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Exchange rates and different degrees of capital market integration: A monetary approach to the Mark/Dollar rate

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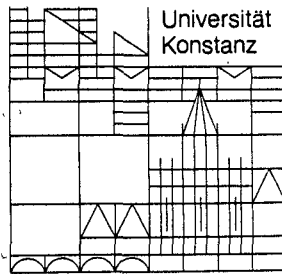
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**Fakultät für
Wirtschaftswissenschaften
und Statistik**

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**Exchange Rates
and Different Degrees
of Capital Market Integration
A Monetary Approach
to the Mark/Dollar-Rate**

Diskussionsbeiträge

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Exchange Rates and Different Degrees of Capital Market Integration
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Peter Koenig

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Serie A: Volkswirtschaftliche Beiträge

Serie B: Finanzwissenschaftliche Arbeitspapiere

Serie C: Betriebswirtschaftliche Beiträge

Abstract

In the political discussion, exchange rates are often said to be overvalued or undervalued. This is due to the fact that exchange rates have to fulfill a (more than) dual role: they have to balance international goods markets and international capital markets.

In general, economic models try to handle this problem by introducing short-term overshooting effects of the exchange rate induced by monetary disturbances. Yet, especially in estimating these models, a fixed relationship between asset markets and goods markets is assumed: the adjustment speed of the actual overshooting exchange rate to its long-run level is kept constant over time.

In this paper, we introduce a time-varying index for capital market integration via expectation formation in the context of a monetary approach to the exchange rate with sticky prices.

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I. INTRODUCTION

Over the last few years, a remarkable intensification of international capital movements between the Federal Republic of Germany and other western industrial countries can be observed.

The Mark-value of portfolio investment flows between Germany and industrialized countries increased from 1981 to 1985 by almost 500 percent, and between Germany and the U.S. the growth rate for 1978 to 1985 amounts even to 2000 percent.¹⁾

While economic literature generally assumes international asset markets to adjust infinitely fast, the increased volume of capital flows suggests that recently there has also been a change of the adjustment processes in international capital markets. This may be due to financial deregulation by further reduction of capital controls, and to innovation of new technologies affecting transaction costs and information, but it may also be caused by changes in the behaviour of market participants in different countries.

Consequently, the exchange rates connecting international goods markets and international capital markets were switching differently in balancing both types of markets with different adjustment processes on the latter.

In modern asset market models, international goods and capital markets are linked together by an exchange rate adjusting instantaneously to asset market disturbances in the short-run, and adjusting to (price-) changes on the goods markets only in the long-run. However, especially in estimating asset models determining the exchange rate, the difference in the adjustment speed on both markets is generally assumed to be constant over time. For some periods this simplification may be

correct, on the other hand, it cannot be justified for estimations of the Mark/Dollar-rate over the last 10 years.

In this paper, we try to incorporate a time-varying index for different degrees of integration of international capital markets in a monetary approach to the exchange rate with sticky prices.

Section II lists three approaches to exchange rate determination following Frankel (1983): The monetary and Dornbusch's overshooting approach (Dornbusch 1976 a) are described, followed by a simple portfolio balance approach and a synthesis of all three.

Section III starts with a short description of the development of capital flows between the Federal Republic of Germany and the rest of the world.

Then, the overshooting model of section II is formulated differently including an index varying the adjustment speed of the exchange rate between its short-run and long-run level and the capital market adjustment, respectively. The result is a mixture of the basic overshooting and the synthesis approach of section II.

Section IV provides some estimations of the reduced form exchange rate equations shown in sections II and III for the Mark/Dollar-rate for the period from 74 (I) to 85 (II). It is highlighting the fact that, as long as OLS is an appropriate estimation technique for exchange rate equations at all, some requirements of OLS are fulfilled better by the models of section III than by the conventional models.

Section V closes with a summary .

II. APPROACHES TO EXCHANGE RATE DETERMINATION 2)

1) The Monetary Approach to the Exchange Rate

It is assumed that expectations are formed rationally and that the system is stable. Also, there is one good in the goods markets, perfect substitutability of bonds (including perfect capital mobility), e.g. one bond in the asset markets. Purchasing power parity is assumed to hold, this yields³⁾

$$(1a) \quad e = p - p^* \quad \text{respectively}$$

$$(1) \quad E(de) = E(dp) - E(dp^*)$$

Perfect capital mobility results in the domestic interest rate being tied to the foreign rate by covered interest arbitrage

$$(2a) \quad f_t = i - i^*$$

where f_t is the percentage forward discount of the domestic currency. With risk-neutral agents, the forward discount must equal the expected rate of depreciation

$$(2) \quad E(de) = i - i^*$$

Assuming (conventional) money demand functions

$$(3a) \quad m = p + \Phi y - \delta i$$

$$(3b) \quad m^* = p^* + \Phi^* y^* - \delta i^*$$

yields

$$(3) \quad (m - m^*) = (p - p^*) + (\Phi y - \Phi^* y^*) - \delta(i - i^*)$$

Substituting (2) into (3) results in

$$(4) \quad (p-p^*) = (m-m^*) - (\Phi y - \Phi^* y^*) + \delta E(de)$$

Substituting (1) and (1a) into (4) leads to

$$(5) \quad e = (m-m^*) - (\Phi y - \Phi^* y^*) + \delta (E(dp) - E(dp^*))$$

2) The Monetary Approach to the Exchange Rate with Sticky Prices (Overshooting Approach)

Assumptions are as in 1) (rational expectations, the system is stable, one good in the goods markets, perfect substitutability of bonds, e.g. one bond in the asset markets), yet prices are sticky e.g., the money (bond) markets adjust faster than the goods markets.

The long-run adjustment is determined by

$$(6) \quad \bar{e} = \bar{p} - \bar{p}^*$$

$$(7) \quad \bar{e} = (\bar{m} - \bar{m}^*) - (\bar{\Phi} y - \bar{\Phi}^* y^*) + \delta (\bar{E}(dp) - \bar{E}(dp^*))$$

Assuming that all explanatory variables follow random walks yields

$$(8) \quad \bar{e} = (m - m^*) - (\Phi y - \Phi^* y^*) + \delta (E(dp) - E(dp^*))$$

In the short-run, the gap between the actual overshooting and the equilibrium exchange rate is expected to be closed with the adjustment speed θ . In the long-run, the exchange rate is expected to adjust as in equation (1).

This yields

$$(9) \quad E(de) = -\theta (e - \bar{e}) + (E(dp) - E(dp^*))$$

Combining (9) with the uncovered interest parity equation (2)

$$E(de) = (i - i^*) \text{ results in}$$

$$(10) \quad (e - \bar{e}) = -1/\theta (i - i^*) + 1/\theta (E(dp) - E(dp^*))$$

Adding equation (8) gives

$$(11) \quad e = (m - m^*) - (\phi y - \phi^* y^*) + (\delta + 1/\theta) (E(dp) - E(dp^*)) \\ - 1/\theta (i - i^*)$$

3) The Portfolio Balance Approach to the Exchange Rate

Assumptions are again as in 1) (rational expectations, the system is stable, one good in the goods markets, perfect capital mobility), but there exists no perfect substitutability of assets due to exchange risk and other (constant) parameters. Bonds are equal to home-currency-denominated government indebtedness, there are identical portfolio preferences across countries.

