An affine multifactor model with macro factors for the German term structure: Changing results during the recent crises

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This version: 24. April 2012
Preliminary, please do not cite or quote.

Abstract

Using arbitrage-free affine models, we analyze the dynamics of German bond yields and risk premia for the period 1999 to 2010 (EMU). We estimate two model specifications, one with only latent factors, and another one with a Taylor-type rule comprising a price and a real activity factor drawn from a large macro variable data set as additional driving forces. Combining a structural policy rule and an affine no-arbitrage framework for estimating the term structure yields the advantage of evaluating the influence of macro factors on the complete term structure and not just on single interest rates. In addition we can analyze effects of the macro factors on the risk aversion of market participants. Macro factors, notably the real activity factor, help to improve the fit of the model. Looking at the impact of the recent subprime, financial and sovereign debt crises we conclude that risk aversion of market participants captured in the market price of risk changed most dramatically for the real activity and the price factor. Offsetting safe haven flows affecting especially shorter maturities explain why yield risk premia increase less at the short end as compared to longer maturities in times of crisis. A liquidity stress factor included into the macro model mirrors this slope influencing effect and leads to smoother forward rates for yield risk premia. The slope influencing factor takes effect especially during times of crises and allow for deriving results from the real activity factor on the term structure without interference from safe haven flows.

JEL Classification: E43, E52, G12

Keywords: Affine term structure models, macroeconomic factors, risk premia, liquidity, financial crisis.

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1 Introduction

The growing influence of the level and the development of long term interest rates in fiscal and monetary policy has boosted the term structure literature especially during the recent crises. What drives the whole term structure and what is its relation to policy controlled short term rates and the state of the real economy are questions that came to the fore not the least by unconventional monetary policy settings that are much more directed to long term capital market rates. How can fundamental influences incorporated in macroeconomic variables be taken into account in bond yield estimations, given that these could be already well described by unobservable, latent factors which determine level, slope, and curvature of the term structure?[1] And do the fundamental macroeconomic influences matter more during the recent crises? How to determine those time series from a huge macroeconomic data set that should be incorporated in the term structure estimation? And which alternative factor can be used to explain term structure dynamics in times of crisis? These are key questions the paper tries to answer.

This paper applies a new estimation approach for affine term structure models to German data in shifting from traditional maximum likelihood to minimum chi square estimations following Hamilton and Wu (2012a). In order to keep the model simple we choose a similar setup as Smith and Taylor (2009) and particularly Ang and Piazzesi (2003) employ for the US. Moreover we use information from a large macroeconomic data set to construct our macro factors and have a closer look at a liquidity stress factor influencing the slope of risk premia attached to the term structure of interest rates.

To shed a little more light on the relation of the fundamental factors to the term structure, we choose a setup that explicitly incorporates a price and a real activity factor as additional driving forces besides three latent factors. Incorporating macro factors by formulating monetary policy rules seems to be a promising starting point since long term interest rates depend on expectations of future short term interest rates which are again influenced by the response of central banks to developments in the real economy. This response can be formulated in a Taylor type monetary policy rule following Taylor (1999) and Smith and Taylor (2009). Whereas common Taylor type rules consist of inflation and output gap as parameters to respond to, it is obvious that most central banks include in their assessment of the state of the economy and of the risks to price and financial stability a broader set of macroeconomic variables. We therefore employ a vast set of macro variables (see Section 3.2) which we condensed by means of shrinkage and factor analysis to two macro factors which we call price and real activity factor. Classical factor literature has shown that a large number of variables condensed into a small set of factors is effective in explaining and forecasting macro variables (Eickmeier and Ziegler (2008)).We apply that result in formulating our monetary policy rule.

Liquidity and volatility of assets have come increasingly to the fore since the onset of the recent crisis. In an attempt to capture this additional attribute of bond yields we substitute the price

[1] See, e.g., Litterman and Scheinkman (1991) or Dai and Singleton (2000).

factor by a liquidity stress factor drawn from an array of time series signaling liquidity and volatility of the German fixed income market. If this liquidity stress factor captures effects of the crisis efficiently, it can improve estimations of term structure effects in response to the real activity factor.

The fast-growing number of affine term structure models with macroeconomic variables in the literature divides - amongst other things - along the line of how the "macroeconomy" is specified. A good overview of recent research provide Gürkaynak and Wright (2010). We apply a reduced form VAR representation of the macroeconomic data which started with a paper from Ang and Piazzesi (2003) for US data. They also use a principal component analysis for extracting macro factors but from a much more contained data set. Papers dealing with US data often expand the macro part of the models from simple Taylor rules to a more structural framework (e.g. Dewachter and Lyrio (2006), Rudebusch and Wu (2008) or Bekaert, Cho, and Moreno (2010)). Applications for German data mostly impose less structure on the macro variables. The latter comprise an ex-post correlation of macro factors with unobservable factors (Cassola and Luis (2003)), a Taylor rule with inflation and output gap (Lemke and Stapf (2006)) and a canonical representation of the term structure which includes inflation, output gap and three unobservable factors in the short rate (Pericoli and Taboga (2006)). Hördahl, Tristani, and Vestin (2006) uses German data as an application and allow for explicit feedbacks from the short rate to macro factors namely inflation and output gap and get therefore an endogenous description of the dynamics of the short rate.

The remainder of the paper is organized as follows. The next section outlines the model specifications, followed by a description of the data in Section 3. The influence of macro variables on the term structure, risk premia developments during the crisis, and the role of a liquidity stress factor are subsumed under empirical results (Section 4). Section 5 discusses out robustness checks. The last section concludes.

2 Model specification

We apply an affine term structure model to estimate the yields given two different sets of state variables. One set contains only latent factors, the other contains additionally two principal components which summarize macroeconomic information. In general, we take the modeling approach from Ang and Piazzesi (2003). However, we estimate the model with an approach that was recently proposed by Hamilton and Wu (2012a)[2]. Their method is based on minimum chi square estimation (MCSE) instead of the commonly used maximum likelihood. Moreover, they estimate the reduced form parameters with least squares methods and use then those

[2]We used the Matlab code for this approach that was kindly provided by James Hamilton and Jing Cynthia Wu on their web site: http://dss.ucsd.edu/ jhamilto/software.htmatsm.

estimates to infer the structural parameters. This has at least two advantages. First, it lowers the computational burden significantly as one does not have to try several different sets of starting values. Second, the application of MCSE allows detecting if an optimum that was found is indeed global or rather local. We refer to the papers of Ang and Piazzesi (2003) and Hamilton and Wu (2012a) for thorough discussions of their modeling approaches. Here we present the equations of Hamilton and Wu (2012a) that are most relevant for our model, and widely retain their notation to ease the comparison.

The state variables represent the information about the economy that the investors use to price the bonds. They follow a vector autoregressive (VAR) process:

$$F_{t+1} = c^j + \rho^j F_t + \Sigma u^j_{t+1}, \tag{2.1}$$

with u^j_{t+1} being a standard Gaussian error term. As the bond yields will depend on the investors' assessment of the economic dynamics, this assessment depends on the risk appetite of the investors. Thus we consider two representations of equation 2.1 which pin down two different specifications of certain risk measures. The risk-neutral pricing measure, $j = Q$, and the pricing measure of a risk-averse investor, $j = P$, which is sometimes called the physical probability measure. The relation of the parameter estimates of these specifications is established through the market price of risk. In general, those prices can be understood as the premia that a risk-averse investor demands over the risk-neutral price. The time-varying market prices of risk, λ_t, are affine functions of the underlying state variables F_t:

$$\lambda_t = \lambda + \Lambda F_t. \tag{2.2}$$

The relation of the parameters of the P-measure to the Q-measure are then:

$$c^Q = c^P - \Sigma\lambda, \tag{2.3}$$

$$\rho^Q = \rho^P - \Sigma\Lambda. \tag{2.4}$$

It is assumed that also the short rate is an affine function of the state variables:

$$r_t = \delta_0 + \delta_1' F_t. \tag{2.5}$$

Given the estimates of the short rate parameters together with those of the VAR-parameters, we obtain the yield of a n-period zero coupon bond:

$$y^n_t = a_n - b_n' F_t, \tag{2.6}$$

where:

$$\begin{aligned} a_n &= \delta_0 + (b_1' + 2b_2' + ... + (n-1)b_{n-1}')c^Q/n - \\ &\quad (b_1'\Sigma\Sigma' b_1 + 2^2 b_2'\Sigma\Sigma' b_2 + ... + (n-1)^2 b_{n-1}'\Sigma\Sigma' b_{n-1})/2n, \end{aligned} \tag{2.7}$$

$$b_n = \frac{1}{n}[I_m + \rho^{Q'} + ... + (\rho^{Q'})^{n-1}]\delta_1. \tag{2.8}$$

We can use a_n and b_n to derive yield risk premia. Yield risk premia are the difference of the observed yields to the hypothetical yields given by the expectations hypothesis:

$$\begin{aligned} yrp_t^n &= \frac{1}{n}\sum_{i=1}^{n-1}(\ln P_t^n - \ln P_t^{n+1} - E_t(y_{t+n}^1)) \\ &= a_n + b_n' X_t - a_1 - b_1'(I_N - \mathcal{K}^n)(I_N - \mathcal{K})^{-1} X_t. \end{aligned} \tag{2.9}$$

P_t^n is the price of a bond that is an exponential function of the according yield, $P_t^n = \exp(-n y_t^n)$. $\mathcal{K}$ is the coefficient matrix of a VAR(1) of the state variables X_t without intercept. N, the size of the unity matrices, is the number of all factors used as state variables.

Given this general model description, consider now the specification for the approach with solely latent factors: In line with various contributions to the literature, we construct $N_l = 3$ latent factors from a set of three representative maturities which are assumed to be observed without error. This method, that also Hamilton and Wu (2012a) apply, was originally proposed by Chen and Scott (1993). The choice of which maturity is measured with error and which not can have consequences for the estimation (see for example Hamilton and Wu (2012b)). However, our choice of the maturity sets is driven by our particular interest in obtaining a very good estimate of the 10 year yield. Hence, we assume that yields maturing in 12 months, and also 5 and 10 years are priced with error ($Y_t^2 = (y_t^{12}, y_t^{60}, y_t^{120})'$), while the maturities of 1 month and 2 and 11 years are priced without error ($Y_t^2 = (y_t^1, y_t^{24}, y_t^{132})'$). The inclusion of the 11 years yield in this subset backs the meaning of the long end of the term structure for the latent factors. Overall, we thus have six different maturities, from which $N_e = 3$ are priced with error.

Hence, following again Hamilton and Wu's model description, equation 2.6 becomes:

$$\begin{bmatrix} y_t^1 \\ y_t^{24} \\ y_t^{132} \\ y_t^{12} \\ y_t^{60} \\ y_t^{120} \end{bmatrix} = \begin{bmatrix} a_1 \\ a_{24} \\ a_{132} \\ a_{12} \\ a_{60} \\ a_{120} \end{bmatrix} + \begin{bmatrix} b_1' \\ b_{24}' \\ b_{132}' \\ b_{12}' \\ b_{60}' \\ b_{120}' \end{bmatrix} F_t + \begin{bmatrix} 0 \\ {\scriptstyle N_l \times N_e} \\ \Sigma_e \\ {\scriptstyle N_e \times N_e} \end{bmatrix} u_t^e, \tag{2.10}$$

where the latent factors F_t are inverted from the blocks of equation 2.10 that are related to the yield subset that is observed without error:

$$F_t = B_1^{-1}(Y_t^1 - A_1). \tag{2.11}$$

Hamilton and Wu (2012a) apply some normalization restrictions on the parameters of the approach that we maintain, i.e. $\Sigma = I_{Nl}$, $\delta_1 \geq 0$, $c^P = 0$, and ρ^Q is lower triangular.

