A Financial Conditions Index as indicator for monetary policy in times of low, stable inflation and high financial market volatility

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Abstract

During times of high financial market volatility, conventional guidelines to monetary policy-making no longer deliver the good results seen before, stabilising inflation and GDP growth. Taylor rules or strict inflation targeting lead to monetary policy reactions that come “too late”, if asset price bubbles have already built or a crash is imminent. A Financial Conditions Index may serve as an additional indicator during periods of considerable asset price misalignment. A method for identifying share price overvaluation is presented, and credit growth is shown to provide early warning signals in combination with our measure of misalignment.

Keywords: monetary policy strategy, inflation, asset price misalignment, financial stability, channels of monetary transmission

JEL classifications: E 44, E 52, E 58
1. Introduction

The last couple of years witnessed an increase and subsequent fall in share prices not seen since the 1923-29 period. Consequently, towards the end of the 1990s a discussion between academics and central bank practitioners emerged, whether monetary policy should respond to movements in asset prices. Until today, the answers given to this question are quiet controversial. Even among those economists, where a broader consensus was reached that monetary policy action seems to be useful, there is ongoing controversy about the appropriate indicators to watch and the measures to be taken. No doubt, the economic slowdown in the EU and the United States in the aftermath of the bursting of the “technology share bubble” in spring 2000 demonstrates real economic costs of longer lasting asset price misalignments. The US Federal Reserve as well as the ECB has lowered interest rates in the years thereafter.

The aim of this paper is the construction of a Financial Conditions Index (FCI), which may serve as an indicator for the conduct of monetary policy in times of high financial market volatility. This comprises the search for early warning signals of an incipient stock market overvaluation, to be able to deliberate far-sighted actions in due time, as well as benchmarks for the appropriateness of interest rate decisions taken by a central bank when asset prices begin to fall. We will include exchange rates as a second relevant asset category for monetary policy purposes.

The paper proceeds as follows: Section 2 starts with the famous Taylor rule concept as a benchmark for the conduct of monetary policy since the mid-1980s. It is then asked, whether some form of Taylor rule is still the best guideline for central banks aiming at price stability and sustainable GDP growth in the presence of high asset price volatility. The focus is on the European Monetary Union (EMU) and the monetary policy of the ECB. Section 3 discusses the indicator properties of a financial conditions index for the conduct of monetary policy in EMU. Some aspects of the transmission process are highlighted, demonstrating the relative importance of different asset categories for the construction of our FCI. A concept for measuring stock market over- and undervaluation referring to the Dow Jones EuroStoxx 50 share price index is presented. Then it is asked, if there is a special role for credit growth as an early warning signal for the menace of asset price misalignments. Section 4 discusses the concept of our FCI and gives some empirical evidence on how it would have performed in recent years. The interest rate policy of the ECB since the beginning of 1999 is compared with the recommendations of our FCI concept. Section 5 concludes.

2. Disinflation and the usefulness of Taylor rules

Most industrialised countries have seen substantial efforts and successes in bringing inflation rates down soon after the second oil price crisis of 1979/80. Central banks in the United States and Western Europe, especially the Bundesbank in Germany, started to fight inflation with vig-
our. This was the result of a discussion about the economic and social costs of high and volatile inflation rates in the 1970s. Since the mid-1980s, central banks followed different strategies to achieve disinflation. Most popular were the monetary targets of the Bundesbank as well as the more or less discretionary strategy of the Federal Reserve under the presidency of Alan Greenspan since 1987. In the 1990s, direct inflation targeting strategies emerged and have shown considerable success too, especially in the UK. It was John B. Taylor (1993) who proposed a monetary policy rule, which became prominent in the following years. This later called “Taylor rule” was able to explain the conduct of monetary policy of the US Federal Reserve over the period 1987-92 quiet well.

Before the ECB took over the responsibility for monetary policy in EMU on January 1, 1999, there was considerable debate on its monetary strategy. A Taylor rule was proposed inter alia, but a “hybrid” two pillar strategy with elements of monetary targeting as well as a broad outlook on economic conditions signalling potential dangers of inflation was chosen. Besides all differences of the mentioned monetary strategies, they all have in common the objective of preserving low and stable inflation rates (or price stability).