The portfolios of home and foreign bonds are balanced following

$$(12a) \quad B/eF = \pi (i - i^* - E(de))$$

Assuming that $\pi(\cdot)$ is of the form $\pi = \exp(\alpha + \mu(i - i^* - E(de)))$ yields

$$(12) \quad b - e - f = \alpha + \mu(i - i^* - E(de))$$

Static exchange expectations $E(de) = 0$ result in

$$(13) \quad e = -\alpha - \mu(i-i^*) + (b-f)$$

4) A Synthesis of the Monetary and Portfolio Balance Equations

Adding and subtracting the interest differential in equation (9)

leads to

$$(14) \quad (e-\bar{e}) = -1/\theta (i-i^*) + 1/\theta (E(dp)-E(dp^*)) \\ + 1/\theta (i-i^* - E(de))$$

Adding equation (8) yields

$$(15) \quad e = (m-m^*) - (\phi y - \phi^* y^*) + (\delta+1/\theta) (E(dp)-E(dp^*)) \\ - 1/\theta (i-i^*) + 1/\theta (i-i^* - E(de))$$

Substituting equation (12a) into equation (15) determines the exchange rate as

$$(16) \quad e = (m-m^*) - (\phi y - \phi^* y^*) + (\delta+1/\theta) (E(dp)-E(dp^*)) \\ - 1/\theta (i-i^*) + 1/\theta \mu (b-e-f-\alpha)$$

And solving equation (16) for e results in

$$(17) \quad e = a_0 + a_1(m-m^*) - (a_2y - a_3y^*) + a_4(E(dp)-E(dp^*)) \\ - a_5(i-i^*) + a_6(b-f)$$

with

$$a_0 = \frac{\alpha}{\theta\mu + 1} \quad a_1 = \frac{\theta\mu}{\theta\mu + 1} \quad a_2 = \frac{\theta\mu\phi}{\theta\mu + 1} \quad a_3 = \frac{\theta\mu\phi^*}{\theta\mu + 1} \\ a_4 = \frac{\mu(\theta\delta+1)}{\theta\mu + 1} \quad a_5 = \frac{\mu}{\theta\mu + 1} \quad a_6 = \frac{1}{\theta\mu + 1}$$

III. THE CAPITAL MOBILITY PROBLEM

1) Exogenous Variations in the Integration of International Financial Markets

Portfolio investment flows between the Federal Republic of Germany and foreign countries have increased remarkably over the last four years. The Deutsche Bundesbank states that gross volumes of portfolio transactions have increased to about 5 times their 1981-value, and that this affects nearly all kinds of assets.⁴⁾ Moreover, the advance of securities and equities over alternative forms of financing has been an international phenomenon concerning all western industrialized countries. It is referred to deregulation of international capital markets, to new technologies, to new types of assets, but above all to a changing behaviour of private banks and non-banks. This includes, for example, that private banks have increased their dealing in equities and securities in order to improve their portfolio management and to avoid banking supervision of their capital resources which has been intensified recently due to the Euro-market development especially in Luxembourg.⁵⁾

The shift towards international portfolio transactions can also have been induced by the fact that private investors have intensified their portfolio diversifications, partly caused by the increase in wealth, partly by the better access to information, and, last not least, by their experiences with making "easy" money during the rise of the gold price in 1981 and - above all - during the hausse on international stock exchanges since 1982.

If, however, large shifts in investment and financing behaviour towards international portfolio investments have taken place, and if these shifts have been induced by variations of exogenous variables like

new technologies of financing or better access to information, then these shifts must have affected the adjustment processes of international capital markets: these markets, having reacted to interest rate changes quite fast in the past, are likely to be linked even closer to interest rate differentials since 1982.

All approaches to exchange rate determination presented in the previous section have in common that they assume asset markets to adjust infinitely fast. Yet, while the overshooting approach is based on a constant adjustment speed of the exchange rate to its long-run level, approaches including various types of assets may consider variations in the asset market adjustment processes by introduction of new forms of assets.

Moreover, recently there have been some studies and estimations concentrating on the instability of demand behaviour in these markets.⁶⁾ Also, in some theoretical articles, the adjustment speed of the exchange rate is varied endogenously in the framework of the overshooting approach.⁷⁾ In another study, different degrees of goods market and capital market integration are specified but kept constant in the equations determining the exchange rate.⁸⁾

In the following, we try to construct an exogenous time-varying index for different degrees of adjustment speed of the exchange rate and different degrees of capital market integration, respectively. As for the data underlying the index, we take gross investment flows on the German/international asset markets (e.g. portfolio investments) as provided by the long-term capital balance sheet published by the Deutsche Bundesbank. Gross flows are taken because for measuring capital market integration, the values of all flows and not only net flows are of interest.⁹⁾

Yet, this seems a rather poor proxy for various reasons: gross flows of portfolio investments are net values of the different types of those

investments. Then, since we are estimating the bilateral Mark/Dollar-rate, using these data might not be appropriate because they include transactions not influencing this exchange rate at all. On the other hand, there remain basically two alternatives : first, to take into regard many different types of assets which are connected to the Mark/Dollar-rate. This solution has been rejected because it would imply estimating a more or less complicated portfolio balance model including all the difficulties arising from the specification of the assets and their substitution elasticities, which might not be satisfactory over a 11-year period.

Second, to base the index on the bilateral portfolio data between Germany and the U.S. This has been rejected because it would mean not to account for all those transactions which have had any impact on the Mark/Dollar-rate but have not been carried out between citizens of the two countries.

Since in our opinion the latter are of considerable importance, we relied on the multilateral data for a first proxy.¹⁰⁾

2) The Overshooting Approach to the Exchange Rate with Time-Varying Adjustment Speed

In order to stay consistent with eq.(9), the portfolio data were transformed according to

$$\text{delp}_t = \frac{LP_t - LP_0}{LP_1 - LP_0}$$

with

LP_t = gross portfolio investments in period t

LP_0 = minimum gross portfolio investments over all periods

LP_1 = maximum gross portfolio investments over all periods

This (linear) transformation results in the index varying between 0 and +1 in the period to be examined.

Then we assume the (expected) adjustment speed between money markets and goods markets to follow a non-linear function of the exogenous variations of capital market integration as measured by the index.

Two functional forms were tested in order to fit the index to the expectation formation :

$$a) \quad \Gamma_t = (1 + \text{delp}_t)^n$$

$$b) \quad \Gamma_t = \exp (n \cdot \text{delp}_t)$$

These functional forms have Γ_t vary between +1 and $+\infty$, respectively $1/\Gamma_t$ between +1 and 0 when capital market integration is low or high. Substituting $1/\Gamma_t$ for θ in eq.(9) yields

$$(18) \quad E(\text{de}) = - 1/\Gamma_t (e - \bar{e}) + (E(\text{dp}) - E(\text{dp}^*))$$

This means that the exchange rate is expected to adjust to its long-run level very slowly when capital market integration is high and very fast when it is low. From a theoretical point of view, the adjustment speed of the exchange rate should be varied according to different degrees of goods market integration, yet, since it is the relative adjustment speed as determined by both types of markets that matters, the above specification can be justified.

Combining eq.(18) with the uncovered interest parity equation eq.(2)

$$E(\text{de}) = (i - i^*) \quad \text{results in}$$

$$(19) \quad (e - \bar{e}) = - \Gamma_t (i - i^*) + \Gamma_t (E(\text{dp}) - E(\text{dp}^*))$$

Adding equation (8) yields

$$(20) \quad e = (m - m^*) - (\phi y - \phi^* y^*) + \delta (E(\text{dp}) - E(\text{dp}^*)) \\ + \Gamma_t (E(\text{dp}) - E(\text{dp}^*)) - \Gamma_t (i - i^*)$$

3) The Overshooting Approach to the Exchange Rate with Time-Varying Capital Market Integration

In order to stay consistent with eq.(9), the portfolio data were transformed as above.

Then we assume the uncovered interest parity condition to hold only relational to the degrees of capital market integration as measured by the non-linear index function.

Again, two functional forms were tested in order to fit the index to the expectation formation :

$$a) \quad \Gamma_t = \text{delp}_t^n$$

$$b) \quad \Gamma_t = \exp(n \cdot (\text{delp}_t - 1))$$

These functional forms have Γ_t vary between 0 and +1 when capital market integration is low or high.

