Information content and wealth effects of asset prices – the Austrian case

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In the framework of Austria's monetary and exchange rate policy, asset prices traditionally did not play a prominent role. Over long periods, asset formation, to a very large extent, took place only in the form of savings deposits via the banking system. Capital markets did not develop sufficiently to be a factor of great concern or an interesting source of information. Consequently, also wealth effects in the transmission process of monetary policy could be largely disregarded. Recent years, however, brought increasing discussion and research on this topic at the international level. Thus, in this paper we try to approach two questions which seem to be of major importance in this context, namely the information content of financial asset prices and the weight of wealth effects in the transmission process.

1. The information content of the term structure

1.1 Introduction

In recent years empirical research has increasingly focused on the interdependence of asset returns, inflation and real activity. In this respect, yield curve spreads and stock prices in particular are thought to contain valuable information and, therefore, are usually taken into account in economic forecasting.

In principle, policymakers can make use of these financial indicators in implementing monetary policy. Yield curve spreads can be used as a benchmark for macroeconomic forecasts, for example. On the one hand, if the indicators coincide with the model forecasts, confidence in the model results is enhanced. On the other hand, in the case of inconsistencies between financial indicators and model results, a review of the assumptions or the structure of the model may be necessary. Additional advantages are that yield curve data are available in real time and are not subject to revision.

For the United States, strong evidence exists that the steepness of the yield curve is a good predictor for real activity[1] (Estrella and Hardouvelis (1991), and Estrella and Mishkin (1996)). In other industrial countries, in particular the EU economies, the evidence is mixed. Good forecasting properties of the slope of the yield curve have been identified for Canada and Germany (Plosser and Rouwenhorst (1994), Estrella and Mishkin (1995), and Bernard and Gerlach (1996)) and to a lesser extent for the United Kingdom (Estrella and Mishkin (1995), and Bernard and Gerlach (1996)), Italy (Estrella and Mishkin (1995)) and France (Davis and Fagan (1995), and Bernard and Gerlach (1996)).[2]

Moreover, Estrella and Mishkin (1996) concluded that the information content of yield

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1 In the United States the best predictability was found for 6 and 8 quarters ahead (Estrella and Mishkin (1996)).

2 Estrella and Mishkin (1995) did not find any information content of the slope of the yield curve for predicting recessions in France.

curve spreads is far greater than that of stock prices. However, predictions for real output in the United States were found to become more accurate, if the stock price index was included as a regressor. Thus, stock prices seem to contain information which is not reflected in the yield curve spread and are, therefore, thought to be useful in forecasting recessions and/or recoveries.

Empirical work has also concentrated on analysing the predictive power of yield curve spreads in forecasting future inflation changes. The results indicate that yield curve spreads contain information about future inflation in the United States,[3] although the predictive power is found to be weaker than for real activity (Fama (1990), Jorion and Mishkin (1991), and Estrella and Mishkin (1995)). For the EU countries, empirical results vary but are generally less significant than for the United States (Mishkin (1991)). Davis and Fagan (1995), for example, showed that out of the four largest EU countries, spread variables performed best in the United Kingdom and weakest in France. Empirical analysis of Jorion and Mishkin (1991) points to a limited information content of spreads in Germany. However, Gerlach (1995), using a longer sample period and different spreads, found that German spreads do contain considerable information about future changes in inflation.

Researchers originally used simple or multiple regressions to analyse the information content of the term structure for economic activity and inflation (Estrella and Hardouvelis (1991), Plosser and Rouwenhorst (1994), and Fama (1990)). More recently Vector Autoregressive (VAR) models have been employed to shed light on the forecasting abilities of the term structure for inflation and real activity (i.e. Davis and Fagan (1995), and Canova and De Nicolo (1997)). In principle a VAR – if appropriately specified – approximates the data generating process of a vector of variables and allows to take into account the interdependences between the variables.

1.2 Importance of financial indicators in the Austrian monetary policy framework

In Austria, financial asset prices traditionally have not played a prominent role as monetary indicators. This partly reflects the fact that Austrian capital markets – against the background of the high degree of monetary wealth formation via the universal banking system[4] – have not developed sufficiently in order for asset prices to carry a high information content. Thus, in the implementation of monetary policy, which for more than 17 years has been oriented towards holding the schilling stable vis-à-vis the Deutsche mark, financial indicators, such as yield spreads, have not been given great importance.

In addition, the lack of data – especially the absence of long time series – makes quantitative analysis difficult, which is a major reason for the absence of empirical research of these issues.

However, in spite of these problems we will attempt to analyse whether financial asset prices can provide information and be used as indicators in monetary policy decision making in Austria. In this context, we will concentrate on the information content of yield curve spreads in forecasting economic activity and future inflation.

1.3 Data and methodology

Initially, a regression technique was applied (see Appendix 2) to predict future economic activity, according to the specifications of Estrella and Hardouvelis (1991) and Plosser and

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3 In the United States the forecasting power seems to be best for more than 6 months ahead (Mishkin (1990)).