At the turn of the century, the economic environment confronted central bankers with a new challenge: low, stable inflation rates and high asset market volatility with a considerable higher amount of private wealth than in former times, and an increasing share of this wealth invested in shares and other asset categories which exhibit unsteady price trends (Vinals, 2000; Bean, 2003). And as the bursting of the “technology share bubble” has shown, this isn’t a purely monetary phenomenon, but the economic consequences are real, and there is a role for monetary policy to play when imminent dangers of deflation turn up to manifest themselves (Boone and Girouard, 2002; Bohl et al., 2004A). Asset price inflation in property and equity values has become a topic of special interest; even it doesn’t immediately show up in rising consumer prices (Bernanke and Gertler, 1999, 2001).

Therefore, many economist tried to approximate monetary policy decision making by the ECB with the help of (variants of) a Taylor rule (e.g. Bohl et al., 2004B). The empirical evidence was quiet convincing during 1999-2002, but recently the “spread” between interest rates suggested by a Taylor rule and the interest rates chosen by the ECB has widened. Figure 1 shows the EURIBOR 3-month money market rate for EMU (1996-98 with artificial Euro area data as reported by the ECB) and a simple backward-looking Taylor interest rate constructed according to formula

\[ i_t^\text{EMU} = 2\% + \Delta p + 0,5 \cdot (\Delta p - \Delta p^*) + 0,5 \cdot (\Delta GDP - \Delta GDP^*) \]

with target values for inflation and GDP growth of \( \Delta p^* = \Delta GDP^* = 2\% \). Of course, the performance of forecast-based Taylor rules is often better, but for our purpose as a simple benchmark this original specification seems adequate (Levin et al., 2003). Additionally, we circumvent
the problem of finding the “right” forecast data used for monetary policy purposes, which the ECB didn’t publish for its first years in office. The EURIBOR has exceeded the Taylor interest rate during the period 1996-98, when the Bundesbank dominated monetary policy in all EMU candidate countries. From 1999 until mid-2002, EURIBOR and Taylor interest rate moved in parallel, since the end of 2002 there is considerable divergence.

The same phenomenon can be seen in the United States. The Federal Reserve’s “low interest rate strategy” since 2002 increasingly contrasted with Taylor rule recommendations, regarding the hike in GDP growth during the year 2004. Figure 2 shows our Taylor rule calculations with US data according to formula

\[
i_{US}^{T} = 2,5\% + \Delta p + 0,5 \cdot (\Delta p - \Delta p^*) + 0,5 \cdot (\Delta GDP - \Delta GDP*)
\]

with target values for inflation and GDP growth of \(\Delta p^* = \Delta GDP^* = 2,5\%\). US monetary policy has been extremely expansive since 2002, with nominal money market rates being lower than the US inflation rate, resulting in negative short-term interest rates.

Figure 1: 3-month money market rates (EURIBOR) and interest rates according to a Taylor rule for EMU

Figure 2: US 3-month money market rates and interest rates according to a Taylor rule for the USA
Even in EMU, real short-term interest rates have reached historical lows. The real 3-month money market rate (EURIBOR minus inflation according to the ECB’s harmonised index of consumer prices) fluctuates around zero within a band of \( \pm 0.5\% \) since the beginning of 2003. Despite rising oil prices, inflation rates near to or even a little bit above 2% in 2003/04, and M3 money growth exceeding the ECB reference value, the broad economic outlook signals no dangers of an incipient drastic rise in inflation. The intention of monetary policy seems to be “holding real interest rates as low as possible” over an extended period of time until GDP growth recovers on an enduring basis. This seems to mirror the strategy, which the US Fed has followed until the summer of 2004.

3. A Financial Conditions Index as guideline for ECB monetary policy?

3.1 The EMU transmission mechanism: Components of the FCI

There are four ways in which changes in asset prices - and especially share prices - influence economic activity: wealth effects, effects on capital costs, effects on firm balance sheets, and expectation effects, i.e. the degree of optimism or pessimism of entrepreneurs and consumers (ECB, 2002A). From the point of view of private households, a lowering of their financial wealth caused by a shrinking value of their asset holdings will lead to a cut in consumption expenditure between 1 and 2 € for a wealth loss of 100 € (Deutsche Bundesbank, 2003; Hamburg et al., 2005). This reaction may eventually be magnified by a negative expectations effect, if the asset meltdown appears to be long-lasting, e.g. in the years 2000-2003. From the point of view of firms, the effects of falling asset prices are more drastic. Falling share prices will lead to higher capital costs, if enterprises quoted on the stock exchange are no longer able to finance profitable investment opportunities.