Consider now the second set of state variables, a macro finance model with single lag: Here, the factor matrix F_t contains $N_l = 3$ latent and $N_m = 2$ observed variables, $F_t = (f_t^m, f_t^l)$. The dynamics of the factors follow a VAR(1) of the form of equation 2.1, namely:

$$\begin{aligned} f_t^m &= c_m^j + \rho_{mm}^j f_{t-1}^m + \rho_{ml}^j f_{t-1}^l + \Sigma_{mm} u_t^{jm}, \\ f_t^l &= c_l^j + \rho_{lm}^j f_{t-1}^m + \rho_{ll}^j f_{t-1}^l + \Sigma_{ll} u_t^{jl}. \end{aligned} \tag{2.12}$$

Similarly, the short rate is given by:

$$r_t = \delta_0 + \delta_{1m}' f_t^m + \delta_{1l}' f_t^l. \tag{2.13}$$

Again, we maintain the parameter restrictions proposed by Hamilton and Wu (2012a), i.e. $\Sigma_{lm} = 0$, $\Sigma_{ll} = I_{Nl}$, $\delta_{1l} \geq 0$, $c_l^Q = 0$, and Σ_{mm} is lower triangular.
The reduced form parameters, i.e. the parameters of a restricted vector autoregression for the yields, are collected in vector π and can be conveniently estimated by least squares methods. Given $\hat{\pi}$, the structural parameter vector θ can then be estimated by minimum chi square. The MCSE estimator is based on the assumption that the reduced form parameters coincide with a function of the structural parameters, $\pi = g(\theta)$. The MCSE is then given by:

$$\min_{\theta} \; T(\hat{\pi} - g(\theta))' R (\hat{\pi} - g(\theta)), \tag{2.14}$$

where R is the information matrix of the full information maximum likelihood function $\mathcal{L}(\theta; Y)$. The minimal value that is found by this estimator can then be evaluated by the chi square distribution.[3]

3 Data

3.1 Yields

Our data set runs from January 1999 to December 2010. We use end-of-month yields on (notional) German zero-coupon bonds for maturities of 1, 2, 5, 10, and 11 years. The yields are estimated using the parametric Nelson-Siegel-Svensson method and based on German federal securities with a residual maturity of at least three months up to 30 years. Notwithstanding that we describe the period of a common euro area currency and monetary policy there is no single debt security market for central governments. Using an aggregated euro area long-term yield, whatever the weighting scheme might be, would hide the fact that yields on national government issues might be driven by national demand and supply factors, the more so in the current sovereign debt crisis. Nevertheless we acknowledge that a significant proportion of German federal securities are traded and held outside the country (numbers range from 74% to 86% according to sources: Bundesbank, securities deposit statistics and Havers Analytics, published in Singhania (2011) respectively) and are therefore influenced by non-national factors. This is especially the case for macroeconomic variables which influence interest rates. An Italian investor for example who holds a Bundesanleihe (Bunds) might look more on the Italian price level instead of the German one since he is prone to spend the proceeds from his investment in

[3] Hamilton and Wu (2012a) provide details on the derivation, asymptotic properties and evaluation of this estimator. They also derive explicitly the application of the model to the latent and the macro factor approach.

Italy. The same rationale might apply to other variables and other countries inside and outside of the euro area.

We do not use yields on government bonds for the shortest maturity, i.e. the 1-month interest rate. This is due to the fact that money market rates dominate this segment of the maturity spectrum. Federal debt securities are rarely traded when close to expiry. 1-month yields which can be extracted through the parameters of the Nelson-Siegel-Svensson estimation in fact show a considerable degree of unwarranted volatility (see Figure 1, left hand panel, black line). Yet, the obvious solution of using the 1-month Euro Interbank Offered Rate (Euribor, dashed line) which dates back to 1999 pinpoints to some caveats in the estimation during the crisis period. In 2007, when the banking crisis developed, counter parties requested a higher compensation when lending money even for a short time period on account of fears of not getting back their money. This was the time when secured lending gained importance. The Euro Repo rate (Eurepo, thin line), first published in March 2002, reflects the lending rate against best available collateral averaged from quotes of 36 panel banks. It might better reflect the notion of a risk-free interest rate in times of possible defaults of counter parties. The increasing and volatile spread between secured and unsecured money market rates translates into diverging yield risk (term) premia in the estimation of an affine term structure model with only latent factors (see Figure 1, right hand panel). The term premia for short- or long-term yields with an unsecured lending rate (bold line) is more contained compared to that of an estimation with a secured 1-month rate(dotted line). This let us conclude that starting with a risky asset at the short-end of the yield curve depresses risk premia along the yield curve and blurs future interest rate expectations. We therefore use the Euribor rate from the start of the EMU up to 2002 and the Eurepo 1-month rate from March 2002 onwards (as soon as it became available). Since both rates run closely together during the first time period with a maximum spread of 6 basis points we do not judge the change in the rate as harmful for the estimation.

Looking at the difference of the yield risk premia on bond yields estimated with a secured and

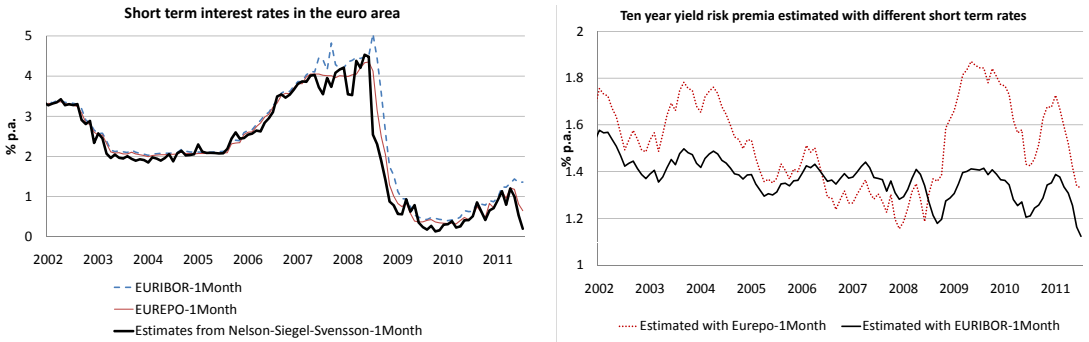


Figure 1: Different short term rates in the euro area and impact on the estimation of yield risk premia.

an unsecured short term rate one might be tempted to term this distance an indicator for the

fragility of euro area banks. The distrust of euro area banks to lend each other money on an unsecured basis was high during the burst of the dot com bubble, the fall of Lehman Brothers Inc., and the recent sovereign debt crisis. In between was a calm period where both risk premia curves run closely together.

3.2 Macro variables

Movements of the yield curve can be described fairly well with latent stochastic factors. Yet, in order to get a more structural interpretation of what drives the yield curve and a formal link to the real economy we include macro factors in the estimation. We started with a data set of 451 time series and grouped them into different macro categories. These comprise balance of payments developments, construction, capacity utilization, GDP (expenditure and gross value added), housing, industrial production, labor market, orders, surveys and world macro factors as categories focusing on real activity developments and good prices, financial variables, bond market liquidity, monetary aggregates and raw material prices as categories reflecting nominal developments. Most of the categories contain German, euro area and US data series. On account of having a balanced data set we restrict the time period from 1999 to December 2010 for which all variables were available.

We transformed all series into stationary time series by means of differencing. We further standardized them to have a unit variance and zero mean and removed outliers following Stock and Watson (2005) (data series description and transformation classification on account of Stock and Watson can be seen in the Appendix in Table A.4). Since the number of factors in a term structure model is restricted at least by the number of yields included we shrinked the data set in several ways. First we excluded categories whose principal components did not help to explain the short term interest rate and the level of the yield curve [4] to a significant amount in univariate regressions. The residual categories we grouped into a price (goods prices, raw material prices, asset prices and other financial variables) and a real activity (GDP, labor market, industrial production, capacity utilization and surveys) group. We used a pooled approach to reduce the number of variables remaining in the groups on account of getting rid of variables which have low correlation with the target variable -the short term interest rate- and which have a strong idiosyncratic component e.g. do not have a strong factor structure.[5] We closely follow Eickmeier and Ng (2010) and Groen and Kapetanios (2008) in applying several shrinkage procedures. The methods used comprise hard and soft thresholding in dropping variables which are not significant in bivariate regressions using LARS, removal of variables with low commonalities, down weighting variables with the inverse of the standard deviation of their idiosyncratic component

[4] We used the first latent factor of the yields-only model which is termed the level factor.

[5] Kuzin, Marcellino, and Schuhmacher (2009) show that in the presence of model uncertainty using a pooled approach over a variety of models outperforms model selection.

and removal of variables which have idiosyncratic errors that are highly correlated with other variables idiosyncratic errors. Out of the remaining time series in each group we draw the first principal component (PC). The PC estimator shows the common component of all variables in the group and is consistent for the factors even if the factor loadings vary somewhat over time as has been shown by Stock and Watson (2008). All in all we ended up with two macro factors -real activity and prices- which feature on the one hand a high proportion of variance explained of the underlying time series (38% and 74% respectively) and on the other hand still have a meaningful interpretation in terms of being a factor driven by goods and asset prices or by labor market and output developments as well as by a forward looking assessment of the business cycle development (see Table A-1 in the Appendix). We additionally computed a liquidity stress factor with the notion to influence the slope rather than the level of bond yields. It is derived from a liquidity and volatility series data set with KfW-Bund spreads, bid-ask spreads of Bunds, volatilities and implied volatilities of interest rate bearing instruments and of spreads of secured and unsecured lending each measure computed for longer and shorter maturities.
For all macro factors the null of a unit root is rejected with a standard ADF test at least at the 5% level. The factors are drawn from different subsets of time series and can therefore be correlated. Our price and real activity factor show a correlation of 0.34, the correlation between the real activity and the liquidity stress factor is -0,08.

4 Empirical results

4.1 Influence of macro variables on the term structure

Comparing the yield estimates resulting from the yields-only model and the macro model allows us to shed some light on the relevance of macroeconomic information for the yield estimation. Overall, the root mean squared error (RMSE) of the yield estimates is indeed smaller for the macro model ($RMSE^{mf} = 0.03$) compared to the yields-only model ($RMSE^{lat} = 0.04$), yet yields are fitted comparatively well with both models. Table 1 provides more details for this result, particularly maturity-specific RMSEs. One can see that the RMSEs are higher for short maturities than for longer maturities in both setups. As explained in Section 2, this pattern may be driven by our choice of maturities and the incorporation of Euribor and Eurepo as short rate. However, the results also indicate that the macroeconomic factors do have some meaning for the yield estimation. This result is in line with other papers including macro factors which enter directly as risk factors, such as in Ang and Piazzesi (2003), Ang, Dong, and Piazzesi (2007), Rudebusch and Wu (2008), Smith and Taylor (2009), and Bibkov and Chernov (2010). Since the model is estimated over the whole sample period we are of course void of detecting structural breaks leading to changes in the relevance of macro factors. As a first approach to this issue we

check for the explanatory power of our macro factors by means of sample split in the robustness check section.