4 The financial structure plays an important role in this context. The Austrian financial system is dominated by universal banks, which provide the major part of external financing for enterprises. Small and medium-sized companies, which dominate the enterprise sector, use credit financing as their principal source of external finance. At the same time, a substantial amount of monetary wealth is held with banks (i.e. in savings accounts).

Rouwenhorst (1994). By using the cumulative growth rate as the dependent variable, long-term economic relationships can be analysed. Thereby, the cumulative industrial growth rate was regressed on the term spread (SM-VIB)[5] on the one hand and on the term spread and a short-term interest rate (VIB)[6] on the other. A Newey-West procedure was used to correct the standard errors.[7] The analysis was based on monthly data between 1983:1 and 1995:12. When the term spread was used as the only regressor, coefficients were significant for all time horizons, with the exception of the 6-month span. When the short-term interest rate is added, results were significant for 18, 24 and 36-month horizons. However, further analysis shows that the Newey-West correction procedure is not sufficient so that the results appear to depend considerably on the method chosen. The inclusion of an AR(3) model for the error terms in the equation reveals almost no significant results (apart from the 12 and 18-month horizons for the regression suggested by Plosser and Rouwenhorst). Regressing changes in inflation on the term spread (see Fama (1990)) produces similar results. When an AR(1) model was included in the equation all coefficients became insignificant.[8]

The following analysis is based on a Vector Error Correction Model (VEC). This methodology facilitates an analysis of the interdependences between the included variables and – above and beyond pure VAR models – to take into account possible relationships among the levels of the variables.

The model comprises the following two variables:

- Real activity, which is measured by the industrial production index (IP)
- Inflation, which is measured by changes in the consumer price index (INF).

The financial variables used in the analysis are the slope of the Austrian yield curve as defined above; the slope of the German yield curve as measured by the difference between the yield on long-term domestic government bonds in the secondary market and a short-term money market interest rate (BMB-B3M); and the foreign yield spreads as measured by the difference between the yields on domestic and foreign 10-year government bonds. (Besides the Austrian/German yield differential (SM-BMB) the German/US yield differential (BMB-BMU) is included.)

In selecting the variables, the following considerations were emphasised. The choice of the yield spreads was based on their presumed macroeconomic relevance. The German yield spread and the Austrian/German yield differential were chosen because of the strong economic links between the Austrian and German economies (reflected also in the exchange rate target of the OeNB). The yield differential to the US is assumed to cover any potential relationship with the German (and therefore indirectly with the Austrian) rate. As far as the domestic yield curve is concerned, the lack of data confined the analysis to the spread between the 10-year government bond yield and a 3-month money market rate. Thus it was not possible to analyse the usefulness of different spreads for predicting inflation and economic activity. Gerlach (1995), for example, found that in Germany the medium-term range of the yield curve and, in particular, spreads vis-à-vis 2-year rates are most indicative of future inflation.

The details of the data sources and time series employed are given in Appendix 1. The sample covers monthly data from 1983:1 to 1995:12. The analysis is based on monthly – instead of

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5 The slope of the Austrian yield curve as measured by the difference between the yield on long-term domestic government bonds in the secondary market and a short-term money market rate.

6 Interest rate on 3-month interbank loans.

7 Estrella and Hardouvelis and Plosser and Rouwenhorst applied the Newey-West procedure to correct the standard errors, since the dependent variable is a long-horizon growth rate and, therefore, the error terms in the regressions exibit substantial serial correlation.

8 When a Newey-West correction is used, all results are significant (apart from the 36-month horizon).

quarterly[9] – data, so as to maximise the number of observations. A sufficiently large sample seems, above all, important to insure reliable results, although there may be the potential problem of noise in the data.

In the VEC all changes of variables are regressed on changes of the variable itself and on lagged changes of all other variables contained in the system. In addition, the VEC includes a cointegration term that conveys information about the levels of all variables in a special restricted form.

Unit root tests were conducted and unit roots were found in all the variables. Thus, the precondition of a VEC model is fulfilled with all time series being integrated of order 1. In calculating the VEC no deterministic trend in the data was assumed. According to the Akaike and Schwartz criteria, two lags were found to be the optimal lag structure.

A Johansen Test (see Appendix 4), which can be interpreted as a multivariate unit root test, was performed to check for the existence of stationary linear combinations of variables. The test found one cointegrating relation at a 5% significance level.

1.4 Empirical results

The results of the VEC analysis (see Appendix 3) indicate that, apart from the dependence of inflation on industrial output, all other variables are autonomously driven. Thus, the analysis does not point to any predictive power of the considered domestic or foreign yield spreads for output or inflation. The changes in inflation significantly depend on the levels of all other variables, as they are closely tied by the error correction term.

This finding contrasts with the empirical results generally found for the United States, Canada and for – though on a minor scale – some of the larger EU economies, in particular Germany (Davis and Fagan (1995), Bernard and Gerlach (1996), and Canova and De Nicolo (1997)). In several smaller economies (more comparable to Austria) predictive power was attributed to yield curve spreads, but no in-depth research has been conducted for such countries.[10]

The inclusion of stock prices does not change these results. Output and inflation are not significantly affected by the stock market. This confirms the finding of Canova and De Nicolo (1997) for some larger European economies (Germany and the United Kingdom). In the United States, by contrast, stock prices were found to add information not contained in yield curve spreads (Estrella and Mishkin (1996)).