This effect can be reinforced by the balance sheet channel of transmission. Falling asset prices feed through in a reduction of firm capital and a loss of value of their collateral. If collateral is needed to obtain bank credit for investment, i.e. firms are credit constrained, expansion plans for new plants and equipment have to be curtailed. An expectations channel may work in the same direction. If the overall economic outlook worsens as a consequence of a stock market crash, investment is postponed or abandoned. According to econometric estimates of the EU Commission (2001), there are four main determinants of industrial investment: firm profits, the relative price of investment goods (as a measure of Tobin’s q), as well as short-term and long-term real interest rates.

In the light of these findings from ECB, Bundesbank and EU Commission, we analyse the following determinants as indicators of overall financial conditions in EMU:

- nominal and real 3-month money market rates (EURIBOR)
- nominal and real 10-year EMU government bond yields
• share prices (on the basis of the Dow Jones EuroStoxx 50 index) in alternative specifications of price changes p.a., market capitalisation in % of GDP, as well as an indicator of “stock market misalignment”
• a broad real effective exchange rate index of the Euro (comprising EMU’s 23 biggest trade partners, taken from the ECB database)
• credit growth rates for the Euro area.

That interest rates - not only bond yields, but money market rates too - influence economic activity is by now common sense (ECB, 2002B). The last two indicators are added, because exchange rates are a driving force behind exports of EMU firms and therefore feed through to production, investment and GDP growth. Besides this, exchange rates are a standard element of Monetary Conditions Indices (MCIs), which should be part of an overall FCI. Credit growth rates are thought to give hints to credit constraints (balance sheet channel) and may serve as early warning signals of stock market overvaluation.

Due to data restrictions in some EU countries, especially Germany, house prices cannot be included in our FCI concept for EMU. Of course, housing represents a considerable amount of private sector wealth and therefore is an important determinant of overall private portfolio allocation decisions; but price volatility at least in the core EMU countries is lower than share price volatility. On the other hand in the UK, house price data quality is far better and they now play an important role for the Bank of England’s monetary policy decisions.

The aim of our FCI is twofold: It is supposed to signal the overall financial conditions in EMU from the perspective of firms, and it is thought to be at least a rough indicator for the conduct of monetary policy in times of high financial market volatility, showing dangers for price stability (be it inflation or deflation). From a monetary policy point of view, more restrictive financial conditions may signal the need for interest rate cuts when asset prices are falling and GDP growth rates as well as inflation are low. The properties of the indicator components from a theoretical point of view are shown in table 1.

<table>
<thead>
<tr>
<th>component of the FCI</th>
<th>perspective of firms: financial conditions are ...</th>
<th>perspective of monetary policy: outlook for inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(real) short-term interest rates ↑</td>
<td>“restrictive” (&quot;tightening&quot;)</td>
<td>Δρº ↓</td>
</tr>
<tr>
<td>(real) long-term interest rates ↑</td>
<td>“restrictive” (&quot;tightening&quot;)</td>
<td>Δρº ↓</td>
</tr>
<tr>
<td>real effective exchange rate of the Euro ↑</td>
<td>“restrictive” (&quot;tightening&quot;)</td>
<td>Δρº ↓</td>
</tr>
<tr>
<td>share prices ↑</td>
<td>“expansive” (&quot;loosening&quot;)</td>
<td>Δρº ↑</td>
</tr>
<tr>
<td>credit growth ↑</td>
<td>“expansive” (&quot;loosening&quot;)</td>
<td>Δρº ↑</td>
</tr>
</tbody>
</table>
3.2 How to measure stock market overvaluation?

One main problem when discussing the need and desirability of monetary policy reactions to asset prices is the measurement of “fair” stock market valuation. There is by now no generally accepted method to distinguish between fundamentally justified higher levels of stock market valuation (of an enterprise or a complete market index) and the formation of a bubble without fundamental basis.