Maturity	Macro-Model	Yields-Only
$y^{(12)}$	0.05	0.06
$y^{(60)}$	0.03	0.04
$y^{(120)}$	0.02	0.02

Table 1: RMSEs of yield estimates that are priced with error for macro model and yields-only model.

	$Y(12m)$	$Y(60m)$	$Y(120m)$	$YRP(12m)$	$YRP(60m)$	$YRP(120m)$
Contemporaneously:						
Real activity factor	0.34	0.26	0.11	-0.50	-0.44	-0.42
Price factor	0.08	0.09	0.06	-0.22	-0.25	-0.24
1st Latent	0.85	0.97	0.99	-0.42	-0.33	-0.31
2nd Latent	0.40	0.19	0.00	-0.79	-0.83	-0.84
3rd Latent	0.96	0.84	0.71	-0.85	-0.74	-0.73
12m-Lagged:						
Real activity factor	0.68	0.53	0.37	-0.59	-0.50	-0.49
Price factor	0.09	0.04	-0.00	-0.05	-0.01	-0.00
1st Latent	0.35	0.48	0.63	-0.26	-0.16	-0.15
2nd Latent	0.33	0.15	-0.01	-0.21	-0.28	-0.31
3rd Latent	0.39	0.56	0.60	-0.23	-0.27	-0.29

Table 2: Correlation of the yields that are assumed to be measured with error (left hand panel) and the according yield risk premia (right hand panel) to the model factors.

At least in the long run, one expects yield dynamics to be anyhow related to the macroeconomic fundamentals. Hence, if our macroeconomic factors are indeed able to capture information about those fundamentals, they should be correlated to the yields. For both the macroeconomic and the latent factors, Table 2 provides these correlations to the yields. Not surprisingly, the highest values for the contemporaneous correlation show up for the latent factors. In fact, standard term structure estimations following Dai and Singleton (2000) and Litterman and Scheinkman (1991) featuring just two or three latent factors are capable of reproducing the cross section of the term structure quite well. Concordantly a principal component analysis of the yields used in our estimation shows a high proportion of variance explained for the first PC and the second PC (89% and 9%, respectively), a moderate for the third PC (1%), whereas it falls under 0.1% for all subsequent PCs.

However, when lagging the macroeconomic factors by 12 months, the real activity factor becomes

most correlated with the yields over nearly all maturities. This seems to provide evidence that macro factors are important to forecast yields and hence can be used to represent information that is unspanned by the cross section of yields. This is in line with Joslin, Priebsch, and Singleton (2010) and Ludvigson and Ng (2009) who showed that so called unspanned macro risks that have virtually no effect on the current term structure, may explain a substantial proportion of the variation of forward term premia and excess bond returns (see also Cochrane and Piazzesi (2005) and Duffee (2011)). So even if the cross section of yields might be fairly well described by latent factors, macro risks that could for example be offset by changes in the term premia and therefore cancel out in the cross-sectional analysis of the term structure bear information for future yields.[6]

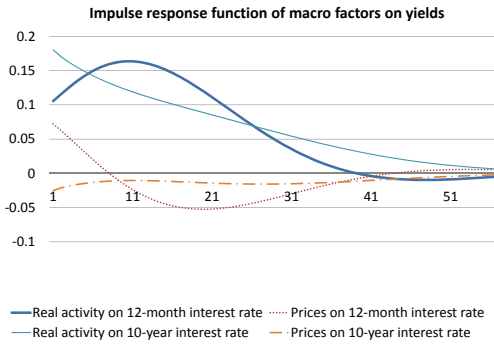


Figure 2: One standard deviation shock of the real activity (price) factor on the x-month interest rate. The response is measured in % p.a. on the y-axis and time is measured in months on the x-axis.

We also derive impulse response functions which show how a shock on a factor affects the yields.[7] A one-standard deviation shock to the real activity factor seem to have stronger and more persistent effects compared to innovations in the price factor especially for longer maturities (see Figure 2). Whereas initial responses of the real activity and price shocks are quite similar on 12-month yields they differ significantly for long term yields. The response of the short rate on a real activity shock shows a hump shaped pattern, peaks after 12 months and wears out after around three years (bold line). A ten-year yield which by definition covers expected future short term yields show the full impact of the shock nearly instantaneously and wears out

[6]The systematic contribution of such unspanned macro factors can be captured technically by putting them into the P (=physical) measure equation where they sum up with the risk factors determining the risk premia. They do not occur in the risk neutral Q measure equation and consequently do not influence the contemporaneous cross sectional pricing of bonds (see Wright (2011) for further explanations).

[7]On account of having clearly interpretable coefficients for the impulse responses we used a partial Gram-Schmidt orthogonalization to correct for correlation between the real activity and the price factor and put most weight on the price factor (see Burgill (2011)). Results with the orthogonalized factor do not differ qualitatively much from those with the original factors. For details on the derivation of impulse response functions in an ATS model, see e.g. Ang and Piazzesi (2003).

more slowly (thin line). Unexpected changes in labor market conditions, GDP growth rates or capacity utilization rates inflict persistent effects on yields. This is somewhat in line with the results Ang and Piazzesi (2003) derived for US data and Hördahl et al. (2006) and Lemke and Stapf (2006) derived for German data before the crises periods. Reactions to innovations in the price factor declined much faster for the 12-month yield and are insignificant for the 10-year yield (dotted and dashed line, respectively). This is in contrast to the higher and more persistent impact of inflation shocks in the US data. Yet, Lemke and Stapf (2006) also find less pronounced responses of German yields to inflation shocks and Hördahl et al. (2006) of yields to monetary policy shocks which is somewhat mirrored in studies finding low coefficients for inflation when estimating Taylor rules for the euro area (see e.g. Gerdesmeier and Roffia (2004)). One possible interpretation for the German result could be that market participants see deviations from the price factor as rather short lived. Consequently they do not adjust expectations on future short-term yields and therefore on long-term yields by much. Having in mind that the price factor captures not only goods but financial assets and raw material prices as well, we compare its low impact with the small wealth effects of asset price changes which are traditionally assumed to be very low in Germany (see Hamburg, Hoffmann, and Keller (2005)). Since asset price changes do not affect income and consumption by much they might not affect interest rates by much, too.

4.2 Risk premia developments during the crisis

For the macro model, we consider now the market prices of risk. Those prices can be understood as the premia that a risk-averse investor demands over the risk-neutral price. In Figure 3, the market prices of risk for every state variable are plotted. They indicate how a shock to the factors, namely u_t in equation 2.1, effects the yields. Note that the very value of the risk prices can hardly be interpreted: The meaning depends on how well the underlying factors are identified. As we use principal components that were extracted from standardized, transformed data, we can only make statements on the sign and the relative change of the series over time. In this sense, Figure 3 allows us to detect remarkable changes of the risk prices over time.

All risk prices indicate either an all-time maximum or minimum for end 2008, thus showing a strong response to the collapse of Lehman Brothers Inc. and its aftermath. However, the premia that were paid for the underlying factor risk returned surprisingly fast to their pre-crisis levels in the following two years -except for the third latent factor. There are two possible explanation lines for that. On a global level the economies and especially interest rates benefitted at that time from substantial and coordinated actions from major central banks to ease liquidity problems. Additionally in most countries fiscal stimulus packages were gotten en route to avoid a collapse of the real economy. Secondly, on a national level Germany recovered relatively

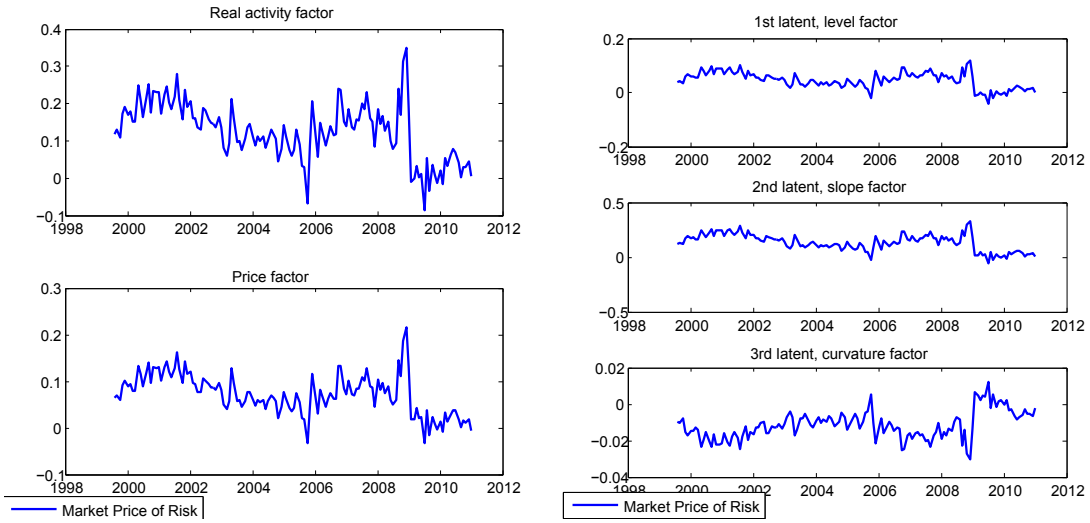


Figure 3: Market prices of risk of the factors of the macro model: All values are divided by 100.

fast from the economic downturn in the wake of the crisis owing to a quick rebound of exports especially directed towards fast developing countries and a robust labor market.
Yield risk premia, on the other hand, can be derived using equation 2.9. Yield risk premia are higher for longer maturities (see Figure 4). Again the shift in risk premia levels since the onset of the banking and sovereign debt crisis is visible in all maturities. Especially the five-to-ten-year forward term premia [8] picked up in the year 2008 after the antecedent period of the great moderation. This is in line with a recent finding by Wright (2011) derived also from an affine term structure model with macro factors for Germany and other countries.[9] Looking at the correlations of the factors with the yield risk premia we see a higher impact of both macro factors (see Table 2 in Section 4.1. The correlation with the price factor becomes now significant at the 5 % level. As it is in boom periods that prices and real activity go up and in bust phases that both go down the yield risk premia exhibits some countercyclicity and therefore a certain degree of predictability (see e.g. Cochrane and Piazzesi (2005)).

Interestingly the yield risk premia shifted more for longer maturities and therefore show a more pronounced rise in the long term forward rate (see Figure 4). Though disruptions in the banking crisis were coming from the money market segment with banks distrusting each other and a drying up of unsecured lending, the uncertainty of future interest rate movements and

[8] The forward term premia is calculated: $(yrp_t^{10y} * 10 - yrp_t^{5y} * 5)/(10 - 5)$.

[9] Wright (2011) shows an overall declining German term premia -though not very pronounced compared to other countries- up to the middle of the first decade of the new millennium. We were not able to reproduce that result. This might very likely be the case because we started our data for the estimation in 1999 whereas his analysis started a decade earlier. The 1990's were indeed a period of much influence on interest rates of German Bunds due to the currency trouble during the ERM crisis and the Asian and Russian crisis towards the end of the decade. Using a longer data sample and only a two latent factor set up we were able to show at least a declining amplitude of term premium fluctuations up to 2007.