1.5 Conclusions

The limited relevance of yield curve spreads for predicting real activity and inflation in Austria – in particular compared to the larger economies such as the United States, Canada or Germany – may be traced to the following factors.

First of all, the lack of data, which precludes a more comprehensive and in-depth analysis of the issues discussed (such as analysing different yield spreads or longer lag structures).

Second, partly as a result of the small size of the market, interest rates did not respond strongly to market forces before the late 1980s, when liberalisation and deregulation of Austrian financial markets started to accelerate. The size of the bond market was limited, and the market was

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9 However, analysis with quaterly data did not substantially change the results.

10 Yield curve spreads were found to be significant for predicting real activity in Belgium and the Netherlands (Davis and Fagan (1995), and Bernard and Gerlach (1996)) and for forecasting inflation in Belgium (Davis and Fagan (1995)).

not fully developed over much of the sample period. Increasing integration of financial markets might improve the forecasting power of yield spreads.

Third, the financial market structure may partly explain the poor forecasting performance of yield curve spreads. Institutional investors, especially investment and pension funds, which are considered to react more rapidly to expected changes in inflation and output, have gained importance in the 1990s. But investments managed by Austrian investment and pension funds are still low by international comparison. However, growth is expected to accelerate within the next few years, as the state pension system is increasingly burdened.

Fourth, the Austrian stock market did not begin to develop until the end of the 1980s (i.e. share turnover totalled Sch 20 billion in 1989) and, even today, is marked by moderate liquidity concentrated in a few shares. Thus, it is not surprising that the stock price index does not provide much information.

Fifth, the information content of the yield curve might also have been affected by Austria's choice of exchange rate regime. Linking the schilling to the Deutsche mark generally implies a parallel movement of interest rates, but not necessarily of economic activity and inflation in the short term. Moreover, German reunification represents an exceptional period with possibly strong effects on the sample.

Looking ahead, the creation of the European Monetary Union will change the focus of research, also for the OeNB. Economic analysis will concentrate more strongly on the EMU area. At the OeNB, economic analysis will attribute great importance to financial indicators, in particular yield curve analysis. Yield spreads, for example, might be a good predictor of economic activity and inflation in the EMU, above all against the background of the significant results often found for larger economies.

2. Some remarks on the wealth transmission channel in Austria

In the context of the Austrian exchange rate and monetary policy of the last decades, attention – as already mentioned – was paid to the mutual dependencies of monetary policy measures, investment decisions, asset prices, and possible consequences for the goods markets only insofar as such measures should *not* influence the expectations of economic agents concerning the stability and credibility of the schilling/Deutsche mark peg. Disturbances, which otherwise would have imparted on the "real" economy, the wage-price link, and interest rates were regarded as potentially considerable and as endangering the concept itself. On the other hand, relatively higher interest rates which were sometimes necessary to defend the peg, were regarded as less harmful as their efforts were mitigated by interest rate subsidies, given for certain purposes, and by the high proportion of medium and long-term loans with fixed interest rates.

The view that effects of monetary policy on private assets and consequently on consumption and investment decisions were of minor importance may have its cause – at least as far as effects on consumers' activity are concerned – in the fact that wealth of relevant size in the form of shares, bonds and property etc. has accumulated only in the more recent past (if we disregard simple savings deposits). But also for the enterprise sector, decisions whether to invest in either real or financial capital were not very relevant for long periods after World War II.

A first attempt to quantify the importance of wealth effects within the transmission process of monetary policy was undertaken by Glück (1995) in connection with the BIS project on the monetary policy transmission process. The wealth effect was defined there as capturing the effects of monetary policy measures on the value of financial assets and consequently on consumption and investment. Because of data restrictions, "financial assets" had to be defined rather narrowly in this exercise (at least for Austria; it included deposits and an estimate for bonds in the portfolio of households – an approach quite frequently used as data problems are not unique to Austria). The outcome of the simulation experiment showed comparatively small effects for the wealth channel (compared, for instance, with the capital cost and the exchange rate channel). Furthermore it seemed to operate with rather long lags.

This was to be regarded, of course, as a quite global result and it would certainly be useful and sensible to improve the knowledge on further aspects and details of the wealth channel. How, for example, do policy measures affect asset prices and other wealth variables and what consequences does this have on aggregates like growth, employment, inflation, etc.? However, this intention is heavily impeded by the lack of reliable data. What can be done, therefore, is to investigate some additional pieces of evidence of interest in this context, try to find some tentative answers to the question as to which wealth effects and which effects on asset prices should be taken into account when formulating a possible monetary policy change.

Like the transmission process itself, the wealth channel can be viewed as a complex bundle of different effects. In the following, we will try to take a closer look at the effects of wealth changes on consumption, looking – as far as possible – at a broader spectrum of wealth; on investment decisions, not only as far as, for instance, the direct influence of higher interest rates on fixed capital investment is concerned, but also on portfolio decisions; on inflationary expectations; on banks' willingness to lend; and at the money demand function.