The finance literature offers a variety of models, of which each has its strength and weaknesses. The most prominent are present-value models recurring on the well-known Gordon growth formula, stating that the current share price is the expected discounted sum of the future stream of dividends the share promises to offer. Apart from the dividends themselves and their expected growth rate, the applied discount rate is the central variable, which normally is the (risk-free) long-term government bond yield, increased by a risk premium. This risk-adjusted, required yield is one of the central elements in the Capital Asset Pricing Model (CAPM) too, where the individual share premium is calculated with the help of a beta factor. Present-value relations are capable of modelling “fundamental value” as opposed to “unexpected share returns” or “rational bubbles”, but the main task is an empirical one. There are three ways of testing: long-horizon regressions, volatility tests, and vector-autoregressive methods (Campbell et al., 1997, pp. 267-87), but all of these present-value models with constant discount rates explain very little of the empirical variation in share prices relative to the variation in dividends.

Event-study analysis with models aimed at measuring normal performance and abnormal returns is another alternative, using the basic concepts of CAPM or multifactor models, like e.g. Arbitrage Pricing Theory. The main drawback for our purpose of using these approaches as part of a FCI in a macroeconomic context is the microeconomic focus on single shares or groups of shares with common characteristics (Campbell et al., 1997, pp. 149-80). More heterodox models of investor psychology have become popular in recent years, but the task of modelling overall asset price developments based on behavioural assumptions is still in its infancy. Furthermore, it is difficult to say something about the fundamentally justified value at a distinct point in time (see e.g. Kontonikas et al., 2002 and 2003).

Therefore, our approach is somewhat different. We try to extrapolate a “fair” stock market trend starting from selected historical values and choose the one, which seems to be nearest to fundamentals. This is motivated by the belief that stock markets have to be valued according to their underlying fundamentals at least some of the time. In comparing alternative starting points from a period, where share prices seemed to be fundamentally justified, we are able to sketch their potential future development. This approach was motivated by the famous “Fed model”, allegedly first encountered in the July 1997 Monetary Policy Report to Congress (Board of Governors, 1997, p. 24). The discussion of the pros and cons of the Fed model is carried on with some
vigour among academics (see e.g. Asness, 2000, 2003); but because it is widely used by financial
analysts and others who “make the market prices”, this appears to be a fruitful approach. Al-
though the Fed model has only little power to forecast long-term share returns, it shows robust
In this tradition, our concept holds that shares and bonds should be valued in context. We are
able to calculate a price-earnings ratio (P/E) for shares and we know the risk-free interest rate on
long-term government bonds r. By dividing 100 / r it is possible to calculate a price-earning ratio
for bonds. Say r is 4 %, and then the P/E for the bond is 100 / 4 = 25. By comparing the P/Es of a
broad share price index and 10-year government bonds we get at least a hint (from the point of
view of a risk-neutral investor), if both assets are valued in coincidence. This of course isn’t an
absolute benchmark, but a relative one. When comparing the P/Es of shares and bonds over a
period of 10 years or more, periods show up where bonds are relatively overvalued compared
with shares et vice versa, and there are periods where both asset categories are valued “in line”.
Figure 3 shows, that the latter was more or less the case in the years from 1992 to 1996, with a
P/E divergence never exceeding the shaded range of ± 3 index points, which may be regarded as
a corridor resulting from varying risk premia. On the other hand, the situation in 2004/05 illus-
trates an unprecedented divergence of the relative valuation of shares and bonds, which is most
pronounced in EMU in comparison with the UK or the US, although even Alan Greenspan sees
himself confronted with an “interest rate conundrum”.

![Figure 3: Price / earning ratios of shares and 10-year government bonds in EMU (1992:Q1 - 2005:Q2)](image)

To start our modelling, the EuroStoxx 50 index levels from January 1994, 1995, 1996, 1997 and
1998 were taken as basic values. Under the assumption, that these values mirror the fundamen-
tals, we calculated monthly levels of the EuroStoxx index up to December 2004 for each series.
The critical component is the chosen “required return” of an investor holding EU shares. On the
basis of our former comparison of bond yields and share returns, we approximated the risk-adjusted share return on a month-by-month basis with the help of a 10-year government bond yield and augmented this yield by a risk premium of 2 % p.a.. The bond yield for our calculations is the average EMU 10-year government bond yield (as calculated by the ECB) for the years 1996-2004, beginning with the start of the interest rate convergence rally in the forefield of EMU.