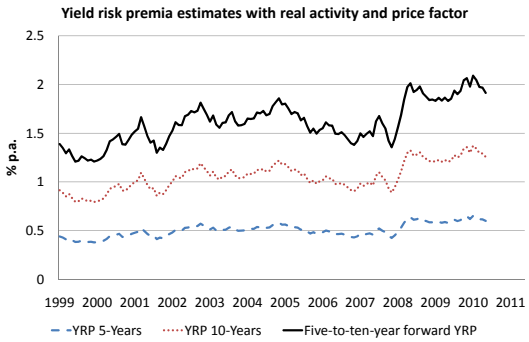


Figure 4: Yield risk premia for the maturities that are assumed to be priced with error.

increasing macro volatility spilled over quickly to longer maturities and caused term premia to increase. The distinct development of term premia of different maturities could also be an indication of investors concentrating more on shorter maturities. Consequently the so-called safe haven flows might have hindered term premia of shorter maturities to increase as much as longer maturities. This interpretation which focus on liquidity influences is somewhat more explained in the next section.

4.3 Including liquidity into the model

In the recent years, financial market participants became increasingly concerned about the liquidity of assets. In times of turbulent markets, investors are willing to pay a premium for assets that can be easily sold at any time. In this section, we follow two ways to investigate the meaning of market liquidity developments for government bond yields. First, we replace our price factor in the macro model by a measure of liquidity stress. Second, we reestimate the whole macro model for the term structure using German agency bond yields instead of German government bond rates.

Bonds issued by the German Agency KfW (Kreditanstalt für Wiederaufbau, Reconstruction Loan Corporation) are backed by an explicit government guarantee and therefore bear the same credit risk as government bonds itself. Yet, Bunds belong to the most liquid assets traded worldwide. They are frequently used as collateral and are deliverables for several contracts on the derivative markets. Compared to that KfW, bonds show a far smaller issued amount outstanding (bn €166 in KfW bonds compared to bn €1080 in Bunds, respectively) and have a lower average issue volume (bn €1,3 in KfW bonds compared to bn €20,9 in Bunds for ten year maturities, respectively). The differences in size and in usage translate into a difference in liquidity, hence the possibility to buy and sell large quantities of the security without affecting its market price (Amihud, Mendelson, and Pederson (2005)). The liquidity differential translates in turn into higher yields of KfW bonds compared to Bunds.

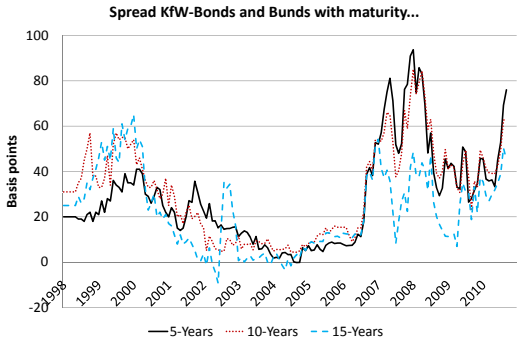


Figure 5: Spread between KfW bonds and Bunds for different maturities.

Figure 5 provides an overview of the five (bold line), ten (dotted line), and fifteen (dashed line) year KfW-Bund spread. The yield spreads indicate a first height in the second half of 2000 and the beginning of 2001, when the burst of the dotcom-bubble turned asset prices down. After coming down again in the following years, the spreads reached a new maximum in end 2008. The spread of shorter maturities that runs in calm periods under that of longer maturities picked up in crisis periods more and drifts above that of longer maturities. This feature of a divergent development of spreads of different maturities provoked sharp fluctuations in forward rates (e.g. the five-to-ten-year forward yield risk premium in Figure 4). It can be captured by introducing a factor that picks up the slope component of liquidity spreads into the model. Our liquidity stress factor features such a slope influencing component. It is the second PC derived from a set of differenced liquidity and volatility variables with different maturities of the underlying instruments. It shows reverse signs on the loadings of the eigenvectors of instruments of shorter maturities compared to longer maturities (see Table A.2 in the Appendix). An estimation of the model with the liquidity stress instead of the price factor and keeping the real activity factor shows a much smoother five-to-ten-year forward yield risk premium (see Figure 6) compared to the estimation without the liquidity factor. Yield risk premia of different maturities run much closer together once divergent liquidity premia are taken care of. Still there is a shift in the forward risk premium in End 2008 at the junction of the recent crisis. This shift can be found in nearly all time series displaying liquidity, volatility or macro risks (see Figures 3 and 5). Liquidity risk variables like the KfW-Bund spread explain therefore a larger amount of the developments of forward premia than they do for forward interest rates.[10]

As a second approach to check for the influence of liquidity on bond yields we estimate the macro model with a real activity and a price factor for the term structure of KfW bonds instead of Bunds. The model delivers a comparable fit ($RMSE^{mfKfW} = 0.03$) to the government bond model. The correlations of the yields with the macro factors are as well alike (see Table A.3 in

[10]The adjusted R^2 increases from 1% to 14% in univariate regressions with a dependent variable forward rate and forward premium, respectively.

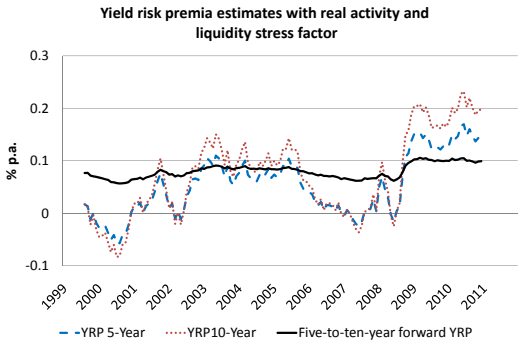


Figure 6: Yield risk premia for the model which include a liquidity stress factor.

the Appendix). This means that fundamental influences to government bonds and KfW bonds are akin to each other. Yet, the correlation to the first latent factor is significantly negative (positive for Bunds) and the positive correlation to the second latent factor is much stronger for the KfW bond model. Since the first latent factor represents influences on levels of yields this indicates that yields of both kind of bonds go in different directions. This is in agreement with the notion of safe haven flows going into the most liquid assets and therefore widening the spread between liquid (Bunds) and less liquid (KfW bonds) instruments. The much stronger effect of the second latent (slope) factor on KfW yields is a consequence of the shift in yield spreads of different maturities during times of crisis. The KfW macro model mirrors therefore findings of including the liquidity factor in the government bond model but does not allow to derive explicit conclusions on the government yield curve and is therefore not developed further.

Introducing a structural policy rule and macro factors into the affine term structure model helps to fundamentally ground long-term interest rate movements. The comparison of the yields-only and the model with macro factors shows the yield influencing effect especially of the real activity factor. Impulse response functions corroborate that unanticipated changes in fundamental factors move the whole term structure for a significant period of time. The recent crises considerably affect risk aversion of market participants and yield risk premia derived within the model. Since German government bonds are considered to be virtually credit risk free we included a liquidity factor to take care of the (liquidity) risk premium shifts. Including a slope influencing liquidity stress factor allows for deriving results from the real activity factor (and the latent factors) on the term structure without interference from save haven flows.

5 Robustness checks

5.1 Estimates with different sample sizes

The ongoing financial crisis which started as a subprime market exaggeration turned into a banking crisis and subsequently a sovereign debt crisis might suggest that not just single variable levels or time series developments changed but that more structural relations have also changed or are interrupted. In order to assess the instability of the influence of macro factors in the monetary policy rule and a subsequent shift in the coefficients of the affine equations for long term rates we split the sample in two parts. Since the crisis sample which starts in 2007 is too short to support a reliable estimation we split the sample into a shorter pre-crisis period (1999-2006) and a whole period sample (1999-2010) -which are already quite short- and look at the difference in the reactions to latent and macro factors in both samples.
Estimations for the long sample and the short (pre crises) sample period display comparatively good fits of the data whereas the short sample shows slightly higher RMSEs for shorter maturities. State variables show comparable loadings over the course of the maturities as well except for the price factor (see Figure A-1 in the Appendix). It shows a positive loading for all maturities within the long sample and only a positive loading for maturities up to 7 months and a negative loading thereafter within the short sample. Possibly, market participants do not adjust their expectations of future short term rates by much during the period of the great moderation before the onset of the recent crises. Yet, differences are statistically not significant and should therefore not be overemphasized. Overall loadings tend to be lower for longer maturities implying that changes in contemporaneous macro variables have a higher influence on short term compared to long term interest rates. Our preliminary conclusion that the recent crises does not render the estimation of a long data sample starting in 1999 meaningless must of course be verified once estimations with only crisis data are viable.

5.2 Forecast experiments

Evaluating a model's out of sample forecasting performance is generally a good way to check its reliability. However, due to data availability it is hardly possible for us to perform a reasonable forecasting exercise: We estimated the model originally for the sample from 1999 to 2010, hence about 140 periods. If we start out of sample forecasting from period 100 onwards till the end of the sample, we would have to deal with at least three problems. First, an initializing sample for the forecasting of only 100 periods is very short. Second, also the 40 remaining periods for the forecasting sample are everything but much and should not be further reduced to expand the initializing sample. Third, and most importantly such a forecasting period would fall in the time of October 2007 to December 2010 and thus directly in the crisis periods. Not surprisingly,

the model is not able to deliver good forecasts for that period.
These problems cannot be cured by ignoring the structural break of the monetary union and starting the estimation before 1999. Especially our preferred model, the macro model with one lag, relies on some measures on the European Monetary Union that did not exist beforehand. However, we did a forecasting experiment with the latent factor approach for a longer sample (11/1982-09/2011). We expanded the Euribor/Eurepo rates by the money market rate reported by Frankfurt banks for the time before 1999. We chose a long forecasting sample, starting in February 1991 and running till August 2011 (hence also covering the crises). While the short maturity forecasts appear to be slightly disturbed by the use of different money market rates, the 10-years bonds could be forecasted one year ahead comparatively well with a root mean squared error of 0.81 percentage points.
The robustness checks are not conclusive in giving advice on the usage of the model with macro factors in the actual crisis period. Whereas the estimation results do not change significantly the forecast performance breaks down. Indeed our model is just one viable approach to a fundamental interpretation of the German term structure. Yet it offers the advantage of including such fundamental macro factors besides unobservable factors that drive the term structure and assign them a certain weight.

6 Conclusion

Using arbitrage-free affine models, we analyzed the dynamics of German bond yields and risk premia for the period 1999 to 2010. We condensed our macro factors from a vast set of time series describing the economic development in Germany, the euro area, the US, and the world as a whole. A heuristic shrinkage procedure helped us to preserve the sparse parameterization of our affine term structure set up by including just two macro factors on the one hand. On the other hand we were still able to catch the influence of a broad variety of real world developments in these two factors by maintaining a high proportion of variance explained of the underlying time series. We found evidence that our macro factors, notably the real activity factor, helped to improve the fit of the model and explained a substantial amount of variation in (future) bond yields. So even if short lived variations in the term structure might be mainly driven by changes in the unobserved slope, level, and curvature factors, longer term developments are more grounded within fundamental factors such as business cycle and growth trends. Looking at the impact of the recent subprime, financial and sovereign debt crises we concluded that risk aversion of market participants captured in the market price of risks of the factors included in the model changed most dramatically for the real activity and the price factor. Offsetting safe have flows affecting especially shorter maturities explain why yield risk premia increase less at the short end as compared to longer maturities in times of crisis. A liquidity stress factor included into the macro model mirrors this slope influencing effect and leads to smoother forward

rates for yield risk premia. The slope influencing factor takes effect especially during times of crises and allow for deriving results from the real activity factor on the term structure without interference from safe haven flows.