The transformation of eq.(2) results in

$$(21) \quad E(\text{de}) = \Gamma_t (i - i^*)$$

This means that the exchange rate is expected to adjust to the interest differential only gradually when capital market integration is low and completely when it is high.

$$\text{Combining eq.(9)} \quad E(\text{de}) = -\theta (\bar{e} - e) + (E(\text{dp}) - E(\text{dp}^*))$$

with eq.(21) yields

$$(22) \quad (\bar{e} - e) = -1/\theta \cdot \Gamma_t \cdot (i - i^*) + 1/\theta (E(\text{dp}) - E(\text{dp}^*))$$

Adding equation (8) yields

$$(23) \quad e = (m - m^*) - (\Phi y - \Phi^* y^*) + (\delta + 1/\theta) (E(\text{dp}) - E(\text{dp}^*)) - 1/\theta \cdot \Gamma_t \cdot (i - i^*)$$

IV. EMPIRICAL RESULTS: The Mark/Dollar-Rate from 1974 to 1985

The equations determining the exchange rate in the models of sections II and III were estimated for the Mark/Dollar-rate from 74(I) to 85(II) using OLS. The results are as follows :

Table 1: Estimations for the log of the DM/\$-rate

Eqs.	(5)	(11)	(17)	(20a)	(20b)	(23a)	(23b)
Const.	0.43 (1.08)	-0.86 (-0.91)	2.81 (2.12) ^s	1.33 (2.85) ^s	1.21 (2.75) ^s	0.99 (2.48) ^s	1.18 (2.89) ^s
dcp	0.023 (5.03) ^s	0.026 (5.18) ^s	0.016 (3.27) ^s	0.024 (4.67) ^s	0.024 (5.68) ^s	0.024 (5.92) ^s	0.024 (6.10) ^s
di		-0.012 (-1.49)	-0.015 (-1.95)				
dm	-1.16 (-8.23) ^s	-1.11 (-7.93) ^s	-0.57 (-2.93) ^s	-0.98 (-6.92) ^s	-0.99 (-7.07) ^s	-1.03 (-7.83) ^s	-0.99 (-7.55) ^s
gnpg	-1.71 (-4.86) ^s	-1.29 (-2.89) ^s	-1.64 (-4.06) ^s	-1.42 (-4.40) ^s	-1.42 (-4.32) ^s	-1.47 (-4.50) ^s	-1.42 (-4.42) ^s
gnpus	1.32 (4.31) ^s	1.39 (4.55) ^s	0.57 (1.62)	0.84 (2.71) ^s	0.87 (2.82) ^s	0.97 (3.28) ^s	0.88 (2.97) ^s
bond			-0.0005 (-3.57) ^s				
dcp· Γ_t				-0.00023 (-0.20)	0.00009 (0.19)		
di· Γ_t				0.00030 (0.61)	0.00014 (0.74)	7.23 (3.19) ^s	2.38 (3.54) ^s
n				10	10	10	10
\bar{R}^2	0.877	0.880	0.908	0.903	0.901	0.899	0.904
D-W	1.213	1.140	1.199	1.655 ^s	1.646 ^s	1.669 ^s	1.666 ^s

dcp	$:= E(dp) - E(dp^*)$	with $E(dp), E(dp^*)$	Change of the log of the price index over the same period of the previous year
di	$:= i^* - i$	with i, i^*	Long-term yield on government bonds
dm	$:= m - m^*$	with m, m^*	Log of M_1
$gnpg, gnpus$	$:= y, y^*$	with y, y^*	Log of real GNP (1975 prices = 100)
$bond$	$:= b - f$	with b, f	Log of government debt
Γ_t	$:=$		Index for Capital market integration

The GNP and all portfolio data are end-of-quarter values, all other data are quarterly averages from 74(I) to 85(II). Sources for the capital market data are the Statistische Beihefte der Deutschen Bundesbank, Reihe 3, all other data are from the IMF-International Financial Statistics, T-statistics in paranthesis, coefficients marked ^s are significant on the 1%-level.

As data for the expected inflation rates we took the change of the log of the price index over the corresponding period of the previous year. This seemed quite reasonable because those data are usually published as "inflation rates" and should be more related to inflation expectations than, for example, money growth data, which would have to be adjusted for GNP growth. For the interest rates, we relied on long-term yields on government bonds, first to provide comparibility with the government debt variables, but also because in examining international portfolio investments, these interest rates should be representative at least in their relative movements for interest rates in general.

All estimations shown in Table 1 have some aspects in common: nearly all coefficients are rather stable over all equations, and those for the inflation differential, the German GNP, the U.S. GNP and the relative money supply are always significant, yet, the latter of the incorrect sign. This can be related to extensive German central bank interventions against the depreciation of the Dollar in 1977 and 1978. Those interventions could not or should not be sterilized and thus made the German money supply grow relative to U.S. money supply during an appreciation of the Mark after all. This means of course that there exist repercussions from the exchange rate on the money supply imbedded in central banks' target functions. Moreover, from 1980 to 1985, U.S. money supply was increasing relative to German money supply, yet, U.S. budget deficits combined with U.S. credit worthiness had the Dollar appreciate.¹¹⁾ Altogether, there are good reasons for the negative sign of the relative money supply contrasting with the assumptions of the model.

As can further be seen in Table 1, the results of the estimations of eqs.(5), (11) and (17) are quite bad for statistical matters: coefficients of the interest rate differentials are not significant, moreover, the Durbin-Watson statistics suggest strong first-order autocorrelations. Estimations of eq.(20) yield improved results as for the D-W-statistics, yet, both coefficients related to the capital market integration are not significant. Estimations of eq.(23) provide better results: the coefficients of the modified interest rate differentials become significant and of the correct sign, and first-order autocorrelation is reduced to insignificance. This is due to the fact that the capital market index pushes the weight of the interest differential up compared to the remaining variables and especially the inflation differential for the time since mid-1984.¹²⁾

Further test on OLS-performance were applied to eqs.(5) to (23):

Table 2: Tests

Eqs.	(5)	(11)	(17)	(20a)	(20b)	(23a)	(23b)
F-Test F	80.98 (0.000)	67.20 (0.000)	74.61 (0.000)	70.50 (0.000)	69.61 (0.000)	81.42 (0.000)	85.59 (0.000)
G.- Q. F c=10	1.51 (0.235)	2.18 (0.096)	1.82 (0.167)	2.03 (0.128)	2.05 (0.125)	1.47 (0.259)	1.99 (0.124)
χ^2 -Test Q v=8	21.93 (0.005)	29.67 (0.0002)	28.75 (0.0004)	14.51 (0.069)	14.75 (0.064)	14.91 (0.061)	14.42 (0.071)

The first row in Table 2 shows results of F-Tests on overall significance. All equations have very high significance levels, which, by comparing F-values and t-values given in Table 1, leads to the assumption that with eqs.(23a) and (23b) there remain problems with multicollinearity much more distinctive than with the other equations.

The second row in Table 2 gives results of a Goldfeld-Quandt-Test on heteroscedasticity over time, splitting the samples and taking 10 observations out of the middle. The hypothesis that there is heteroscedasticity can be rejected on the significance levels shown in paranthesis below, which also demonstrates that eq.(23a) performs better than the rest.

The third row provides χ^2 -Tests on autocorrelation of the residuals up to order 12. The Q-values and the correlograms in the Appendix suggest that in eq.(5) is strong first-order autocorrelation, while in eqs.(11) and (17), autocorrelation of order 1, 6, 7 and possibly 8 must be assumed. However, in eqs.(20a), (20b), (23a) and (23b), the hypothesis of auto-

correlation up to order 4 ($= 12 - v$) clearly can be rejected on the significance levels shown in paranthesis below. The possibility of autocorrelation of order 6 is still reflected by the correlograms of these equations, where the dashed lines represent the 2σ -levels of the hypothesis that there is no autocorrelation at all.¹³⁾ As for eq.(23a), all autocorrelations lie within the 2σ -bounds, so that the H_0 -hypothesis can be rejected.

Comparing the performances of eqs.(5) to (23b) over all tests leads to the assumption that eqs.(11) on the one side, and (23a) and (23b) on the other, perform approximately equal but for the significance of the interest rate differential and the autocorrelation behaviour of residuals:

While estimations of eqs.(5), (11) and (17) for the period from 74(I) to 81(IV) showed no autocorrelation at all, the systematic influence of the capital market developments not seized on by those equations caused above all strong first-order autocorrelation since the beginning of 1982. The capital market integration index reflects these changes especially when applied to eq.(23) and makes the interest parity condition hold for the last few quarters and hold only partially for the quarters before. This of course results in the coefficients of the modified interest differential not being interpretable and the equation not being prognosticable anymore, but in a further study, it shall be tried to sophisticate this approach by using estimation techniques with variable coefficients.

Accordingly, any estimations taking variations of the capital market adjustment processes into regard as was done in eq.(23) and as may be done with portfolio balance approaches formulated in greater detail than in eq.(17), must come out with better results than the original reduced

form monetary equations determining the exchange rate.

Some remarks on the most recent depreciation of the Dollar since the third quarter 1985 should be added. This depreciation is partly due to a decline of the interest rate differential (di) from 4.4 percent in January to 3.2 percent in December 1985, still in favour of the U.S.