2.1 Consumption

The consumption channel of wealth effects has been strongly advocated, for example, in the MPS model. Based on Modigliani's life-cycle model, consumption spending is determined by the lifetime resources of consumers, which are made up of discounted income representing human capital, financial wealth and property. A major component of financial wealth is common stocks. Since a contractionary monetary policy can lead to a decline in stock prices, the value of financial wealth decreases, thus reducing the lifetime resources of consumers, and consumption should fall (Mishkin (1995)).

Formally, real consumption C is a function of life-cycle (permanent) income LCI and financial wealth FW:

$$C_t = f((LCI_t + FW_t)/P_t), \text{ with } P_t = \text{price index} \tag{1}$$

Permanent income LCI can be determined with different degrees of complexity as the current and discounted future expected net income stream of households. The other determinant of private consumption, financial wealth FW, has been defined as (Dramais et al. (1997)):

$$FW_t = MV_t + F_t + B_t$$

i.e., it consists of the market value of firms in the domestic economy, MV, the net foreign asset position, F, and government debt, B. Though government debt enters the definition of private wealth, it has been discussed whether it has a positive effect on private consumption because households will deduct future tax payments and expected reductions in transfer payments, required to service the debt, from their permanent income. This proposition, known as Ricardian Equivalence, will, however, only hold in its extreme form of infinitely lived consumers. Life cycle consumers will discount the future more heavily and thereby underestimate the tax burden associated with government debt. Consequently, they regard government debt, at least partially, as net wealth. Some studies (e.g. Summers and Poterba (1987)) have shown, however, that this net wealth effect of government debt is negligible in the life-cycle model.

Some tests with the consumption equation used in Glück (1995) showed that government debt does not exert any significant influence, either on durable or on non-durable consumption. On the other hand, the influence of financial wealth, as used in this exercise, seems to have increased in the course of time, at least as far as durables are concerned, for which the elasticity with respect to wealth has risen from 1 in the period from the 1970s to the beginning of the 1980s to 2 in the period from the beginning of the 1980s to 1995.

The most difficult problem for estimations for Austria along the lines described at the beginning of this chapter is to find an appropriate wealth variable. In many studies we find a somewhat resigned attitude to this issue, for example in Gerdesmeier (1996): Wealth in a wide definition "... should include financial assets as well as real capital and human wealth. Quantifying the latter, however, faces unsurmountable problems. Consequently, it seems appropriate to rely on the sum of financial assets and real capital, the so-called non-human wealth" (p.10, our translation).

Others, e.g. Dramais et al. (1997), approximate human wealth as the discounted value of an infinite stream of labour income and transfers:

$$LCI_t = \int_t^{\infty} [(1-tl)W_s N_s / P_s + TR_s / P_s] \exp - \int_t^{s} (r+p) dj \, ds$$

with LCI = life-cycle income, tl = tax on labour income, W = wage rate, N = number of people employed, P = price index, TR = transfers, r = interest rate, and p = probability of death.

We calculated a simplified form for use in equation (1).

For the second component in (1), financial wealth FW, an estimate of the market value of firms, MV, is required. Usually this is deducted from the firm's maximisation problem (see, e.g. Galeotti (1988)). In a first approximation we use the market capitalisation of firms quoted at the stock exchange.

Estimation of (1) yields disappointing results which are, in any case, inferior to the Brown-type consumption function augmented by the wealth term used in Glück (1995). Taking into account the findings of many other studies that a sizeable fraction of consumption is based on real current disposable income because of liquidity constraints and constructing a linear combination of the independent variable in (1) and current disposable income (as, e.g. in Dramais et al. (1997)), did not improve the results.

Digression on property

Meltzer (1995) emphasized that asset price effects extend beyond those operating through interest rates and equity prices. In his description of the Japanese experiences in the 1980s and 1990s he found that monetary policy had an important impact on the economy through its effect on land and property values. Generally, a monetary contraction can lead to a decline in income and property values, which causes households' wealth to shrink, thereby causing a reduction in consumption and aggregate output.

In econometric models, this property aspect of the wealth channel is frequently dealt with in relation to housing services, i.e. the interaction of demand and supply of housing services plays a decisive role for this aspect of the transmission of monetary policy to the household sector. In these approaches, as used, for instance, in the Bank of Finland model, the market price of housing is the discounted present value of the determinants of the rental price of housing and affects household sector wealth via the value of the housing stock and the accumulation of the housing stock. Monetary policy affects the market price of housing directly through the interest rate used in discounting. For the time being, lack of data does not allow the modelling of this aspect of the wealth channel for Austria.

2.2 Investment and portfolio decisions

In the context of investment and wealth effects, Tobin's q theory seems to be useful as it provides a mechanism through which monetary policy affects the economy by its effects on the valuation of equities. Tobin (1969) defines q as the market value of firms divided by the replacement cost of capital. If q is high, the market price of firms is high relative to the replacement costs, and new plant and equipment are cheap relative to the market value of business firms. Companies will then issue equity and get a high price relative to the cost of the plant and equipment they are buying. Investment spendig will rise as firms can buy much equipment for a small issue of equity (Mishkin (1995)). The influence of monetary policy on this process – apart from the role of the interest rate as a discounting factor in determining the market value of firms – is simply that monetary contractions raise the incentive for the public to hold more bonds and less stocks, thus reducing stock prices and the market value of the firms.