Nonetheless forecast experiments hint at more profoundly disturbing effects of the recent crises on the performance of the model. Future research might therefore be directed towards either enlarging the number of factors that describe market behavior during times of crisis or introducing modeling alternatives such as implementing macro factors as unspanned factors and therefore exploring their relation to yield risk premia more closely. Using the same model set up but different term structure data might be another rewarding extension the paper. Since the macro data used comprises time series not only for Germany but the euro area, the US, and world data an estimation with US yields or yields of other European countries is viable.

Appendix

Table A-1: Macro factors: explained variance of PC, significance in univariate regressions and correlation with each other.

Macro factor	Eigenvalues: Proportion of 1st PC	Correlation to first macro factor	Regress. on short rate: Coefficient (T stat)* [Adj. R^2]	Regress. on 1st latent fac.: Coefficient (T stat)* [Adj. R^2]
Real activity factor	0.38	-	0.026 (4.35) [0.35]	0.052 (2.22) [0.05]
Price factor	0.74	0.35	0.017 (1.64) [0.10]	0.031 (1.26) [0.02]
Liquidity stress factor	0.33	-0.08	-0.03 (2.30) [0.05]	-0.09 (1.93) [0.03]

** HAC standard errors with Bartlett kernel, Newey-west fixed.*

Table A-2: Liquidity stress factor extracted through principal component analysis.

Sample: 1999M08 2010M12
Included observations: 137
Computed using: Ordinary correlations
Extracting 2 of 21 possible components
Maximum number of components: 2

Eigenvalues: (Sum = 21, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	6.905449	4.581613	0.3288	6.905449	0.3288
2	2.323835	0.400112	0.1107	9.229284	0.4395

Eigenvectors (loadings):

Variable	PC 1	PC 2
LIQ_KFWBUND_1Y	0.281475	-0.078139
LIQ_KFWBUND_2Y	0.268027	0.045096
LIQ_KFWBUND_3Y	0.322522	0.049510
LIQ_KFWBUND_4Y	0.323149	0.016408
LIQ_KFWBUND_5Y	0.353277	-0.021906
LIQ_KFWBUND_7Y	0.334321	-0.128583
LIQ_KFWBUND_8Y	0.308960	-0.148603
LIQ_KFWBUND_9Y	0.325464	-0.082669
LIQ_KFWBUND_10Y	0.310631	-0.065817
LIQ_KFWBUND_15Y	0.221829	-0.022150
LIQ_BA_DE_2Y	-0.014291	-0.256982
LIQ_BA_DE_10Y	0.053222	-0.020124
BUNDVOLA_10Y_DE	-0.003282	0.198572
BUNDVOLA_IMPL10Y_DE	0.042848	0.356329
EURIBORVOLA_EWU	0.063398	0.110230
EURIBORVOLA_IMPL_EWU	0.068167	0.299934
BUND_EURIBOR_SPREAD_EW	0.072655	-0.107811
IRSWAP_EWU	0.073052	0.529139
OIS_EURIBORSPREAD_EWU	0.105481	-0.003035
YIELDSPREADCORP_EWU	0.075123	0.528645
SPITZENREFI_NUTZUNG_EWU	0.126074	0.179848

Table A-3: Correlation of the yields that are assumed to be measured with error to the model factors for estimation with KfW bonds.

	$y(12m)$	$y(60m)$	$y(120m)$
Contemporaneously:			
Real activity factor	0.34	0.26	0.11
Price factor	0.08	0.09	0.06
1st Latent	-0.21	-0.28	-0.47
2nd Latent	0.97	0.90	0.79
3rd Latent	0.20	-0.18	-0.45
12m-Lagged:			
Real activity factor	0.70	0.56	0.39
Price factor	0.09	0.04	-0.00
1st Latent	0.14	-0.10	-0.32
2nd Latent	0.43	0.57	0.70
3rd Latent	0.11	0.05	-0.05

Table A-4: Data description

#	Group	Variable	Trans form.*)	Source
EMU time series				
1	Prices	Wholesale producer prices all items, sa	5	BIS
2		Euro area (changing composition) - HICP - All-items excluding energy and food, Monthly Index, European Central Bank, sa	5	ECB
3		Euro area (changing composition) - HICP - Overall index, Monthly Index, European Central Bank, sa	5	ECB
4		Euro area (changing composition) - Farm-gate and wholesale market prices in euro, Total	5	ECB
5	Financials	Money stock M1, national concept, sa	2	BIS
6		Money stock M3, national concept, sa	2	BIS
7		Money stock M3, national concept, sa	2	BIS
8		stock-exchange prices , shares, overall index, nsa	2	BIS
9	Surveys	Consumer confidence indicator, sa	1	BIS
10		Business confidence indicator, sa	1	BIS
11		EMU Construction - Business situation: present , sa / Quantum (non-additive or stock figures) , sa	1	OECD
12		EMU Construction - Confidence indicator , sa / Quantum (non-additive or stock figures) , sa	1	OECD
13		EMU Construction - Employment: future tendency , sa / Quantum (non-additive or stock figures) , sa	1	OECD
14		EMU Retail trade - Business situation: present , sa / Quantum (non-additive or stock figures) , sa	1	OECD
15		EMU Retail trade - Confidence indicator , sa / Quantum (non-additive or stock figures) , sa	1	OECD
16		EMU Manufacturing - Industrial confidence indicator , sa / Quantum (non-additive or stock figures) , sa	1	OECD
17		EMU Manufacturing - Employment: future tendency , sa / Quantum (non-additive or stock figures) , sa	1	OECD
18		EMU Services - Business situation: present , sa / Quantum (non-additive or stock figures) , sa	1	OECD
19		EMU Services - Employment: future tendency , sa / Quantum (non-additive or stock figures) , sa	1	OECD
20		EMU Consumer - Confidence indicator , sa / Quantum (non-additive or stock figures) , sa	1	OECD
21		EMU Consumer - Expected economic situation , sa / Quantum (non-additive or stock figures) , sa	1	OECD
22		EMU Consumer - Prices: future tendency , sa / Quantum (non-additive or stock figures) , sa	1	OECD
23	Retail sales	Retail sales value, sa	2	BIS
24		EMU , sales of total manufactured goods (Value) , sa / Index publication base , sa	2	OECD
25		EMU Total retail trade (Value) , sa / Index publication base , sa	2	OECD
26	Labor market	Unemployment rate young person, sa	6	BIS
27		Unermployment rate adult person, sa	6	BIS
28		Wagerates in whole economy, nsa	2	BIS
29		Euro area (changing composition) - Indicator of negotiated wage rates, Total, Annual rate of change	5	ECB
30		Euro area (changing composition) - Standardised unemployment, Rate, Total (all ages), Total (male & female)	6	ECB
31		EMU Harmonised unemployment rate: all persons , sa / Quantum (non-additive or stock figures) , sa	6	OECD
32	Raw materials	Hamburg World Economic Archive - Raw material prices 2000 = 100	2	HWWA
33	BOP	Merchandise Imports, Cif, total, nsa	2	BIS
34	Industry production	EMU Total PPI Industrial activities / Index publication base	2	OECD
35		EMU Production of total construction / Index publication base , sa	2	OECD
36		EMU Production of total industry / Index publication base , sa	2	OECD
37		EMU Production in total manufacturing / Index publication base , sa	2	OECD
38	monetary aggregate	M1, sa	2	ECB
39		M2, sa	2	ECB
40		M3, sa	6	ECB
41		M2_M1, sa	2	ECB
42		M3_M2, sa	2	ECB
43		CASH, sa	2	ECB
44		Overnigt deposits, sa	6	ECB
45		Time deposits, sa	2	ECB
46		Savings deposits, sa	2	ECB
47		REPOS, sa	2	ECB
48		Money market shares, sa	6	ECB
49		LOANS to the privat sector, sa	6	ECB
50		LOANS to the privat sector adjusted with securitizations, sa	5	ECB
51		LOANS to private housholds, nsa	5	ECB
52		LOANS to non financial companies, nsa	5	ECB
53		LOANSto other financial companiesOFI, nsa	6	ECB
54		Consumtion loans to private housholds, nsa	6	ECB
55		Housing loans to private housholds, nsa	5	ECB
56		Other loans to privarte housholds, nsa	5	ECB
57		LOANS to non financial companies with maturity up to 1 year, nsa	5	ECB
58		LOANS to non financial companies with maturity up to 5 years, nsa	5	ECB
59		LOANS to non financial companies with maturity longe than 5 years, nsa	5	ECB
60		Deposits, all excluding general governement, nsa	5	ECB
61		Deposits, other financial institutions, nsa	5	ECB
62		Deposits, non financial institutions, nsa	5	ECB
63		Deposits, private housholds, nsa	5	ECB
64		Deposits, all excluding general governement, sa	6	ECB
65		Time deposits, all excluding general governement, nsa	5	ECB
66		Time deposits, other financial institutions, nsa	5	ECB
67		Time deposits, non financial institutions, nsa	5	ECB
68		Time deposits, private housholds, nsa	5	ECB
69		Time deposits, all excluding general governement, sa	6	ECB
70		Savings deposits, all excluding general governement, nsa	5	ECB
71		Savings deposits, other financial institutions, nsa	5	ECB
72		Savings deposits, non financial institutions, nsa	6	ECB
73		Savings deposits, private housholds, nsa	5	ECB
74		Savings deposits, all excluding general governement, sa	5	ECB
75		Long term deposits, all excluding general governement, nsa	5	ECB
76		Long term deposits, other financial institutions, nsa	5	ECB
77		Long term deposits, non financial institutions, nsa	6	ECB
78		Long term deposits, private housholds, nsa	5	ECB
79		Long term deposits, all excluding general governement, sa	5	ECB
80		Long term savings deposits, all excluding general governement, nsa	5	ECB
81		Long term savings deposits, other financial institutions, nsa	5	ECB
82		Long term savings deposits, non financial institutions, nsa	5	ECB
83		Long term savings deposits, private housholds, nsa	5	ECB
84		Long term savings deposits, all excluding general governement, sa	5	ECB
85		Deposits of private housholds and cash, nsa	5	ECB
86		Deposits of private housholds, cash and repos, nsa	5	ECB
87		Sight deposits (excluding general government), sa	5	ECB
US time series				
88	Consumer Prices	CPI: all items (urban)	5	www.bls.gov/news.release/pdf/cpi.pdf
89		CPI: food and beverages	5	www.bls.gov/news.release/pdf/cpi.pdf
90		CPI: housing	5	www.bls.gov/news.release/pdf/cpi.pdf
91		CPI: apparel	5	www.bls.gov/news.release/pdf/cpi.pdf
92		CPI: transportation	5	www.bls.gov/news.release/pdf/cpi.pdf
93		CPI: medical care	5	www.bls.gov/news.release/pdf/cpi.pdf
94		CPI: commodities	5	www.bls.gov/news.release/pdf/cpi.pdf
95		CPI: commodities, durables	5	www.bls.gov/news.release/pdf/cpi.pdf
96		CPI: services	5	www.bls.gov/news.release/pdf/cpi.pdf
97		CPI: all items less food	5	www.bls.gov/news.release/pdf/cpi.pdf
98		CPI: all items less food and energy	5	www.bls.gov/news.release/pdf/cpi.pdf
99		CPI: all items less shelter	5	www.bls.gov/news.release/pdf/cpi.pdf
100		CPI: all items less medical care	5	www.bls.gov/news.release/pdf/cpi.pdf
101	Foreign Exchange I	Nominal effective exchange rate	2	www.census.gov/indicator/www/m3/prel/pdf/s-i-o.pdf
102		Spot Euro/US (2)	2	www.federalreserve.gov/releases/h10/update
103		Spot SZ/US (2)	2	www.federalreserve.gov/releases/h10/update
104		Spot Japan/US	2	www.federalreserve.gov/releases/h10/update
105		Spot UK/US	2	www.federalreserve.gov/releases/h10/update
106		Spot CA/US	2	www.federalreserve.gov/releases/h10/update
107	GDP	Sales: Mfg. & Trade: Total (mil of chained 96$)	2	www.ism.ws/ISMReport/
108		Sales: Mfg. & Trade: Mfg., total (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
109		Sales: Mfg. & Trade: Mfg., durables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
110		Sales: Mfg. & Trade: Mfg., nondurables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
111		Sales: Mfg. & Trade: Merchant wholesale (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
112		Sales: Mfg. & Trade: Merchant wholesale, durables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
113		Sales: Mfg. & Trade: Merchant wholesale, nondurables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
114		Sales: Mfg. & Trade: Retail trade (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
115		PCE: Total (bil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
116		PCE: Durables (bil of chained 96$)	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
117		PCE: Nondurables (bil of chained 96$)	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
118		PCE: Services (bil of chained 96$)	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
119		PCE: Durables - MVP -New autos (bil of chained 96$)	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
120		Inventories: Mfg. & Trade, Total (mil of chained 96$)	2	www.census.gov/const/C30/release.pdf

Table A-4: Data description contind.