Although Germany was also able to increase her advantage of price stability (dcp) from -1.3 percent to -2.0 percent over the same period, the role of the interest differential in determining the Mark/Dollar exchange rate can have changed again, since capital market integration or international capital flows, respectively, still remained on a high level.

It must be assumed that the synchronized announcements of the intent to "bring the Dollar down" by authorities of several industrialized countries were of considerable impact on expectation formation concerning the Dollar exchange rates and the future development of interest rates.

It might also be assumed that the demand for internationally dealt moneys like the Mark and the Dollar cannot be sufficiently explained by national money demands in the two countries. Thus, during strong fluctuations in the goods and capital balance sheets of international investors like OPEC, it should be appropriate to account for those instabilities in money demand by abandoning the two-country-approach.

This has already been indicated by the choice of the index data, and it will also be extended in a forthcoming paper.

V. SUMMARY AND CONCLUSIONS

As could be shown by the estimations, the traditional monetary approaches to the exchange rate provide rather insufficient statistical results if applied to periods exceeding 1982.¹⁴⁾ This is caused by changing capital market adjustment processes induced, for example, by shifts in international investment behaviour. Those shifts can be modelled via expectation formation with respect to the exchange rate in the framework of the monetary or overshooting approach, yet, the more sophisticated approach would be to seize on those shifts in an elaborately specified portfolio balance model.

However, the advantage of the approach presented here can be expressed by the fact that it can be placed between the overshooting approach and portfolio balance approaches. If further research should allow for improvement of the index construction or for estimation techniques with variable coefficients, it could combine the simplicity of the monetary (overshooting) approach with the portfolio balance approach's consideration of varying capital market adjustment processes.

NOTES

- 1) See Table 3 in the Appendix
- 2) See Frankel, J.(1983), Monetary and Portfolio-Balance Models of Exchange Rate Determination, in: Bhandari,J., Putnam,B., (eds.), Economic Interdependence and Flexible Exchange Rates, pp.84-115.
- 3) In the following, all variables but the interest rates will be expressed by their logs.
- 4) See Table 3 in the Appendix
- 5) Deutsche Bundesbank (1985), Neuere Entwicklungen im Wertpapierverkehr mit dem Ausland, Monatsbericht 11/85, pp.32-33.
- 6) See MacDonald, R.(1985), Buffer Stocks, Exchange Rates and Deviations from Purchasing Power Parity, Empirical Economics 10, 3/85, pp.163-176.
Woo, W.T.(1985), The Monetary Approach to Exchange Rate Determination under Rational Expectations, Journal of International Economics 18, pp.1-15.
- 7) See De Grauwe,P.(1983), Exchange Rate Oscillations and Catastrophe Theory, in: Claassen,E., Salin,P., (eds.), Recent Issues in the Theory of Flexible Exchange Rates, pp.181-193.

- 8) See King, D., Putnam, B., Wilford, S. (1978), A Currency Portfolio Approach to Exchange Rate Determination, in: Putnam, B., Wilford, S., (eds.), A Monetary Approach to International Adjustment, p. 204.
- 9) See Obstfeld, M. (1985) Capital Mobility in the World Economy: Theory and Measurement, NBER-Working Paper #1692, 8/85, p.20.
- 10) This might also be rectified by the ceteris-paribus assumption under the condition that all kinds of flows behaved approximately the same way.
- 11) See Figure 3 in the Appendix.
- 12) See Figures 1 and 2 in the Appendix.
- 13) See Box, G., Jenkins, G. (1976), Time Series Analysis, pp. 289-294.
- 14) See also the results presented by Frankel (1983) on the monetary approach, the overshooting approach and several portfolio balance approaches for the periods from 74,1 to 78,10 and 74,1 to 80,12, respectively, and various others.

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VI. APPENDIXSYMBOLS

e	Log of the exchange rate (DM/\$-rate)
p, p^*	Log of the price index (Consumer prices)
f_t	Percentage forward discount on domestic currency
$E(de)$	Expectation of exchange rate movements
$E(dp), E(dp^*)$	Expectation of price movements (changes of the log of the price indices over the same period in the previous year)
i, i^*	Interest rates (Long-term yield on gov. bonds)
m, m^*	Log of the money supply (M_1)
y, y^*	Log of real GNP
ϕ, ϕ^*	Elasticity of money demand with respect to income
δ	Semi-elasticity of money demand with respect to interest rates
θ	Adjustment speed of the exchange rate to its long-run level
b, f	Log of domestically denominated government bond supplies (government debt)
π	Portfolio adjustment function
α	Risk parameter excluding exchange risk
μ	Exchange risk parameter
LP_t	Gross flows on the German/international asset markets (portfolio investment flows from Germany to foreigners plus from foreigners to Germany per period)
LP_0	Minimum gross portfolio investments over all periods
LP_1	Maximum gross portfolio investments over all periods
Γ_t	Time-varying index for capital market integration as a function of LP

Table 3: Portfolio investment flows between Germany and major country groups, upper rows(-): German capital exports, lower rows(+): German capital imports, millions of DM (Source: Deutsche Bundesbank, Stat. Beihefte, Reihe 3, various issues)

Years	1975	1978	1981	1982	1983	1984	1985
Industrialized Countries			-5503 +8410	-8205 +6761	-9551 +22399	-15393 +19272	-28007 +38864
USA	-617 +200	-398 +19	-2253 +893	-4756 -3480	-2195 -1376	-4383 +557	-6910 +1361
EC-Countries	-350 -1066	-832 +847	-686 +7495	-864 +6371	-3819 +15339	-3844 +9424	-7737 +19372
Great Britain	+77 -346	+94 +313	+7 +2810	+3 +1568	-142 +3529	-149 +5738	-689 +15225
OPEC-Countries	-152 +2054	-595 -121	-432 +15713	-413 +3603	+114 -410	+106 -236	+37 +300
Less Developed Countries	-1303 +301	-2670 +1557	-2851 +1356	-4730 +1642	-3138 +2763	-3226 +1637	-1496 +2536

Figure 1: Expected inflation differentials, interest differentials and the log of the DM/\$-rate

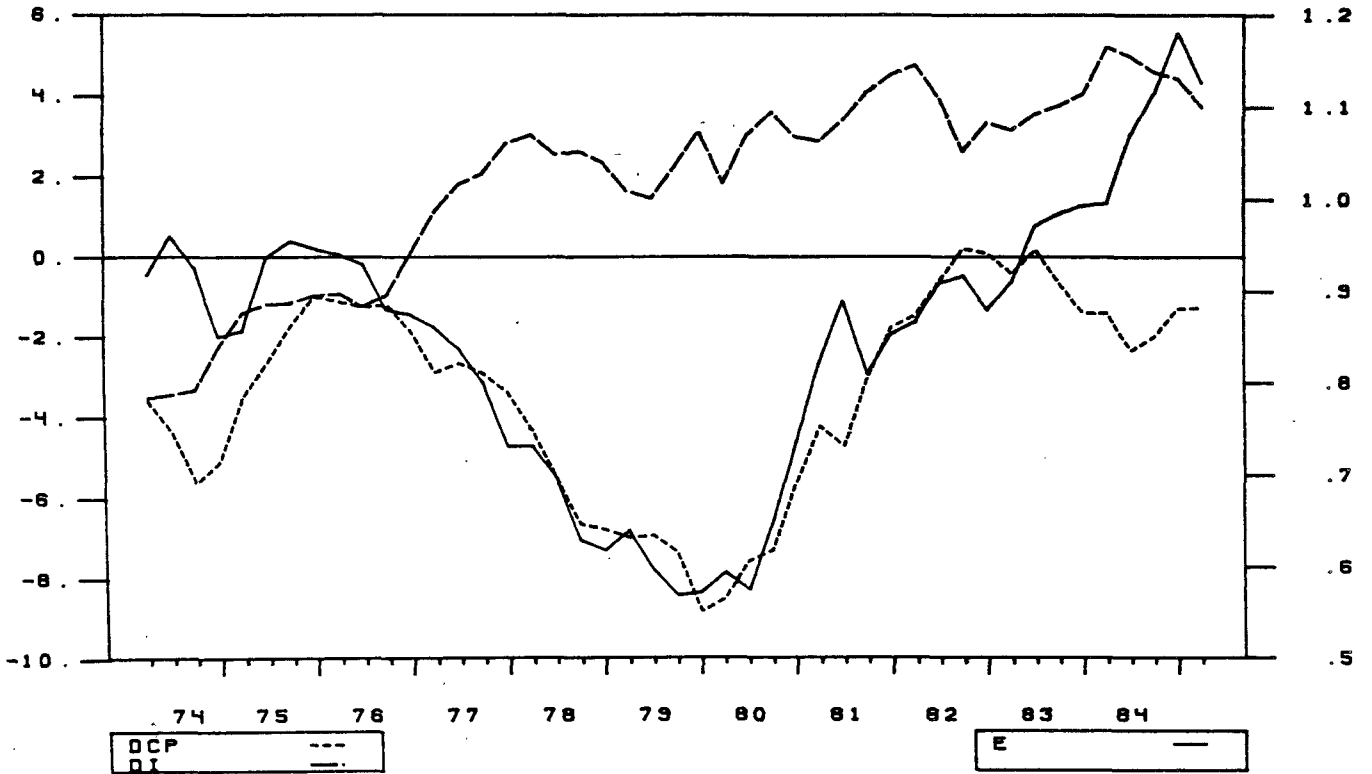


Figure 2: Gross flows on the German/international asset markets (portfolio investment flows from Germany to foreigners plus from foreigners to Germany per period, billions of DM)