For the years 1994/95 the German 10-year government bond yield was applied, because the “artificial EMU” average interest rate was some three percentage points higher, biasing required share returns too much upward. Results are shown in figure 4. The factual development of the EuroStoxx 50 is compared with the calculated “fundamentally justified” or “fair” trends. A closer inspection shows that the hypothetical index values for the series starting in 1994 (with German bond data) and 1997 (with hybrid EMU bond data) are nearly identical.

Figure 5 presents the deviation of the factual from our “fair value” index data. After a period of share prices broadly in line with fundamentals from 1994 to 1996, misalignment began in 1997 and grew to a full-fledged bubble in spring 2000 with overvaluation reaching 120 % according to our calculations. After the stock market crash, share prices were “too low” in 2002 and 2003, starting their recovery up to nearly fair levels again at the end of 2004 and in the first two quarters of 2005. No matter which of our hypothetical time series is taken, in spring 2000 the EU stock market was overvalued by something in between 171 % (according to the 1995 series) and 78 % (according to the 1998 series, already starting from a relatively high level).
In section 4 we will show, how this indicator of stock market valuation diverging from fundamentals can be embedded in our financial conditions index for EMU. Previously some results should be presented, why credit growth is an especially useful indicator for the menace of stock market misalignments, and therefore has to be included in a FCI too.

3.3 A special role for credit as early warning signal of imminent stock market bubbles?

Recently, the ECB (2004) has presented a study concerning the indicator properties of its “monetary analysis” (second pillar), especially regarding M3 growth and its components, of which credit growth seems to be the most informative for inflation prospects. Borio and Lowe (2004) have shown, that maybe credit should “come back from the wilderness” (of former monetary policy strategies) as an indicator of future threats to asset price misalignments too. For being an asset price indicator, credit growth has to antecede a rise in share prices, what is nowadays posted in the concept of “over-liquidity”. Searching for empirical evidence leads to a rather disillusioning result. Credit growth doesn’t lead share prices in EMU, but seems to be a consequence of higher share prices. This is confirmed by Granger causality tests (see table 2); of course, Granger causality mustn’t mean economic causality. Rising (falling) share prices (the percentage change of the EuroStoxx 50 index on a year-by-year basis: ΔEuroStoxx) Granger cause rising (falling) credit growth rates in EMU countries over the sample period 1995 - 2004. The same is true for M3 money growth rates. Some further results from table 2 are worth noting: GDP growth Granger causes M3 growth and credit growth in EMU, and changes in the EuroStoxx index seem to be indicators of future GDP growth.
Table 2: Pairwise Granger causality tests
(Sample: 1995:01 - 2004:12; Lags: 1)

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>obs.</th>
<th>F-Statistic</th>
<th>probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔM3 does not Granger cause ΔEuroStoxx</td>
<td>117</td>
<td>0.65251</td>
<td>0.42090</td>
</tr>
<tr>
<td>ΔEuroStoxx does not Granger cause ΔM3</td>
<td>16.5508</td>
<td>2.69139</td>
<td>0.10365</td>
</tr>
<tr>
<td>credit growth does not Granger cause ΔEuroStoxx</td>
<td>117</td>
<td>11.7145</td>
<td>8.8 * e^(-5)</td>
</tr>
<tr>
<td>ΔEURIBOR does not Granger cause ΔEuroStoxx</td>
<td>117</td>
<td>1.83012</td>
<td>0.17879</td>
</tr>
<tr>
<td>ΔEuroStoxx does not Granger cause ΔEURIBOR</td>
<td>16.5508</td>
<td>4.44746</td>
<td>0.03714</td>
</tr>
<tr>
<td>ΔM3 does not Granger cause ΔEuroStoxx</td>
<td>116</td>
<td>0.35127</td>
<td>0.55458</td>
</tr>
<tr>
<td>ΔEuroStoxx does not Granger cause ΔGDP</td>
<td>18.7412</td>
<td>3.3 * e^(-5)</td>
<td>0.00086</td>
</tr>
<tr>
<td>ΔGDP does not Granger cause ΔM3</td>
<td>116</td>
<td>3.92484</td>
<td>0.05001</td>
</tr>
<tr>
<td>ΔM3 does not Granger cause ΔGDP</td>
<td>0.01373</td>
<td>7.38034</td>
<td>0.00763</td>
</tr>
<tr>
<td>ΔGDP does not Granger cause credit growth</td>
<td>116</td>
<td>0.86307</td>
<td>0.35486</td>
</tr>
<tr>
<td>credit growth does not Granger cause “stock market misalignment indicator” does not Granger cause credit growth</td>
<td>118</td>
<td>8.86460</td>
<td>0.03355</td>
</tr>
</tbody>
</table>