The q theory of investment has a number of theoretical advantages over competing models of investment. First, unlike the neoclassical model, it is forward-looking rather than being based on lags and past variables. Second, it allows for a distinct analysis of the effects of temporary versus permanent changes in tax parameters. Finally, it avoids the Lucas-critique, since the estimated adjustment parameters should not depend on policy rules (Schaller (1990)). Unfortunately, the theoretical appeal of the q theory has not been matched by empirical success. It is true that most of the studies find that investment is significantly related to q. However, in most cases variations in q explain only a small part of the variation in investment. The unexplained portion is usually highly serially correlated, and variables like profit and output, which should not matter according to the q theory, frequently exert a more significant influence on investment (Schaller (1990)).

Despite these problems and shortcomings we try to estimate an investment function based on the q theory as, to our knowledge, this has not been tried before for Austrian data.

It can be shown (Galeotti (1988)) that values for q can be approximated by:

$$q = MV/gK$$

with MV the aforementioned market value of firms, g the investment market price divided by the price of output, and K the capital stock.

The equations to be estimated can have the form:

$$I_t = a + bq_t + u_t \qquad \text{or} \qquad (2)$$

$$(I_t/K_t) = a' + b'q_t + u_t' \qquad (3)$$

with I = investment.

The first problem we encountered was the fact that because of the strongly rising values of MV our q does not oscillate around 1, as theory demands. We tried to overcome this by estimating on changes. The results then were in conformity with the ones mentioned above for other studies insofar as the explanatory power of (2) and (3) is very poor, as the significance of q, with one exception, never reaches the 5% level. The exception is the equation for construction for the period 1976-86, where the t-value for q reaches 2.32.

As far as portfolio decisions are concerned, Hahn (1990) investigated the potential influence of interest rate changes on portfolio decisions of large enterprises. He found that the portion of financial assets in relation to all assets correlated positively with the movements of bond yields (secundary market rate), i.e. the higher the bond yield, the higher the portion of assets held as financial wealth and the less invested in "productive" capital, such as machinery and equipment. Hahn also found evidence that large financial portfolios correlated negatively with rentability. He interpreted these results as an indication that low rentability and the weak investment performance of large enterprises could be caused by higher financial involvements, implying that large companies probably more often overlook profitable investment and innovation opportunities than smaller firms do.

In terms of the transmission mechanism, this would mean that raising interest rates would reduce investment, not only because of higher capital cost but also because of greater incentives to invest in financial assets, leading to a shift from real to financial assets. It can be supposed that high – and the perspective of further rising – asset prices would strengthen this tendency.

The simple but illustrative equation estimated by Hahn was:

$$FS_t = \underset{(9.799)}{3.117\, t} + \underset{(10.968)}{4.027\, RS_t}$$

$R^2 = 0.763$, D.W. = 1.605

with FS = financial asset as % of total assets, t = time, and RS = bond yield, secondary market. Figures in parentheses are t-values.

2.3 Price expectations

Monetary policy action changes price expectations, thus strongly influencing the discounted real values of permanent income, market valuation of firms etc. It is obvious that small variations of prices and interest rates change these discount factors heavily. For future work, some sensitivity analysis will be useful to check the magnitude of these effects.

2.4 Bank lending

In a recent study on the credit channel in Austria, Quehenberger (1997) found that the influence of monetary policy on credit conditions did not appear to have marked consequences for the investment activity of firms. Also, there is no evidence for credit rationing, as banks obviously try to refrain from quantity restrictions in tight monetary conditions. All in all, there does not seem to exist a credit channel in Austria as far as price and quantity of loans are concerned. It would need further investigation to see whether this result is modified when wealth effects are taken into account, i.e. whether changes in asset prices and market valuation via their influence on collateral affect the volume of loans. Some preliminary and very simple correlation and estimation attempts show that the market value of firms delivers a minor explanatory contribution in equations for the credit volume, not enough, however, for far-reaching conclusions.

2.5 Money demand

There is no room for monetary targeting in the concept of the Austrian exchange rate and monetary policy. This, however, will change soon, so that a more precise knowledge of the determinants of money demand will be necessary. When based on portfolio considerations, the influence of wealth on money demand has to be taken into account. The inclusion of wealth as an additional explanatory variable in money demand functions for Austria gives the correct sign, but wealth is insignificant. More detailed research, however, seems necessary.

Conclusion

This section of our paper documents our endeavour to push ahead the empirical knowledge on wealth effects within the transmission process of monetary policy in the Austrian economy. In this first attempt, we concentrated mainly on life-cycle approaches to consumption and Tobin's q theory of investment, which seemed most appropriate in this context. Unfortunately, our results are rather disappointing. This may have its cause, above all, in the very weak data base, with the consequence that in many cases we had to work with rough approximations. We hope that further research will bring some improvements.

Appendix 1: Data sources

IP: Industrial production at constant prices (seasonally adjusted monthly series; energy excluded).
Source: WIFO (Austrian Institute for Economic Research).

