibrium relationships (4.1) and (4.2). At least one of the two error correction terms is significant in every equation. From a positive sign of these terms one cannot infer instability, insofar as the stability behaviour is dependent on the entire short-run dynamics. [45] Whilst its own lagged yield differences as well as those of the capital market interest rate are decisive for the adjustment process on the bank credit market, a feedback is not statistically provable. The adjustment process in the capital market is, in contrast, influenced by changes in the money market, which presumably join with international influences that are not examined here. In the short-run dynamics, temporal differences of the yields on bonds itself are of great importance. Finally, the error correction model renders the feedback process from the bank credit market to the money market transparent.

From an economic perspective, the result is of interest insofar as whether the transmission of a monetary impulses in the financial markets is effective, is brought into question time and again. Against this it is often argued that time-varying risk premiums can oppose the propagation of such impulses. Despite the need for care with interpretation, in view of the problematic of an adequate operationalisation of the financial market constructs, our co-integration analysis shows that a drifting apart of the risk-adjusted yield rates is limited. Whilst the non-adjusted interest rates appear in no way to be always striving towards a steady state, risk-adjusted interest rates do not arbitrarily drift apart, since there are obviously market forces existing that provoke tendencies toward a state of equilibrium.[46]

It is, however, important to draw attention to a critical point in the maximum likelihood estimation of the VEC models. This lies in the fact that the residuals in all VAR and VEC models analysed possess a leptocurtic, left-skewed distribution, through which a significance of the Jarque-Bera statistic is brought to the fore. This clearly brings the assumption of normal distribution into question. For this reason rather than speaking of a maximum likelihood estimation of the VEC models, we should speak of a quasi maximum likelihood estimation.[47] With this the question of the robustness of the model estimation is raised,[48] which has not yet been examined in the cointegration technique.

5. Cointegration in the financial market model with the stock market

Including the stock market in the transmission analysis raises the discussion as to what evidence will be found for a cointegration of the financial markets up to the interface between the financial and real spheres of the economy. In this instance at first we will examine a potential cointegration of the risk-adjusted yield rates and disregard the implications arising from the cointegration analysis of the financial market model I. From Table 5.1 we can see that with virtually all specifications of the short-run dynamics of the yield rates, it is possible to extract one cointegration vector. As we can see, considering the white noise properties of the VAR and VEC disturbances, respectively, leaves the choice of a lag order between 5 and 7 open to discussion.

[44] The t-values are given in brackets. R^2: Coefficient of determination, SSE: Sum of squared residuals, SE: Standard error of regression, L*: Log likelihood.
[45] See Hendry (1995), pp. 309 and p. 583.
[46] Without concretely going into the test results it turns out that the non-adjusted yield rates show no evidence of a cointegration in the financial markets within the period of our research.
[47] For quasi maximum likelihood estimation see Gouriéroux, Monfort and Trognon (1984).
[48] The consequences of a robust estimation in capital market analysis are discussed by Kosfeld (1996), pp. 144.

Table 5.1: Cointegrations rank in financial market model II[a]

Maxim. lag	λ_k	λ_{trace}	λ_{max}	LB stat.	BG stat.	ARCH
1	0.1023 0.0799 0.0597 0.0081	55.55* 32.57(*) 14.84 1.73	22.97 17.73 13.11 1.73	r_A-eq.* r_K-eq.** r_B-eq.*	r_A-eq.* r_K-eq.** r_B-eq.*	r_A-eq.* r_K-eq.* r_B-eq.*
2	0.1242 0.0755 0.0490 0.0058	56.64* 28.52 11,88 1.24	28.12(*) 16.64 10.64 1.24	r_A-eq.* r_K-eq.**	r_A-eq.* r_K-eq.**	r_A-eq.* r_K-eq.*
3	0.1136 0.0596 0.0405 0.0041	48.01 22.56 9.59 0.87	25.45 12.98 8.72 0.87	r_A-eq.* r_K-eq.**	r_A-eq.* r_K-eq.**	r_A-eq.* r_K-eq.(*)
4	0.1376 0.0608 0.0411 0.0062	54.39* 23.29 10.12 1.30	31.10* 13.17 8.82 1.30	r_A-eq.** r_B-eq.**	r_A-eq.* r_B-eq.**	r_A-eq.(*) r_K-eq.*
5	0.1498 0.0480 0.0353 0.0054	52.86(*) 18.93 8.65 1.14	33.92** 10.29 7.51 1.14	r_A-eq.[b]	r_A-eq.[b]	r_K-eq.*
6	0.1344 0.0397 0.0315 0.0056	46.25 16.24 7.81 1.16	30.01* 8.42 6.65 1.16	no sign.	no sign.	r_A-Gl.* r_K-Gl.*
7	0.1740 0.0508 0.0256 0.0085	57.48* 17.92 7.12 1.76	39.56** 10.80 5.36 1.76	no sign.	no sign.	no sign.
8	0.1723 0.0735 0.0230 0.0092	38.94** 15.74 4.80 1.91	38.94* 15.74 4.80 1.91	no sign.	no sign.	no sign.