#	Group	Variable	Trans form.*	Source
121	GDP	Inventories: Mfg. & Trade, Mfg. (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
122		Inventories: Mfg. & Trade, Mfg., durables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
123		Inventories: Mfg. & Trade, Mfg., nondurables (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
124		Inventories: Mfg. & Trade, Merchant wholesales (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
125		Inventories: Mfg. & Trade, Retail trade (mil of chained 96$)	2	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
126		PCE: chain weight price index: Total	5	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
127		PCE prices: total excl food and energy	5	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
128		PCE prices: durables	5	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
129		PCE prices: nondurables	5	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
130		PCE prices: services	5	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
131		Real GDP growth (annualized qurterly change)	2	www.bea.gov/National/Index.htm
132		Real disposable personal income	2	/www.bea.gov/bea/newsrel/pinewsrelease.htm
133	Housing	New 1-family houses sold: Total (thous)	2	www.census.gov/const/newresconst.pdf
134		New 1-family houses - months supply@ current rate	2	www.census.gov/const/newressales.pdf
135		New 1-family houses for sale at end of period (thous)	2	www.census.gov/const/newressales.pdf
136		Mobile homes - mfg. shipments (thous) (SA)	2	www.census.gov/const/newressales.pdf
137		Privately-owned housing, started: Total (thous)	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
138		New privately-owned housing authorized: Total (thous)	2	www.census.gov/const/newresconst.pdf
139	Industrial productio	Total	2	www.federalreserve.gov/releases/G17
140		Final Products and non-industrial supplies	2	www.federalreserve.gov/releases/G18
141		Final Products	2	www.federalreserve.gov/releases/G19
142		Consumer goods	2	www.federalreserve.gov/releases/G20
143		Durable consumer goods	2	www.federalreserve.gov/releases/G21
144		Nondurable consumer goods	2	www.federalreserve.gov/releases/G22
145		Business equipment	2	www.federalreserve.gov/releases/G23
146		Materials	2	www.federalreserve.gov/releases/G24
147		Materials, nonenergy, durables	2	www.federalreserve.gov/releases/G25
148		Materials, nonenergy, nondurables	2	www.federalreserve.gov/releases/G26
149		Mfg. (NAICS)	2	www.federalreserve.gov/releases/G27
150		Mfg., durables (NAICS)	2	www.federalreserve.gov/releases/G28
151		Mfg., nondurables (NAICS)	2	www.federalreserve.gov/releases/G29
152		Mining (NAICS)	2	www.federalreserve.gov/releases/G30
153		Utilities (NAICS)	2	www.federalreserve.gov/releases/G31
154		Energy, total (NAICS)	2	www.federalreserve.gov/releases/G32
155		Non-energy, total (NAICS)	2	www.federalreserve.gov/releases/G33
156		Motor vehicles and parts (MVP) (NAICS)	2	www.federalreserve.gov/releases/G34
157		Computers, comm. Equip., semiconductors (CCS) (NAICS)	2	www.federalreserve.gov/releases/G35
158		Non-energy excl CCS (NAICS)	2	www.federalreserve.gov/releases/G36
159		Non-energy excl CCS and MVP (NAICS)	2	www.federalreserve.gov/releases/G37
160	Capacity utilization	Capacity Utilization: Total (NAICS)	2	www.federalreserve.gov/releases/G38
161		Capacity Utilization: Mfg. (NAICS)	2	www.federalreserve.gov/releases/G39
162		Capacity Utilization: Mfg., durables (NAICS)	2	www.federalreserve.gov/releases/G40
163		Capacity Utilization: Mfg., nondurables (NAICS)	2	www.federalreserve.gov/releases/G41
164		Capacity Utilization: Mining	2	www.federalreserve.gov/releases/G42
165		Capacity Utilization: Utilities	2	www.federalreserve.gov/releases/G43
166		Capacity Utilization: Computers, comm. Equip., semiconductors	2	www.federalreserve.gov/releases/G44
167		Capacity Utilization: Mfg. excl CCS	2	www.federalreserve.gov/releases/G45
168	Financials	Avg. weekly initial claims	2	http://www.bls.gov/news.release/pdf/empsit.pdf
169		Interest rate: federal funds rate	2	www.federalreserve.gov/releases/cp
170		Interest rate: U.S. 3-mo. Treasury (sec. Market)	2	www.federalreserve.gov/releases/h15/update
171		Interest rate: U.S. 6-mo. Treasury (sec. Market)	2	www.federalreserve.gov/releases/h15/update
172		Interest rate: 1-year Treasury (constant maturity)	2	www.federalreserve.gov/releases/h15/update
173		Interest rate: 5-year Treasury (constant maturity)	2	www.federalreserve.gov/releases/h15/update
174		Interest rate: 7-year Treasury (constant maturity)	2	www.federalreserve.gov/releases/h15/update
175		Interest rate: 10-year Treasury (constant maturity)	2	www.federalreserve.gov/releases/h15/update
176		Bond yield: Moodys AAA Corporate	2	www.federalreserve.gov/releases/h15/update
177		Bond yield: Moodys BAA Corporate	2	www.federalreserve.gov/releases/h15/update
178		Primary market yield on 30-year fixed mortgage	2	www.federalreserve.gov/releases/h15/update
179		New car loans at auto finance companies (NSA): loan to value ration	5	www.federalreserve.gov/releases/g19
180		New car loans at auto finance companies (NSA): Amount finance ($)	5	www.federalreserve.gov/releases/g19
181		Commercial paper month-end outstanding: Total (mil of $)	2	www.federalreserve.gov/releases/h10/update
182		M1 (mil of $)	2	www.federalreserve.gov/releases/h9
183		M2 (mil of $)	2	www.federalreserve.gov/releases/h10
184		Monetary base (mil of $)	5	www.federalreserve.gov/releases/h3
185		Depository institutions reserves: Total (mil of $)	2	www.federalreserve.gov/releases/h4
186		Depository institutions: nonborrowed (mil of $)	2	www.federalreserve.gov/releases/h5
187		Loans and Securities @ all commercial banks: Total (mil of $)	2	www.federalreserve.gov/releases/h8
188		Loans and Securities @ all comm. banks: Securities, total (mil of $)	5	www.federalreserve.gov/releases/h9
189		Loans and Securities @ all comm. banks: Securities, U.S. govt. (mil of $)	5	www.federalreserve.gov/releases/h10
190		Loans and Securities @ all comm. banks: Real estate loans (mil of $)	5	www.federalreserve.gov/releases/h11
191		Loans and Securities @ all comm. banks: Comm. And Indus. Loans (mil of $)	5	www.federalreserve.gov/releases/h12
192		Loans and Securities @ all comm. Banks: Consumer loans (mil of $)	5	www.federalreserve.gov/releases/h13
193	Labor market	Unemployment rate	2	http://www.bea.gov/bea/newsrel/pinewsrelease.htm
194		Participation rate	2	http://www.bls.gov/news.release/pdf/empsit.pdf
195		Mean duration of unemployment	2	http://www.bls.gov/news.release/pdf/empsit.pdf
196		Persons unemployed less than 5 weeks	2	http://www.bls.gov/news.release/pdf/empsit.pdf
197		Persons unemployed 5 to 14 weeks	2	http://www.bls.gov/news.release/pdf/empsit.pdf
198		Persons unemployed 15 to 26 weeks	2	http://www.bls.gov/news.release/pdf/empsit.pdf
199		Persons unemployed 15+ weeks	5	http://www.bls.gov/news.release/pdf/empsit.pdf
200		Employment on nonag payrolls: Total	6	http://ows.doleta.gov/unemploy/claims.asp
201		Employment on nonag payrolls: Total private	6	http://www.bls.gov/news.release/pdf/empsit.pdf
202		Employment on nonag payrolls: Goods-producing	6	http://www.bls.gov/news.release/pdf/empsit.pdf
203		Employment on nonag payrolls: Mining	5	http://www.bls.gov/news.release/pdf/empsit.pdf
204		Employment on nonag payrolls: Construction	6	http://www.bls.gov/news.release/pdf/empsit.pdf
205		Employment on nonag payrolls: Manufacturing	6	http://www.bls.gov/news.release/pdf/empsit.pdf
206		Employment on nonag payrolls: Manufacturing, durables	6	http://www.bls.gov/news.release/pdf/empsit.pdf
207		Employment on nonag payrolls: Manufacturing, nondurables	5	http://www.bls.gov/news.release/pdf/empsit.pdf
208		Employment on nonag payrolls: Service-producing	5	http://www.bls.gov/news.release/pdf/empsit.pdf
209		Employment on nonag payrolls: Transportation and warehousing	5	http://www.bls.gov/news.release/pdf/empsit.pdf
210		Employment on nonag payrolls: Utilities	5	http://www.bls.gov/news.release/pdf/empsit.pdf
211		Employment on nonag payrolls: Retail trade	5	http://www.bls.gov/news.release/pdf/empsit.pdf
212		Employment on nonag payrolls: Wholesale trade	6	http://www.bls.gov/news.release/pdf/empsit.pdf
213		Employment on nonag payrolls: Financial activities	5	http://www.bls.gov/news.release/pdf/empsit.pdf
214		Employment on nonag payrolls: Professional and business services	6	http://www.bls.gov/news.release/pdf/empsit.pdf
215		Employment on nonag payrolls: Education and health services	5	http://www.bls.gov/news.release/pdf/empsit.pdf
216		Employment on nonag payrolls: Leisure and hospitality	5	http://www.bls.gov/news.release/pdf/empsit.pdf
217		Employment on nonag payrolls: Other services	5	http://www.bls.gov/news.release/pdf/empsit.pdf
218		Employment on nonag payrolls: Government	5	http://www.bls.gov/news.release/pdf/empsit.pdf
219		Avg. weekly hrs. of production of nonsupervisory workers: Total private	2	http://www.bls.gov/news.release/pdf/empsit.pdf
220		Avg. weekly hrs. of PNW: Mfg.	2	http://www.bls.gov/news.release/pdf/empsit.pdf
221		Avg. Weekly overtime hrs. of PNW: Mfg.	2	http://www.bls.gov/news.release/pdf/empsit.pdf
222		Avg. hourly earnings: Total nonagricultural ($)	5	http://www.bls.gov/news.release/pdf/empsit.pdf
223		Avg. hourly earnings: Construction ($)	5	http://www.bls.gov/news.release/pdf/empsit.pdf
224		Avg. hourly earnings: Mfg. ($)	5	http://www.bls.gov/news.release/pdf/empsit.pdf
225		Avg. hourly earnings: Transportation ($)	2	http://www.bls.gov/news.release/pdf/empsit.pdf
226		Avg. hourly earnings: Retail trade ($)	2	http://www.bls.gov/news.release/pdf/empsit.pdf
227		Avg. hourly earnings: Wholesale trade ($)	6	http://www.bls.gov/news.release/pdf/empsit.pdf
228		Avg. hourly earnings: Finance, insurance, and real estate ($)	1	http://www.bls.gov/news.release/pdf/empsit.pdf
229		Avg. hourly earnings: Professional and business services ($)	1	http://www.bls.gov/news.release/pdf/empsit.pdf
230		Avg. hourly earnings: Education and health services ($)	1	http://www.bls.gov/news.release/pdf/empsit.pdf
231		Avg. hourly earnings: Other services	1	www.bls.gov/news.release/pdf/empsit.pdf
232	BOP	Total merchandise exports, total census basis (mil of $)	1	www.census.gov/foreign-trade/Press-Release/
233		Total merchandise imports, total census basis (mil of $)	1	www.census.gov/foreign-trade/Press-Release/
234		Total merchandise imports (CIF value) (mil of $) (NSA)	1	www.census.gov/foreign-trade/Press-Release/
235	Debt	Federal govt. deficit or surplus (bil of $) (NSA)	2	http://www.fms.treas.gov/mts/
236	Retail sales	Sales: Retail & food services, total (mil of $)	2	www.census.gov/svsd/www/fullpub.pdf
237	Construction	Construction put in place: Total (mil of current $)	2	www.census.gov/const/www/mhsindex.html
238		Construction put in place: Private (mil of current $)	2	www.census.gov/const/C30/release.pdf
239		New Orders: All manufacturing industries (mil of $)	2	www.ism.ws/ISMReport/