INF: Annual change in the consumer price index (seasonally adjusted monthy series; all items), 1986=100.
Source: WIFO.

SM: (Sekundärmarktrendite) 10-year government bond yields (monthly averages).
Source: Oesterreichische Kontrollbank.

VIB: Interest rate on 3-month interbank loans (VIBOR) (monthly averages).
Source: OECD.

BMU: 10-year Treasury bond yield (benchmark bonds; monthly averages).
Source: Datastream.

BMB: 10-year government bond yield (benchmark bonds; monthly averages).
Source: Datastream.

B3M: Interest rate on 3-month interbank loans (monthly averages).
Source: Datastream.

Appendix 2

Estrella and Hardouvelis (1991)

Industrial production (cumulative growth rate)

Horizon (months)	Spread (SM-VIB)			
	Standard errors corrected with Newey-West procedure		Equation including AR(3) model for noise	
	Coefficient	t-statistic	Coefficient	t-statistic
6	1.37	1.40	0.34	0.29
12	1.86	2.07	-0.40	-0.47
18	2.36	2.91	-0.36	-0.60
24	2.32	3.06	0.52	1.03
36	1.72	3.23	-0.09	-0.24
48	1.55	4.93	0.38	1.43

Plosser and Rouwenhorst (1994)

Industrial production (cumulative growth rate)

Horizon (months)	Spread (SM-VIB)		VIB		Spread (SM-VIB)		VIB	
	Standard errors corrected with Newey-West procedure				Equation including AR(3) model for noise			
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
6	-0.01	-0.84	-0.01	-2.21	-0.01	-1.20	-0.01	-1.69
12	-0.02	-1.90	-0.03	-4.92	-0.03	-2.72	-0.03	-3.44
18	-0.03	-2.47	-0.04	-6.77	-0.03	-2.70	-0.04	-3.76
24	-0.04	-2.84	-0.06	-6.67	-0.02	-1.69	-0.04	-4.21
36	-0.08	-3.61	-0.08	-7.32	-0.03	-1.89	-0.05	-2.91
48	-0.02	-0.57	-0.05	-2.70	0.00	0.25	-0.02	-0.94

Fama (1990)

Changes in inflation

Horizon (months)	Spread (SM-VIB)		Inflation		Spread (SM-VIB)		Inflation	
	Standard errors corrected with Newey-West procedure				Equation including AR(1) model for noise			
	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
6	0.00	-3.28	-0.35	-3.92	0.00	-0.58	0.00	0.07
12	-0.06	-3.43	-0.71	-7.64	0.00	-0.33	0.08	0.60
18	-0.01	-3.38	-0.98	-10.23	0.00	-0.54	-0.14	-1.23
24	0.00	-2.46	-1.18	-10.96	0.00	-0.38	-0.01	-0.12
36	0.00	0.81	-1.33	-13.51	0.00	0.60	-0.13	-1.28
48	0.01	2.76	-1.30	-23.82	0.00	0.11	0.05	0.42

Appendix 3: Vector error correction estimates

Cointegrating Eq1					
Log(*IP*(-1))	1.000000	Log(*INF*(-1))	-0.100213 (0.03158) (-3.17323)	(*SM*(-1)–*VIB*(-1))	-0.059646 (0.01457) (-4.10849)
(*BMB*(-1)–*BMU*(-1))	-0.072688 (0.01072) (-6.78089)	(*SM*(-1)–*BMB*(-1))	-0.040121 (0.02704) (-1.48399)	(*BMB*(-1)–*B3M*(-1))	-0.000437 (0.01552) (-0.02813)
C	-4.474237 (0.04059) (-110.227)				