Figure 6: An index of “stock market misalignment” (basis 1997) and annual credit growth rates in EMU

Are rising share prices really matters of concern for monetary policy, or is it an incipient bubble process, driving share prices away from fundamentals? As can be seen from figure 6, credit growth rates in EMU are a good leading indicator referring to our variable constructed in the last section, which indicates stock market overvaluation. Credit growth rates surpassed 8 % p.a. and remained very high, two years before the EuroStoxx reached its top. This indicator seems to work the other way round as well: Credit growth rates reached moderate values of 5 % and below (in Germany they were around zero at that time), one year before the stock market collapse led to an undervaluation of about 20 %. These “graphical” interpretations are backed by the results of the Granger causality tests in table 2: High credit growth rates Granger cause stock market overvaluation. Of course, when asking which rate of credit expansion is adequate for high and stable GDP growth without inflationary pressures, a benchmark is needed. Therefore we use
a credit indicator for our FCI, that is calculated as follows: To get a hint, if financial conditions in the market for bank credit are loose or tight, the nominal GDP growth rate on a quarterly basis (real GDP growth plus the GDP deflator) is subtracted from the credit growth rate (a nominal variable as well). Like the “money gap” calculated by the ECB for its monetary analysis, this “credit gap indicator” may serve analysing financial conditions in EMU.

4. Has the ECB reacted to changing financial conditions?

4.1 The composition of a Financial Conditions Index for EMU

The idea to construct a FCI for EMU isn’t a totally new one, even if it hasn’t made its way into the internationally ranked economic journals yet. A paper by Mayes and Viren (2001) was a first attempt to apply an empirically derived FCI concept in a single country, Finland. More basic work in this tradition was done by Goodhart and Hofmann (2000) as well as Stock and Watson (2003). Goldman Sachs (GS) stated in February 2003 that “Euroland financial conditions” were “too tight” (GS, 2003). They underlined their argument with the help of a simple FCI, which was based on an earlier monetary conditions index (MCI) for Euroland (GS, 1998). This Goldman Sachs approach was the basis for the paper by Mayes and Viren (2001). Monetary conditions in EMU are measured with the help of real short-term and long-term interest rates compared with their “equilibrium” or “neutral” values, simply defined as average values since 1991, and the trade-weighted exchange rate of the Euro. Financial conditions comprise these indicators of monetary conditions plus an equity market indicator, defined as the ratio of stock market capitalisation to nominal GDP, again compared with its long-run average. The weights given to these four FCI components are 33,75 % for short-term and 53,75 % for long-term real interest rates, 10 % for exchange rates and 2,5 % for equity.

The reasoning behind this is that interest rates mainly affect private domestic demand (i.e. private consumption and gross fixed capital investment), which is 77 % of GDP, and households as well as firms in many EMU countries (especially Germany) do the bulk of their financing via long-term loans. The exchange rate mainly affects exports, which account for about 35 % of GDP, but imports as well, so the trade balance only accounts for 2,2 % of GDP (data for 2003, from the ECB Monthly Bulletin). These assumptions are rather ad-hoc plausibility reflections, which of course need firmer foundations from future research. A 10 % drop in the ratio of stock market capitalisation to GDP is forecasted to tighten financial conditions by 25 basis points. This last argument seems to be justifiable in the light of the empirical finding by the Deutsche Bundesbank (2003), that a loss of 100 € curtails private consumption spending by 1-2 €.

Some additional empirical analysis seems adequate, to get a better understanding of the transmission process from asset prices to economic activity. Our own calculation of correlation coefficients for an EMU sample 1996-2004 results in correlations of percentage changes of the EuroStoxx 50 index on a year-to-year basis with the annual growth rates of
• firm capital investment of $\rho = + 0.76$
• GDP of $\rho = + 0.74$
• industrial production of $\rho = + 0.65$
• private household consumption of $\rho = + 0.51$
• consumer prices (as measured by the HICP) of $\rho = - 0.49$.