Table A-4: Data description contind.

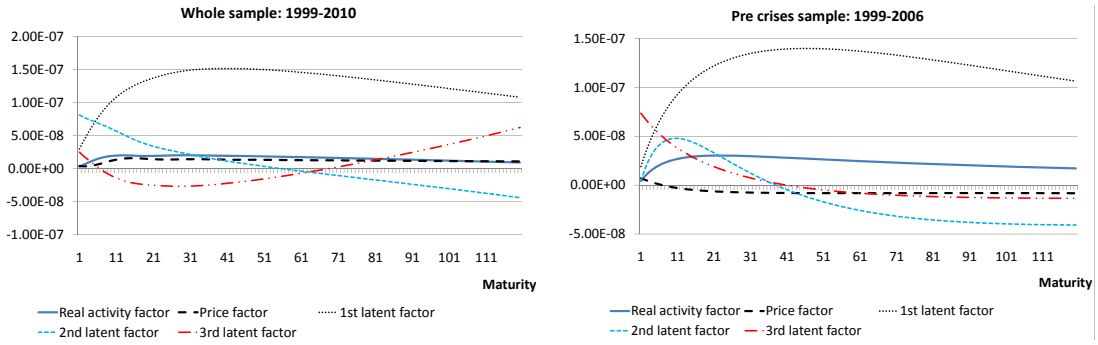
#	Group	Variable	Trans form.*	Source
240	Construction	New Orders: All manufacturing industries w/unfilled orders (mil of $)	2	www.census.gov/indicator/www/m3/prel/pdf/s-i-o.pdf
241		New Orders: Durable goods industries (mil of $)	2	www.census.gov/indicator/www/m3/prel/pdf/s-i-o.pdf
242		New Orders: Nondurable goods industries (mil of $)	2	www.census.gov/indicator/www/m3/adv/pdf/durgd.pdf
243		New Orders: Nondefense capital goods (mil of $)	2	www.census.gov/indicator/www/m3/prel/pdf/s-i-o.pdf
244		Unfilled Orders: All manufacturing industries (mil of $)	5	www.census.gov/indicator/www/m3/adv/pdf/durgd.pdf
245	Prices	PPI: finished goods (1982=100 for all PPI data)	5	www.bls.gov/news.release/pdf/ppi.pdf
246		PPI: finished goods less food and energy	5	www.bls.gov/news.release/pdf/ppi.pdf
247		PPI: finished consumer goods	5	www.bls.gov/news.release/pdf/ppi.pdf
248		PPI: intermediate materials	5	www.bls.gov/news.release/pdf/ppi.pdf
249		PPI: crude materials	5	www.bls.gov/news.release/pdf/ppi.pdf
250		PPI: finished goods excl food	5	www.bls.gov/news.release/pdf/ppi.pdf
251		PPI: crude nonfood materials less energy	5	www.bls.gov/news.release/pdf/ppi.pdf
252		PPI: crude materials less energy	5	www.bls.gov/news.release/pdf/ppi.pdf
253	Survey	Michigan Survey: Index of consumer sentiment	1	www.sca.isr.umich.edu/main.php
254		Chicago Fed Midwest Mfg. Survey: General activity	1	www.chicagofed.org/economic_research_and_data/cfmmi.cf
255		ISM mfg index: employment	1	http://www.bls.gov/news.release/pdf/empsit.pdf
256		ISM mfg index: inventories	1	www.bea.gov/bea/dn/nipaweb/nipa_underlying/Index.asp
257		ISM mfg index: new orders	1	www.ism.ws/ISMReport/
258		ISM mfg index: suppliers deliveries	1	www.ism.ws/ISMReport/
259		Purchasing Managers Index (PMI)	1	www.ism.ws/ISMReport/
260		ISM mfg index: production (Institute for Supply Management)	1	www.ism.ws/ISMReport/
261	Surveys	Outlook: General activity	1	www.phil.frb.org/econ/bos/index.cfm
262		Outlook: New Orders	1	www.phil.frb.org/econ/bos/index.cfm
263		Outlook: Shipments	2	www.phil.frb.org/econ/bos/index.cfm
264		Outlook: Inventories	2	www.phil.frb.org/econ/bos/index.cfm
265		Outlook: Unfilled orders	2	www.phil.frb.org/econ/bos/index.cfm
266		Outlook: Prices paid	2	www.phil.frb.org/econ/bos/index.cfm
267		Outlook: Prices received	2	www.phil.frb.org/econ/bos/index.cfm
268		Outlook: Employment	2	www.phil.frb.org/econ/bos/index.cfm
269		Outlook: Work hours	2	www.phil.frb.org/econ/bos/index.cfm
German time series				
270	Domestic prices	Producer price index, sa	5	Bundesbank dataset
271		Producer price index without energy, sa	5	Bundesbank dataset
272		Consumer price index, sa	5	Bundesbank dataset
273		Consumer price index without energy, sa	5	Bundesbank dataset
274		Consumer price index, energy, sa	5	Bundesbank dataset
275		Import prices without energy, sa	5	Bundesbank dataset
276		Import prices, energy, sa	5	Bundesbank dataset
277		Export prices, sa	5	Bundesbank dataset
278	Labor market	Labor force, sa	5	Bundesbank dataset
279		Emloyees according to ESVG '95, sa	5	Bundesbank dataset
280		Unemployed, sa	5	Bundesbank dataset
281		Unemployment rate, sa	2	Bundesbank dataset
282		Employees, short term	5	Bundesbank dataset
283		Vacancies, sa	5	Bundesbank dataset
284		Employees and self employed, manufacturing, sa	5	Bundesbank dataset
285		working hours per employee, manufacturing, sa wda	5	Bundesbank dataset
286	Financials	CDAX share price index / Basis: Ultimo 1987 = 100 / Month-end	5	Bundesbank dataset
287		DAX Performance index / Basis: Ultimo 1987 = 1000 / Month-end	5	Bundesbank dataset
288		REX German bond index/ Month-end	5	Bundesbank dataset
289		Exchange rate / 1 USD = ... Euro	5	Bundesbank dataset
290		Nominal effective Exchang rate of Euro (17) against currencies of EWK-40-Group	5	Bundesbank dataset
291		Indicator of Germany's price competitveness against 19 industrial countries based on consumer prices	5	Bundesbank dataset
292		Monetary aggregates-Index of notional stocks- M1 - Total, sa	5	Bundesbank dataset
293		Monetary aggregates-Index of notional stocks M2 - Total, sa	5	Bundesbank dataset
294		Monetary aggregates-Index of notional stocks M3 - Total, sa	5	Bundesbank dataset
295	Industrial productio	Production: Energy, sa ca	5	Bundesbank dataset
296		Production: Intermediate godds industry, sa ca	5	Bundesbank dataset
297		Production: durable goods industry, sa ca	5	Bundesbank dataset
298		Production: Durable and non-durable consumer goods, sa ca	5	Bundesbank dataset
299		Production: Steel, sa	5	Bundesbank dataset
300		Production: Mechanical engeneering, sa	5	Bundesbank dataset
301		Production: Electrical engeneering, sa	5	Bundesbank dataset
302		Production: Vehicle engeneering, sa	5	Bundesbank dataset
303		Production: Passenger cars, sa	5	Bundesbank dataset
304		Production: Trucks, sa	5	Bundesbank dataset
305		Domestic turnover: Intermediate goods industry, sa cda	5	Bundesbank dataset
306		Export turnover: Intermediate goods industry, sa cda	5	Bundesbank dataset
307		Domestic turnover: cdapital goods industry, sa cda	5	Bundesbank dataset
308		Export turnover: cdapital goods industry, sa cda	5	Bundesbank dataset
309		Domestic turnover: Durable and non-durable consumer goods industry, sa cda	5	Bundesbank dataset
310		Export turnover: Durable and non-durable consumer goods industry, sa cda	5	Bundesbank dataset
311		Domestic turnover: Mechanical engineering, sa cda	5	Bundesbank dataset
312		Export turnover: Mechanical engineering, sa cda	5	Bundesbank dataset
313		Domestic turnover: Electrical engineering, sa cda	5	Bundesbank dataset
314		Export turnover: Electrical engineering, sa cda	5	Bundesbank dataset
315		Domestic turnover: Vehicle engineering, sa cda	5	Bundesbank dataset
316		Export turnover: Vehicle engineering, sa cda	5	Bundesbank dataset
317		Orders received by the intermediate goods industry from the domestic market, sa cda	5	Bundesbank dataset
318		Orders received by the intermediate goods industry from abroad, sa cda	5	Bundesbank dataset
319		Orders received by the capital goods industry from the domestic market, sa cda	5	Bundesbank dataset
320		Orders received by the capital goods industry from abroad, sa cda	5	Bundesbank dataset
321		Orders received by the consumer goods industry from the domestic market, sa cda	5	Bundesbank dataset
322		Orders received by the consumer goods industry from abroad, sa cda	5	Bundesbank dataset
323		Orders received by the mechanical engineering industry from the domestic market, sa cda	5	Bundesbank dataset
324		Orders received by the mechanical engineering goods industry from abroad, sa cda	5	Bundesbank dataset
325		Orders received by the electrical engineering industry from the domestic market, sa cda	5	Bundesbank dataset
326		Orders received by the electrical engineering goods industry from abroad, sa cda	5	Bundesbank dataset
327		Orders received by the vehicle engineering industry from the domestic market, sa cda	5	Bundesbank dataset
328		Orders received by the vehicle engineering goods industry from abroad, sa cda	5	Bundesbank dataset
329		Industrial production, sa cda	5	Bundesbank dataset
330	Construction	Orders received by the construction sector: Building construction, sa	5	Bundesbank dataset
331		Orders received by the construction sector: Civil engineering, sa	5	Bundesbank dataset
332		Orders received by the construction sector: Residential building, sa	5	Bundesbank dataset
333		Orders received by the construction sector: Non-residential building, sa	5	Bundesbank dataset
334		man-hours worked in building construction, sa cda	5	Bundesbank dataset
335		man-hours worked in civil engineering, sa cda	5	Bundesbank dataset
336		man-hours worked in residential building, sa cda	5	Bundesbank dataset
337		man-hours worked in industrial building, sa cda	5	Bundesbank dataset
338		man-hours worked in public building, sa cda	5	Bundesbank dataset
339		Turnover: Building construction, sa cda	5	Bundesbank dataset
340		Turnover: Civil engineering, sa cda	5	Bundesbank dataset
341		Turnover: Residential building, sa cda	5	Bundesbank dataset
342		Turnover: Industrial building, sa cda	5	Bundesbank dataset
343		Turnover: Public building, sa cda	5	Bundesbank dataset
344		Production in the construction sector, sa cda	5	Bundesbank dataset
345	Surveys	IFO surveys: Business climate: Capital good producers	1	Bundesbank dataset
346		IFO surveys: Business climate: Durable consumer good producers	1	Bundesbank dataset
347		IFO surveys: Business climate: Non-durable consumer good producers	1	Bundesbank dataset
348		IFO surveys: Business climate: Retail trade	1	Bundesbank dataset
349		IFO surveys: Business climate: Wholesale trade	1	Bundesbank dataset
350		IFO surveys: Business expectations for the next six months: Capital good producers	1	Bundesbank dataset
351		IFO surveys: Business expectations for the next six months: Durable consumer good producers	1	Bundesbank dataset
352		IFO surveys: Business expectations for the next six months: Non-durable consumer good producers	1	Bundesbank dataset
353		IFO surveys: Business expectations for the next six months: Retail trade	1	Bundesbank dataset
354		IFO surveys: Business expectations for the next six months: Wholesale trade	1	Bundesbank dataset
355		IFO surveys:Stocks of finished goods: Capital good producers	1	Bundesbank dataset
356		IFO surveys:Stocks of finished goods: Durable consumer good producers	1	Bundesbank dataset
357		IFO surveys:Stocks of finished goods: Non-durable consumer good producers	1	Bundesbank dataset
358		Consumer confidence	1	Bundesbank dataset
359		GFK consumer surveys: Income expectations	1	Bundesbank dataset