Error correction	***D*(log(*IP*))**	***D*(log(*INF*))**	***D*(*SM-VIB*)**	***D*(*BMB-BMU*)**	***D*(*SM-BMB*)**	***D*(*BMB-B3M*)**
CointEq1	0.034030 (0.04481) (0.75942)	0.695906 (0.26027) (2.67379)	0.109866 (0.37036) (0.29665)	1.683871 (0.44436) (3.78941)	0.362445 (0.28776) (1.25952)	-0.834282 (0.46287) (-1.80242)
D(log(*IP*(-1)))	-0.631555 (0.09025) (-6.99807)	-1.208133 (0.52418) (-2.30480)	0.533311 (0.74590) (0.71499)	-0.588403 (0.89494) (-0.65748)	-0.234749 (0.57955) (-0.40505)	0.103271 (0.93221) (0.11078)
D(log(*IP*(-2)))	-0.369388 (0.08384) (-4.40597)	-0.919513 (0.48696) (-1.88829)	0.663936 (0.69293) (0.95816)	-0.899932 (0.83139) (-1.08245)	-0.917188 (0.53840) (-1.70356)	1.309361 (0.86601) (1.51195)
D(log(*INF*(-1)))	-0.000677 (0.01443) (-0.04694)	0.029589 (0.08381) (0.35302)	0.132601 (0.11927) (1.11180)	-0.291888 (0.14310) (-2.03977)	0.147253 (0.09267) (1.58903)	-0.034012 (0.14906) (-0.22818)
D(log(*INF*(-2)))	0.024908 (0.01462) (1.70380)	0.004373 (0.08491) (0.05150)	-0.151528 (0.12083) (-1.25408)	0.064512 (0.14497) (0.44499)	1.159683 (0.09388) (1.70088)	-0.044125 (0.15101) (-0.29220)
D(*SM*(-1)-*VIB*(-1))	0.004865 (0.01116) (0.43577)	-0.052293 (0.06485) (-0.80637)	0.127137 (0.09228) (1.37775)	0.083590 (0.11072) (0.75497)	0.025188 (0.07170) (0.35130)	0.077093 (0.11533) (0.66846)
D(*SM*(-2)-*VIB*(-2))	0.008367 (0.01058) (0.79051)	-0.008058 (0.06147) (-0.13108)	-0.150626 (0.08748) (-1.72192)	-0.030485 (0.10496) (-0.29046)	-0.029205 (0.06797) (-0.42969)	-0.026892 (0.10933) (-0.24598)
D(*BMB*(-1)-*BMU*(-1))	0.014429 (0.00768) (1.87876)	-0.038674 (0.04461) (-0.86697)	-0.217930 (0.06348) (-3.43327)	0.395090 (0.07616) (5.18766)	0.163437 (0.04932) (3.31380)	-0.196282 (0.07933) (-2.47421)
D(*BMB*(-2)-*BMU*(-2))	-0.002627 (0.00822) (-0.31951)	-0.019564 (0.04775) (-0.40968)	0.055760 (0.06795) (0.82058)	-0.289134 (0.08153) (-3.54631)	0.050833 (0.05280) (0.96277)	0.019755 (0.08493) (0.23262)
D(*SM*(-1)-*BMB*(-1))	-0.008102 (0.01364) (-0.59421)	-0.030063 (0.07920) (-0.37958)	-0.093421 (0.11270) (-0.82894)	0.085602 (0.13522) (0.63306)	0.196798 (0.08757) (2.27026)	0.016940 (0.14085) (0.12027)
D(*SM*(-2)-*BMB*(-2))	0.008969 (0.01341) (0.66892)	-0.171114 (0.07788 (-2.19728)	0.060680 (0.11061) (0.54758)	0.183520 (0.13296) (1.38028)	-0.203299 (0.08610) (-2.36115)	0.194368 (0.13849) (1.40344)
D(*BMB*(-1)-*B3M*(-1))	0.000832 (0.00967) (0.08608)	0.043755 (0.05614) (0.77942)	0.178181 (0.07968) (2.23052)	0.015660 (0.09585) (0.16339)	-0.033615 (0.06207) (-0.54158)	0.216755 (0.09984) (2.17109)
D(*BMB*(-2)-*B3M*(-2))	0.001316 (0.00976) (0.13475)	0.046853 (0.05672) (0.82609)	0.117595 (0.08071) (1.45707)	0.081289 (0.09683) (0.83948)	0.043397 (0.06271) (0.69205)	-0.033840 (0.10087) (-0.33550)
R^2	0.332448	0.136271	0.211907	0.290520	0.211349	0.159237
Adjusted R^2	0.275229	0.062237	0.144356	0.229707	0.143750	0.087172
Sum square residuals	0.075950	2.562267	5.188230	7.468846	3.132204	8.103821
S.E. equation	0.023292	0.135285	0.192507	0.230974	0.149576	0.240592
Log likelihood	346.9237	95.75318	41.78241	13.90979	80.38857	7.667764
Akaike AIC	-7.438179	-3.919611	-3.214111	-2.849763	-3.718766	-2.768168
Schwarz SC	-7.180691	-3.662123	-2.956622	-2.592275	-3.461278	-2.510679
Mean dependent	0.002715	-0.004346	0.017974	0.022477	-0.008301	0.001170
S.D. dependent	0.027359	0.139702	0.208113	0.263169	0.161644	0.251818

Determinant residual covariance	8.78E-12	Akaike information criteria	-25.27330
Log likelihood	1,103.969	Schwarz criteria	-24.99271

Notes: Sample (adjusted): 1983:04 – 1995:12. Included observations: 153 after adjusting end-points. Standard errors and t-statistics in parentheses.

References

Barran, F., V. Coudert and B. Mojon (1996): "The transmission of monetary policy in the European countries". London School of Economics, Financial Markets Group, *Special Research paper series*, No. 86.

Bernanke, B. S. (1995): "A conference discussion: what do we know about how monetary policy affects the economy?". Federal Reserve Bank of St. Louis, *Review*, Vol. 77, No. 3.

Bernanke, B. S. and M. Gertler (1995): "Inside the black box: the credit channel of monetary policy transmission". *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 27-48.

Bernard, H. and S. Gerlach (1996): "Does the term structure predict recessions? The international evidence". Bank for International Settlements, *Working papers*, No. 37.

Canova, F. and G. de Nicolo (1995): "Stock returns and real activity: a structural approach". *European Economic Review*, No. 39, pp. 981-1015.

Canova, F. and G. de Nicolo (1997): "Stock returns, term structure, inflation and real activity: an international perspective". Center for Economic Policy Research, *Discussion paper series*, No. 1614.