Explanation:
a Financial market model I: Money market, market for bank credit, capital market and stock market
** 1% significance level, * 5% significance level, (*) 10% significance level
λ_k: kth eigenvalue, k=1,2,3, λ_{trace}: Trace statistic, λ_{max}: Maximum eigenvalue statistic
Q: Ljung-Box test, BG: Breusch-Godfrey test, ARCH: ARCH LM test.

Based on the test results, the relevance of a long-run equilibrium can evidently not be negated in any of the relevant cases. The situation is extremely clear with a lag order of seven, in which the trace and maximum eigenvalue statistics show a significance of at least at the 5% level. In the VEC (7) model the residuals are free of autocorrelation. Furthermore, ARCH effects are no longer existent. Freedom from autocorrelation also exists in the VEC (6) model, whereby ARCH effects are still measurable in the r_A and r_K equations. The significance of a cointegration vector in this error correction model is only shown on the basis of the maximum eigenvalue statistic. In relation to the ARCH effects, the VEC (5) model looks better, although autocorrelation still seems to be present at high lags. With this specification of the short-run dynamics, the maximum eigenvalue statistic clearly shows the existence of a cointegration vector, whilst it is only weakly significant on the basis of the trace statistic. From the perspective of a parsimonious modelling, the VEC (5) model could present a relevant cointegration system for the financial markets, as long as certain restrictions do not have to be considered.

Theoretically, the conditions for a steady state are provided through the equilibrium relationship (2.4). Exactly three independent cointegration vectors of the risk-adjusted yield rates have to exist for the validity of the equations (2.4) in the complete financial market model. Moreover, considerable complications arise in the interpretation of the test results presented in Table 5.1 with an explicit consideration of the cointegration tests conducted for financial market model I. If the adjusted yield rates of the money market, market for bank credit and the capital market are I(1) variables, and the adjusted stock market returns is an I(0) variable, then the latter makes up its own segment within a long-run equilibrium relationship. A second segment is formed by the risk adjusted interest rates r_K, r_B and $r_{G,}$ which can be transformed in I(0) variables through the revealed cointegration relationships (4.4) and (4.5). Under these conditions it conclusively follows that a cointegration of all four financial markets exists, by which the risk-adjusted stock market returns must constitute an independent cointegration relationship. If the existence of two independent cointegration vectors has been secured in financial market model I, then in financial market model II exactly three independent cointegration relationships of the adjusted yield rates ought to be extracted.[49] Even if one were to question the statistically weak second co-integration vector in financial market model I, the 'puzzle' would still remain. In all cases it must be possible to trace an extra independent cointegration vector under the conditions outlined in financial market model II.

The inconsistency could have different reasons. For one thing we should not forget that under certain conditions the I (1) process in finite samples could tend to reflect the characteristics of a stationary process.[50] This fact implies that a unit root test " ... with high power against *any* stationary alternative *necessarily* will have correspondingly high probability of false rejection of the unit root null when applied to near stationary processes".[51] Following this it could be raised the objection to the Dickey-Fuller test that it does not possess the degree of selectivity to propose a sufficiently grounded differentiation under the conditions specified. From this perspective, the stationary properties of the stock market returns, derived on the basis of the ADF test, could be explained as a problem of over-rejection.[52] In this case the test result (Tab. 5.1) would not support the theory of the asset price channel as laid out with the inclusion of the stock market. It could merely support a transmission hypothesis that indicates a single independent cointegration vector.

If, in contrast, the adjusted stock market returns really possess the stationary properties, this could, at first glance, be seen as a failure of the Johansen procedure in identifying the existence of a second cointegration vector. It is important to note in such a case that the

[49] This implication will be clear if one bears in mind that the cointegration rank results from the number of linear independent columns of the respective coefficient matrix (Π) of the multivariate error correction model (see e.g. Johansen, 1995, pp. 45; Harris, 1995, pp. 76; Charemza and Deadman, 1992, pp. 195). Since an I(0) variable always constitutes a linear independent column in a cointegration system, the cointegration rank will rise by one with every additional I(0) variable. See Harris (1995), pp. 79.