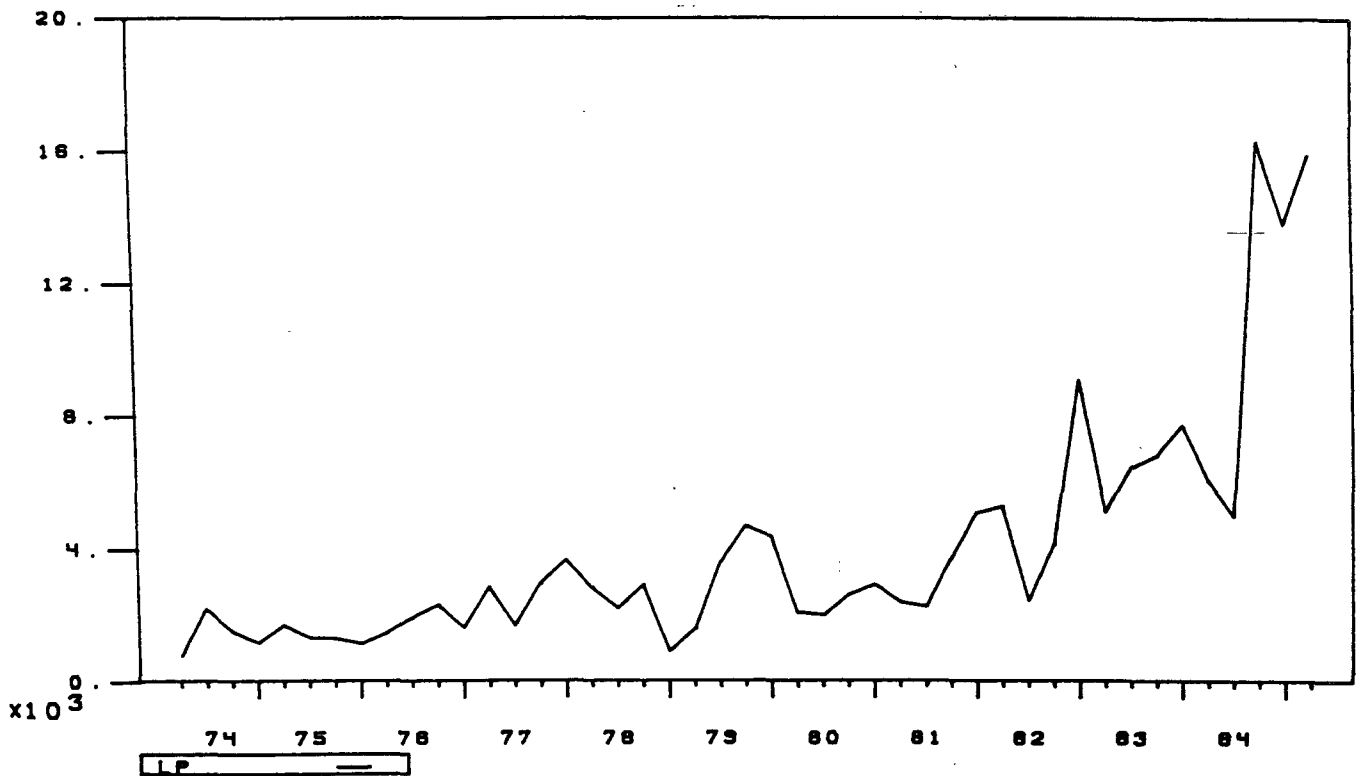


Figure 3: Log of relative money supply (billions of DM and billions of \$)

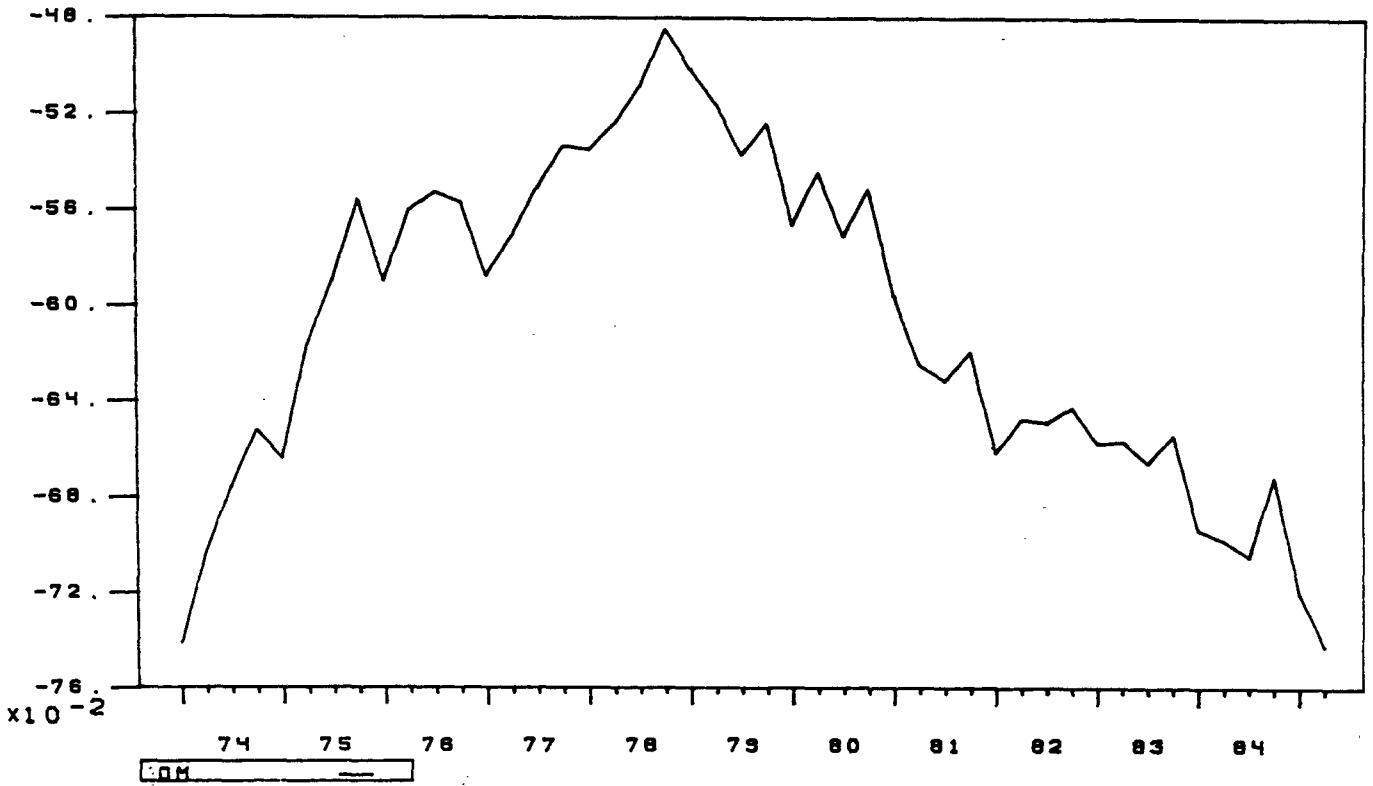


Figure 4: Log of German real GNP and log of U.S. real GNP (billions of DM and billions of \$, prices of 1975 = 100)