Davis, E. P. and G. Fagan (1995): "Are financial spreads useful indicators of future inflation and output growth in EU countries?" *European Monetary Institute*.

Davis, E. P. and G. Fagan (1995): "Indicator properties of financial spreads in the EU: evidence from aggregate union data". *European Monetary Institute*.

Day, J. and R. Lange (1997): "The structure of interest rates in Canada: information content about medium-term inflation". Bank of Canada, *Working paper*, No. 97-10.

Dramais, A., W. Roeger and J. In't Veld (1997): "Quest II: a multi-country business cycle and growth model". Paper presented to the *Project LINK World Economic Conference*, Malaysia.

Dziwura, J. R. and E. M. Green (1996): "Interest rate expectations and the shape of the yield curve". Federal Reserve Bank of New York, *Research paper*, No. 9631.

Estrella, A. and G. A Hardouvelis (1991): "The term structure as a predictor of real economic activity". *The Journal of Finance*, Vol. XLVI, No. 2, pp. 555-76.

Estrella, A. and F. S. Mishkin (1995): "The term structure of interest rates and its role in monetary policy for the European Central Bank". National Bureau of Economic Research, *Working paper*, No. 5279.

Estrella, A. and F. S. Mishkin (1996): "Predicting US recessions: financial variables as leading indicators". Federal Reserve Bank of New York, *Research paper*, No. 9609.

Fama, E. F. (1990): "Term-structure forecasts of interest rates, inflation and real returns". *Journal of Monetary Economics*, 25/1, pp. 59-76.

Galeotti, M. (1988): "Tobin's marginal '*q*' and tests of the firm's dynamic equilibrium". *Journal of Applied Econometrics*, 3, pp. 267-77.

Gerdesmeier, D. (1996): "Die Rolle des Vermögens in der Geldnachfrage". Deutsche Bundesbank, *Diskussionspapier*, 5/96, Frankfurt.

Gerlach, S. (1995): "The information content of the term structure: evidence for Germany". Bank for International Settlements, *Working papers*, No. 29.

Gerlach, S. and F. Smets (1995): "The monetary transmission mechanism: evidence from the G-7 countries". Bank for International Settlements, *Working papers*, No. 26.

Glück, H. (1995): "Transmission mechanisms in the Austrian economy", in Bank for International Settlements, *Financial structure and the monetary policy transmission process*, pp. 278-87.

Hahn, F. (1990): "Portefeuilleverhalten von Großunternehmen der Industrie". Österreichisches Institut für Wirtschaftsforschung, *Monatsbericht*, 7, pp. 440-48.

Hayashi, F. (1982): "Tobin's marginal *q* and average *q*: a neoclassical interpretation". *Econometrica*, 50, pp. 213-24.

Jorion, P. and F. S. Mishkin (1991): "A multicountry comparison of term-structure forecasts at long horizons". *Journal of Financial Economics*, 29/1, pp. 59-80.

Levy, J. and I. Halikias (1997): "Aspects of the monetary transmission mechanism under exchange rate targeting: the case of France". International Monetary Fund, *Working paper*, No. 44.

Meltzer, A. H. (1995): "Monetary, credit and (other) transmission processes: a monetarist perspective". *Journal of Economic Perspectives*, 9, pp. 49-72.

Mishkin, F. S. (1990): "What does the term structure tell us about future inflation?". *Journal of Monetary Economics*, 25, pp.77-95.

Mishkin, F. S. (1991): "A multi-country study of the information in the shorter maturity term structure about future inflation". *Journal of International Money and Finance*, 10, pp. 2-22.

Mishkin, F. S. (1995): "Symposium on the monetary transmission mecahnism". *Journal of Economic Perspectives*, 9, pp. 3-10.

Mishkin, F. S. (1996): "The channels of monetary transmission: lessons for monetary policy". National Bureau of Economic Research, *Working paper*, No. 5464.

Plosser,C. I., K. G. Rouwenhorst (1994): "International term structures and real economic growth". *Journal of Monetary Economics*, 33/1, pp. 133-55.

Quehenberger, M. (1997): "Der Einfluß der Notenbank auf die Finanzierungsbedingungen österreichischer Unternehmen". Oesterreichische Nationalbank, *Berichte und Studien*, 3, pp. 87-113.

Schaller, H. (1990): "A reexamination of the *q* theory of investment using U.S. firm data". *Journal of Applied Econometrics*, 5, pp. 309-325..

Smets, F. and K. Tsatsaronis (1997): "Why does the yield curve predict economic activity? Dissecting the evidence for Germany and the United States". Bank for International Settlements, *Working papers*, No. 49.

Söderlind, P. and L. E. O. Svensson (1997): "New techniques to extract market expectations from financial instruments". Center for Economic Policy Research, *Discussion paper series*, No. 1556.

Summers, L. H. and J. M. Poterba (1987): "Finite lifetimes and the effects of budget deficits on national saving". *Journal of Monetary Economics*, 20/2, pp. 369-91, September.

Taylor, J. B. (1995): "The monetary transmission mechanism: an empirical framework". *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 11-26.

Tobin, J. (1969): " A general equilibrium approach to monetary theory". *Journal of Money, Credit, and Banking*, 1, pp. 15-29.