Table A. 4: Data description contind.

#	Group	Variable	Transfi	Source
360	Surveys	GFK consumer surveys: Business cycle expectations	1	Bundesbank dataset
361		GFK consumer surveys: Propensity to consume	1	Bundesbank dataset
362		GFK consumer surveys: Consumer climate	4	Bundesbank dataset
363		GFK consumer surveys: Price expectations	1	Bundesbank dataset
364		ZWE financial market survey: Business cycle expectations	4	Bundesbank dataset
365	Retail sales	Turnover wholesale trades, sa cda	5	Bundesbank dataset
366		Turnover retail sales trades, sa cda	5	Bundesbank dataset
367		Turnover retail sales trades: Telecommunication, sa cda	5	Bundesbank dataset
368		Turnover retail sales trades: Textiles, sa cda	5	Bundesbank dataset
369		Turnover retail sales trades without vehicles, sa cda	5	Bundesbank dataset
370		New car registration, sa	5	Bundesbank dataset
371		Light fuel oil: Delivery for consumption, sa	5	Bundesbank dataset
372		Gasolene: Delivery for consumption, sa	5	Bundesbank dataset
373	Balance of paymen	Current account: Export volumes, sa	5	Bundesbank dataset
374		Current account: Import volumes, sa	5	Bundesbank dataset
375		Current account: Services exports volumes sa	5	Bundesbank dataset
376		Current account: Services import volumes, sa	5	Bundesbank dataset
377		Current account: Transfers from abroad, sa	5	Bundesbank dataset
378		Current account: Transfers to foreign countries, sa	5	Bundesbank dataset
379		Export prices, sa	5	Bundesbank dataset
380		Import prices, sa	5	Bundesbank dataset
381	Raw materials	World market price: Crude oil, Brent	5	Bundesbank dataset
382		HWWA raw material price index: Total	2	Bundesbank dataset
383		HWWA raw material price index without enegy	2	Bundesbank dataset
384		HWWA raw material price index: Industrial raw materials	2	Bundesbank dataset
385		HWWA raw material price index: Energy industrial raw materials	2	Bundesbank dataset
386	Construction	Ifo business cycle index: Capacity utilization: Manufacturing	1	Bundesbank dataset
387		Ifo business cycle index: Capacity utilization: Non-durable goods	1	Bundesbank dataset
388		Ifo business cycle index: Capacity utilization: Intermediate goods	1	Bundesbank dataset
389		Ifo business cycle index: Capacity utilization: Capital goods	1	Bundesbank dataset
390		Ifo business cycle index: Capacity utilization: Consumer goods	1	Bundesbank dataset
391	GDP	GDP and gross value added: Agriculture, forestry and fishery, sa cda	5	Bundesbank dataset
392		GDP and gross value added: Production sector, sa cda	5	Bundesbank dataset
393		GDP and gross value added: Production sector excluding construction, sa cda	5	Bundesbank dataset
394		GDP and gross value added: Construction, sa cda	5	Bundesbank dataset
395		GDP and gross value added: Services, sa cda	5	Bundesbank dataset
396		GDP and gross value added: Trade, transport, accomodation and food services, sa cda	5	Bundesbank dataset
397		GDP and gross value added: Business services, sa cda	5	Bundesbank dataset
398		GDP and gross value added: Public services, sa cda	5	Bundesbank dataset
399		GDP gross value added: Total, sa cda	5	Bundesbank dataset
400		GDP expenditure, sa cda	5	Bundesbank dataset
401		GDP expenditure: Domestic use, sa cda	5	Bundesbank dataset
402		GDP expenditure: Private consumption, sa cda	5	Bundesbank dataset
403		GDP expenditure: Government consumption, sa cda	5	Bundesbank dataset
404		GDP expenditure: Gross capital formation, sa cda	5	Bundesbank dataset
405		GDP expenditure: Gross fixed capital formation, sa cda	5	Bundesbank dataset
406		GDP expenditure: Production investments, sa cda	5	Bundesbank dataset
407		GDP expenditure: Building investments, sa cda	5	Bundesbank dataset
408		GDP expenditure: Other investments, sa cda	5	Bundesbank dataset
409		GDP expenditure: Changes in inventories, sa cda	1	Bundesbank dataset
410		GDP expenditure: Domestic use, sa cda	5	Bundesbank dataset
411		GDP expenditure: Total, sa cda	5	Bundesbank dataset
412		GDP expenditure: Exports, sa cda	5	Bundesbank dataset
413		GDP expenditure: Imports, sa cda	5	Bundesbank dataset
414		GDP, sa cda	5	Bundesbank dataset
415	Labor market	Domestic labor force, sa cda	5	Bundesbank dataset
416		Labor force volume, sa cda	5	Bundesbank dataset
417		Labor productivity per man-hour worked: Domestic labor force, sa cda	5	Bundesbank dataset
418		Labor productivity per man-hour worked: Labor force, sa cda	5	Bundesbank dataset
419		Gross wages and salaries: domestic labor force, sa cda	5	Bundesbank dataset
420		Gross wages and salaries per employee: Domestic labor force, sa cda	5	Bundesbank dataset
421		Unit labor cost: Domestic labor force, sa cda	5	Bundesbank dataset
422		Unit labor cos on a hourly basist: Domestic labor force, sa cda	5	Bundesbank dataset
423	Liquidity	Spread of KfW bonds and German Federal securities with maturity of 1 Year	2	Bloomberg
424		Spread of KfW bonds and German Federal securities with maturity of 2 Year	2	Bloomberg
425		Spread of KfW bonds and German Federal securities with maturity of 3 Year	2	Bloomberg
426		Spread of KfW bonds and German Federal securities with maturity of 4 Year	2	Bloomberg
427		Spread of KfW bonds and German Federal securities with maturity of 5 Year	2	Bloomberg
428		Spread of KfW bonds and German Federal securities with maturity of 7 Year	2	Bloomberg
429		Spread of KfW bonds and German Federal securities with maturity of 8 Year	2	Bloomberg
430		Spread of KfW bonds and German Federal securities with maturity of 9 Year	2	Bloomberg
431		Spread of KfW bonds and German Federal securities with maturity of 10 Year	2	Bloomberg
432		Spread of KfW bonds and German Federal securities with maturity of 15 Year	2	Bloomberg
433		Bid-ask spread for German Federal securities with maturity of 2 years	2	Bloomberg
434		Bid-ask spread for German Federal securities with maturity of 10 years	2	Bloomberg
Global data				
435		Production index, Global, sa wda	2	Centraal Planbureau www.cpb.nl
436		World trade volume, sa	2	Centraal Planbureau www.cpb.nl
437		Business cycle survey/ PMI / Manufacturing / Headline Index/ world	2	IFO Institut www.cesifo-group.de
438		Business cycle survey / PMI / Services / Headline Index Welt	2	IFO Institut www.cesifo-group.de
439		Business cycle survey / Business Climate/ World	2	IFO Institut www.cesifo-group.de
440		Business cycle survey/ Economic Situation at Present/ World	2	IFO Institut www.cesifo-group.de
441		Business cycle survey / Econ. Situat. next 6 Mon/ World	2	IFO Institut www.cesifo-group.de
442		Production index, Developed economies, sa wda	2	Centraal Planbureau www.cpb.nl
443		Production index, USA, sa wda	2	Centraal Planbureau www.cpb.nl
444		Production index, Japan, sa wda	2	Centraal Planbureau www.cpb.nl
445		Production index, Developping economies, sa wda	2	Centraal Planbureau www.cpb.nl
446		Production index, Developping asiatic economies, sa wda	2	Centraal Planbureau www.cpb.nl
447		Trade volume - Exports, Developed economies, sa	2	Centraal Planbureau www.cpb.nl
448		Trade volume - Exports, USA, sa	2	Centraal Planbureau www.cpb.nl
449		Trade volume - Exports, Japan, sa	2	Centraal Planbureau www.cpb.nl
450		Trade volume - Exports, Developping economies, sa	2	Centraal Planbureau www.cpb.nl
451		Trade volume - Exports, Developping asiatic economies, sa	2	Centraal Planbureau www.cpb.nl

*) Transformation according to Stock and Watson (2008); 1=unchanged, 2=1 st diff., 3=2nd diff., 4=ln, 5=ln 1st diff., 6=ln 2nd diff. Sa = seasonally adjusted, cda = clendar day adjusted, nsa = non seasonally adjusted.

Figure A-1: Loading of state variables on yields of different maturities with different sample sizes.



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