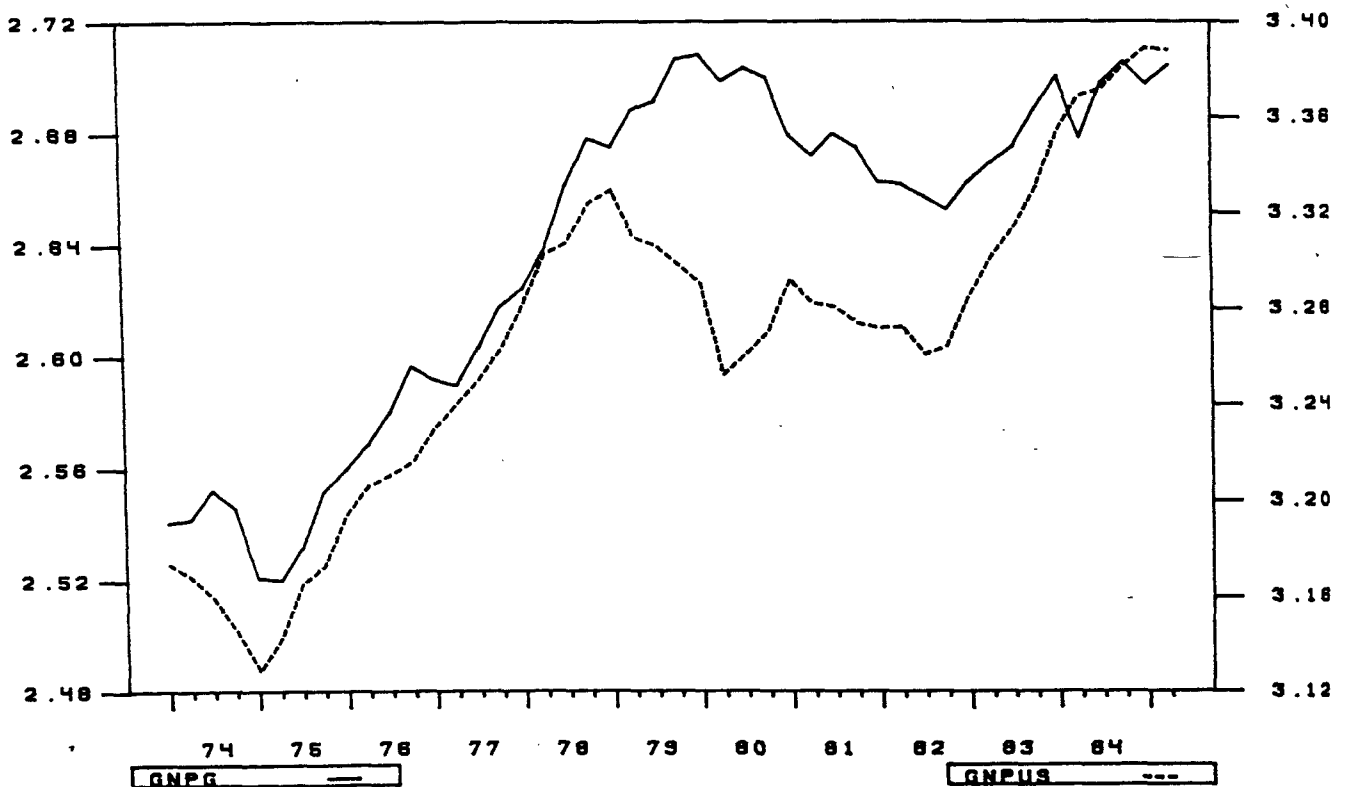


Figure 5: Correlogram of residuals of Equation (5)

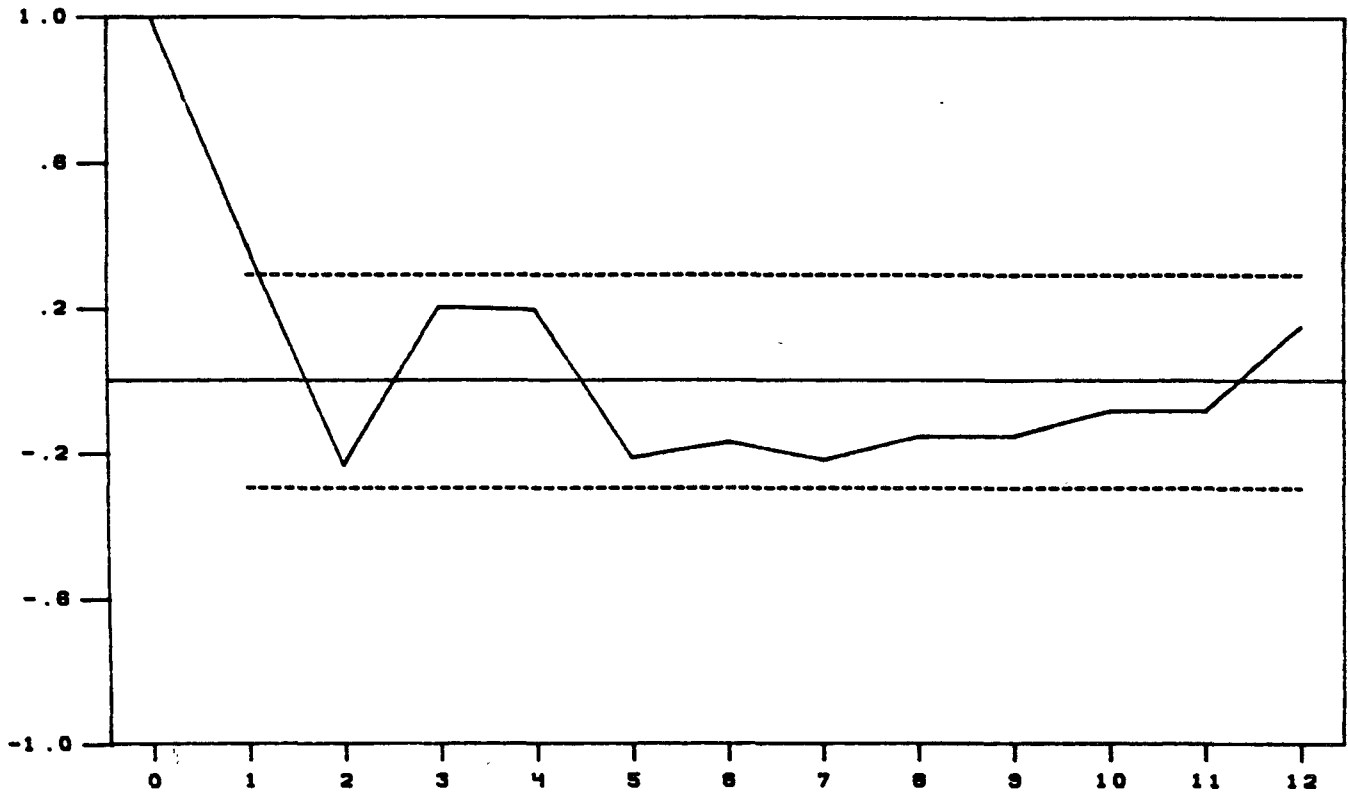


Figure 6: Correlogram of residuals of Equation (11)