[50] See Harris (1995), p. 39.

[51] Blough (1992), p. 298.

[52] The same objections must be raised regarding the Phillips-Perron test, insofar as the statistical inference remains unchanged on the basis of this test. For this there is certainly a reason. See Harris (1995), p. 33.

problematic of the assumption of a multivariate normal distribution cannot be ignored. The distribution problem has been the reason to qualify our econometric model estimation as a quasi maximum likelihood estimation. Theoretically the potential existence of a cointegration vector might not be recognised as a result of the loss of degrees of freedom as a consequence of taking the complete set of the lagged yield rate differences into consideration up to the maximum lag. The findings ascertained by Reimers (1992) in a Monte Carlo study of a trivariate VEC model, in which a second existing cointegration relationship was underestimated through the trace statistic, go in the same direction. Hereby it is rather the validity of the asset price channel in the financial market model, ignoring the stock market, that is supported.

Therewith, the conditions are indicated that have to met in order that a long-run equilibrium on the money market, market for bank credit, the capital market and the stock market can be established. If the adjusted stock market returns were to possess a unit root, we could conclude the existence of a single cointegration relationship on the basis of the empirical findings. This, however, would not agree with our model of the asset price channel. For the validity of the asset price channel, exactly r-1 cointegration relationships must always exist in the case of r financial markets. Based on our cointegration analysis, empirical evidence of this is only provided in the financial market model without consideration of the stock market. Hereby, the considerably greater degree of complexity involved in a transmissions analysis where the stock market is included emerges. Specifically it has been revealed that on the basis of the asset theoretical transmission mechanism selected, the stock market cannot be integrated with the other financial markets in a cointegration system.

6. Conclusions

With the aid of time series econometric procedures time-varying risk premiums of financial assets can be proven that explain a missing cointegration of yield rates for the *Bundesbank* money supply control period. Whilst the raw yields to be obtained from the money market, market for bank credit and the capital market establish no cointegration relationship, a cointegration of the risk-adjusted interest rates of the assets traded on these markets is shown on the basis of a portfolio model of the asset pricing channel. With this, evidence for non-stationary risk premiums of the financial assets is indirectly reflected, which aligns with the findings ascertained by Wolters (1998) and Nautz and Wolters (1999).

If we include the stock market as the market for real existing capital in the asset theoretical transmission mechanism, complications arise. With the inclusion of the stock market in the financial market model, the efficiency of the asset price channel is not empirically supported. A cointegration of the risk-adjusted yield rates in all four considered financial markets could, at best, be grounded on the basis of another transmission model.

An interpretation that attempted to extract a differentiation in favour of a particular variant of the asset theoretical transmission mechanism from these findings would be going too far. As far as the credit channel variant (lending view) is concerned, Neumann (1995) has already elaborated doubts regarding an improvement on the monetarist approach of the relative prices. Even conjecture that it might be possible to differentiate between monetarist and Neo-Keynesian variants of the transmission mechanism proves to be too optimistic, due to the problem of a consistent classification of the stock market as the market for real existing capital in the transmission model. If one bears in mind that in the monetarist theory represents a differing degree of substitutability instead of complimentarity of financial and real assets, the problematic of the ability to differentiate is quite obvious.

Undoubtedly, the knowledge that under a given monetary policy regime on the financial markets, a long-run equilibrium can exist, is information we can scarcely afford to ignore. With this, the stock market does not easily fit into the system of the other financial markets. Furthermore, possibilities for monetary policy control do not necessarily render more reliable. Insofar as a steady state of the risk-adjusted interest rates is established, uncertainty in view of the propagation of a monetary impulse will not necessarily be reduced, since the risk premiums of the financial assets can be both time-varying and non-stationary. However, time series econometric procedures provide starting points from which the time-varying risks may be grasped with greater analytic consistency. It would be much easier to predict the effects of monetary impulses in the case of a steady state of the observed interest rates, but only a ‘naive’ transmission mechanism could stand behind this, which would shut out the complexity of reality from the start.

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PD Dr. Reinhold Kosfeld, Fachbereich Wirtschaftswissenschaften, Universität Gh Kassel, Nora-Platiel-Straße 5, D-34127 Kassel.

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Volkswirtschaftliche Diskussionsbeiträge
Herausgeber:
Fachbereich Wirtschaftswissenschaften
Universität Gesamthochschule Kassel
Nora-Platiel-Str. 4
34127 Kassel
Internet: http://www.wirtschaft.uni-kassel.de

ISSN 1615-2751