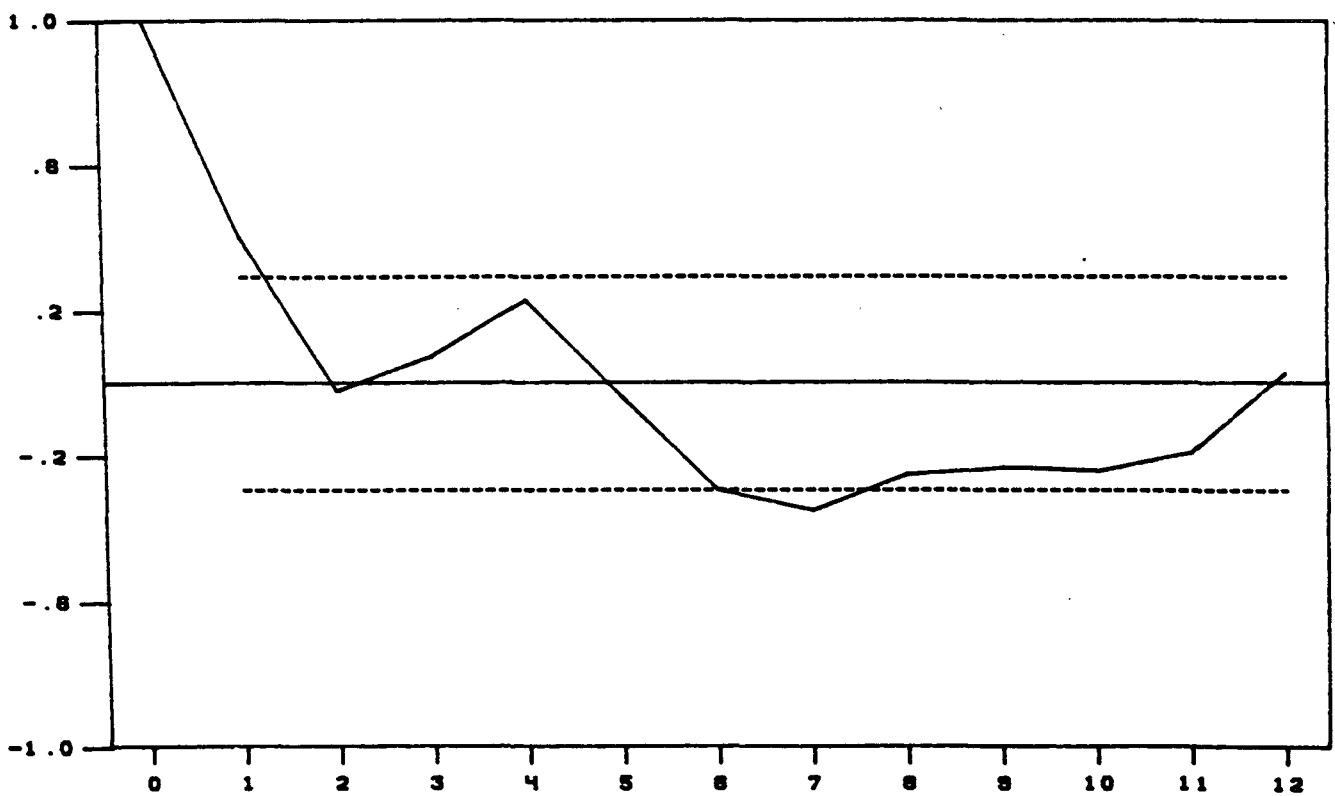


Figure 7: Correlogram of residuals of Equation (17)

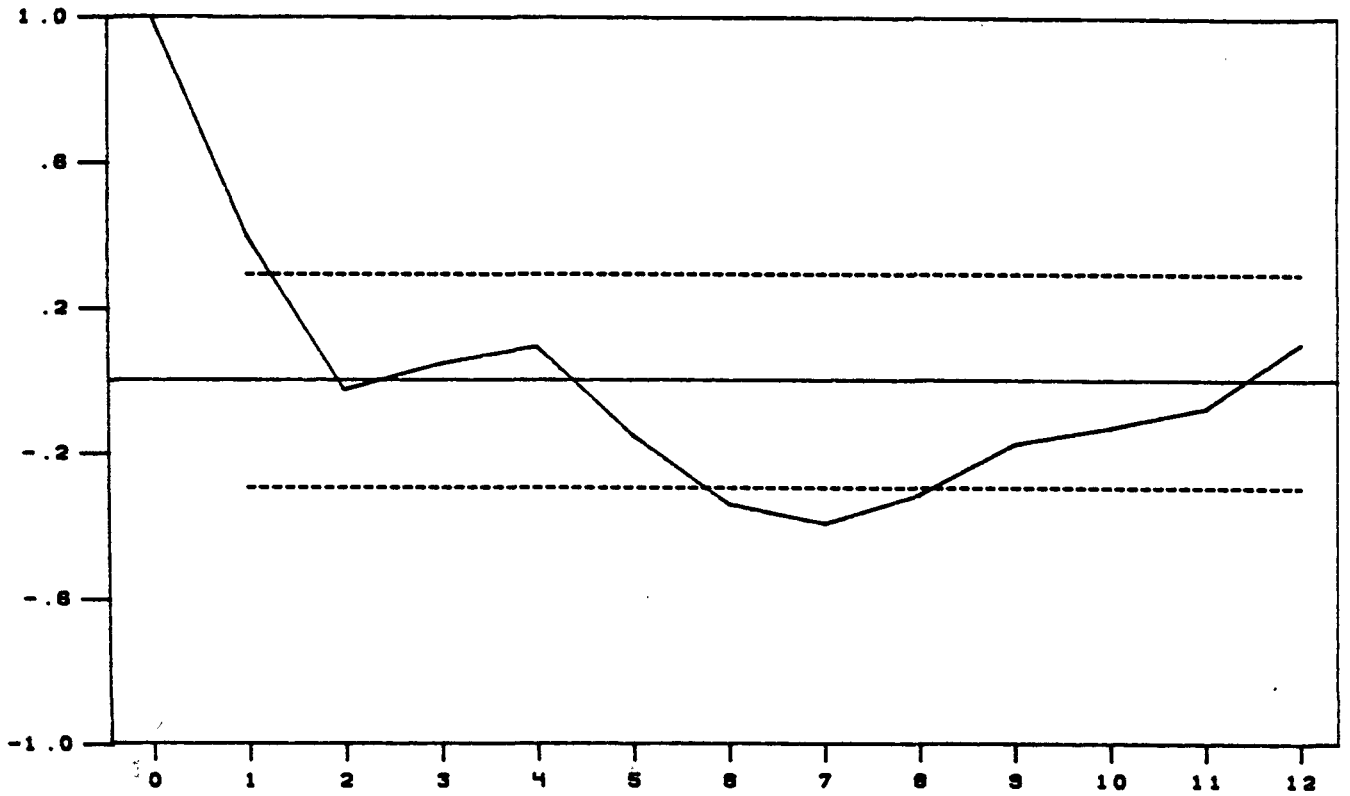


Figure 8: Correlogram of residuals of Equation (20a)

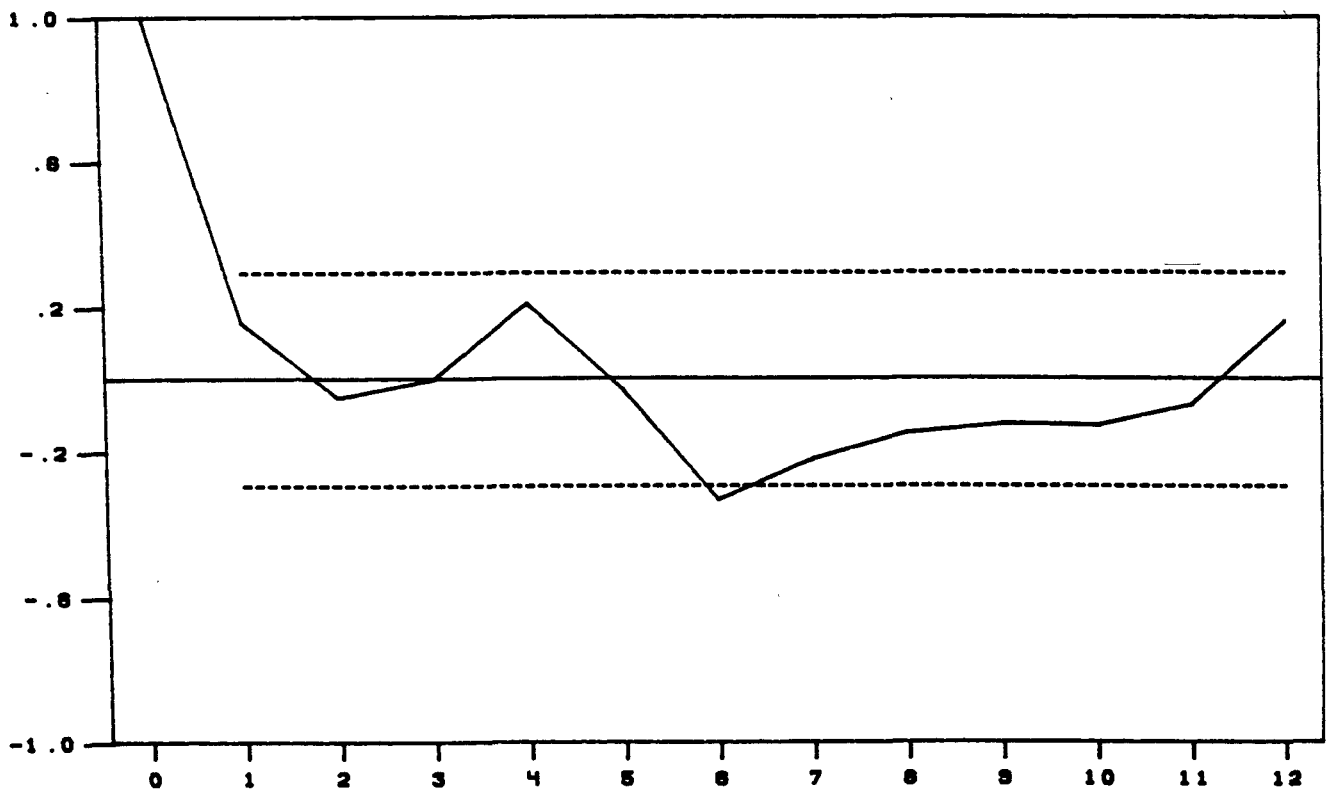


Figure 9: Correlogram of residuals of Equation (20b)

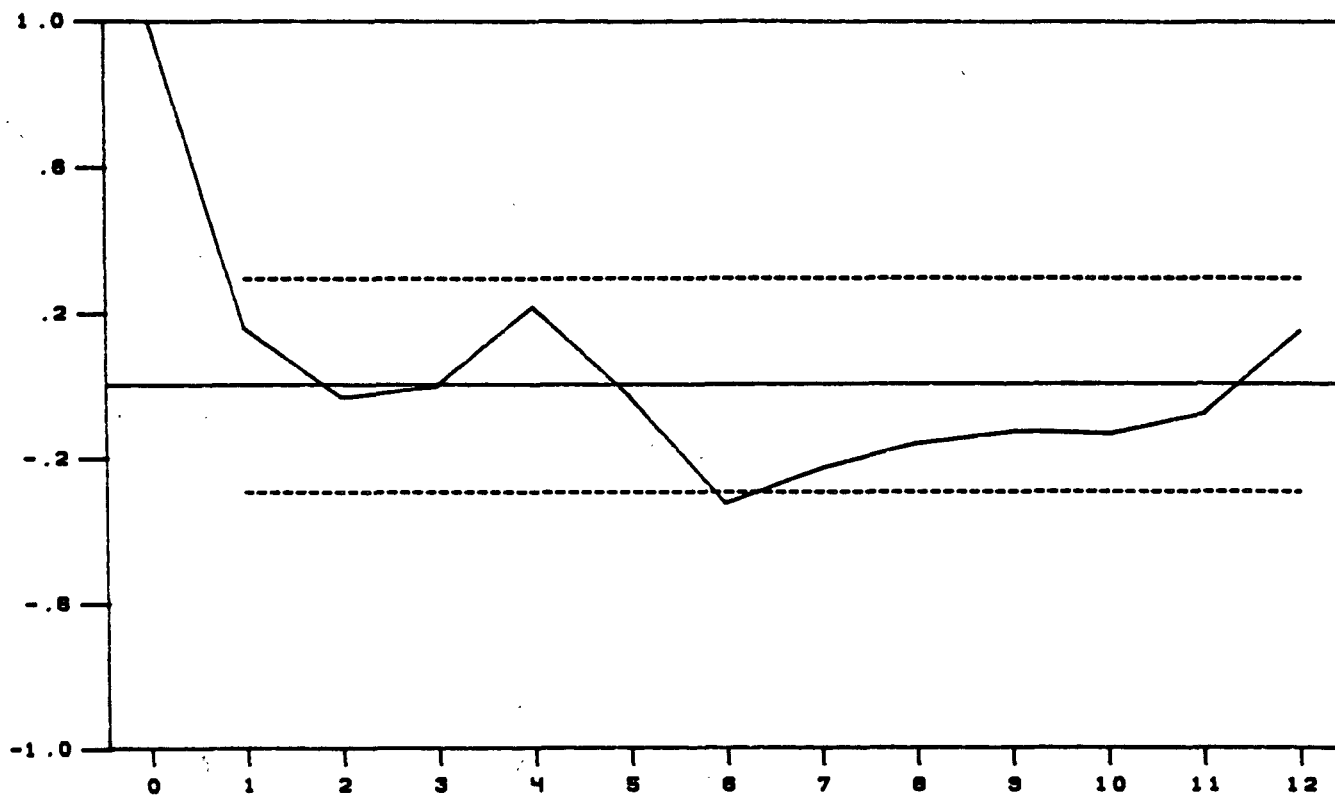


Figure 10: Correlogram of residuals of Equation (23a)

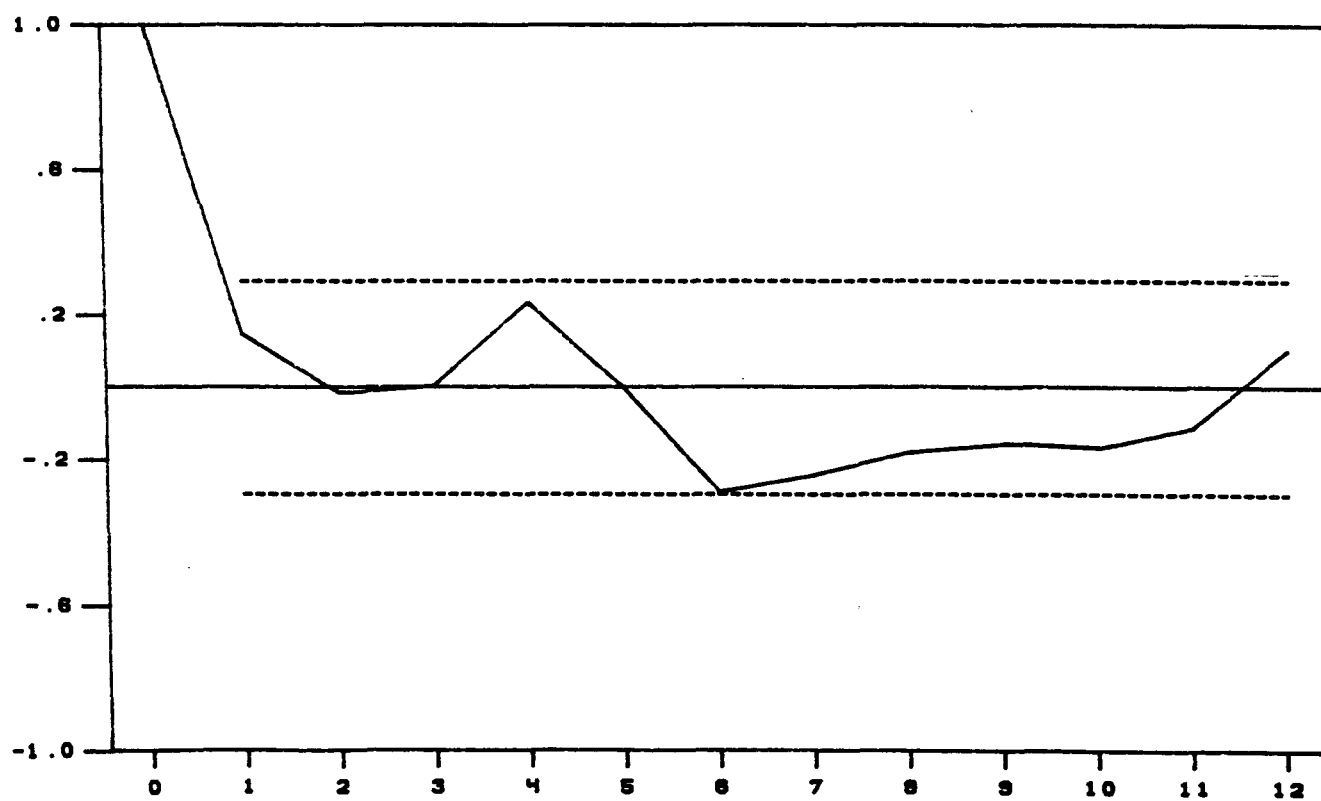


Figure 11: Correlogram of residuals of Equation (23b)