The first four figures seem reasonable and might have been expected by guessing, but the last one underlines once again the urgent need for finding early warning indicators of an incipient asset price misalignment, because it takes a long time before rising asset prices may show up in higher inflation rates. For the purpose of determining the composition of our FCI empirically, some regression analyses were carried out, allowing us to choose weights diverging from those in the Goldman Sachs FCI. Table 3 shows the results.

The growth rate of industrial production is explained with the help of five variables, of which the own lagged values of production show the highest regression coefficient of 0.68, followed by the four FCI components. Short-term interest rates have a coefficient of 0.38, and the coefficient on the “credit gap indicator” is -0.28, whereas long-term interest rates weren’t significant. The FCI component for exchange rates shows a coefficient of 0.10, and the coefficient for “share price misalignment” is 0.02. The adjusted $R^2$ of 0.75 demonstrates, that the fit of regression is quiet good, so at least some tentative conclusions regarding the relative importance of these four FCI components seem to be justified. The time series properties were investigated with the help of the advanced Dickey-Fuller test (unit root test for stationarity).

To circumvent possible problems with first-order auto-regression of residuals, two alternative specifications include the Cochrance-Orcutt correction (an additional AR(1) term, see table 4). This delivers more robust results regarding the adjusted $R^2$ of 0.80 and 0.81 as well as Durbin-Watson coefficients of 2.1. In addition, our constructed FCI components were replaced by their “underlying” original time series, i.e. monthly changes of the 3-month money market rates (EURIBOR) and the exchange rate index as well as year-on-year credit growth rates and stock index changes instead of their “divergence from equilibrium values”. But this comes at a cost, because we are interested in the relative magnitude of the regression coefficients, which allow us to deliver estimates on the relative importance of FCI components. The results of table 4 don’t allow us to infer the weight of the interest rate component of our FCI, because of the different nature of data (resulting in coefficients around 2.0). The relative weights of the three other components are more or less confirmed. On the other hand, what we gain is a demonstration, that not only our constructed FCI components are significant for explaining production growth, but their underlying time series are significant as well. All independent variables show the correct sign: high credit growth and rising share prices lead to increasing industrial production growth, whereas an appreciation of the local currency (the Euro) will reduce the competitiveness of exporters and therefore tends to reduce production growth.
Table 3: Regression result for the determinants of the annual growth rate of industrial production in EMU (1997:01 – 2004:09, monthly data)

<table>
<thead>
<tr>
<th></th>
<th>Specification (1)</th>
<th>Specification (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(nominal) short-term interest rate (3-month EURIBOR)</td>
<td>0.380 *** (2.75)</td>
<td></td>
</tr>
<tr>
<td>credit growth indicator (annualised credit growth minus GDP growth on a year-to-year basis)</td>
<td>-0.281 ** (-2.07)</td>
<td></td>
</tr>
<tr>
<td>real effective exchange rate index of the Euro (divergence from 100 points)</td>
<td>0.097 *** (2.66)</td>
<td></td>
</tr>
<tr>
<td>indicator of stock market misalignment for the EuroStoxx 50 share price index</td>
<td>0.021 ** (2.63)</td>
<td></td>
</tr>
<tr>
<td>annual growth rate of industrial production (own lag (-1), i.e. preceding month data)</td>
<td>0.680 *** (8.47)</td>
<td></td>
</tr>
<tr>
<td>adjusted R²</td>
<td>0.746</td>
<td>2.379</td>
</tr>
<tr>
<td>standard error of regression</td>
<td>1.353</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson coefficient</td>
<td>2.379</td>
<td></td>
</tr>
</tbody>
</table>

T-statistics in parenthesis
** and *** indicate significance of the regression coefficients at the 5 % and 1 % level.

Table 4: Regression result for the determinants of the annual growth rate of industrial production in EMU (1996:01 – 2004:09, monthly data)

<table>
<thead>
<tr>
<th></th>
<th>Specification (1)</th>
<th>Specification (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>changes of the EURIBOR (first difference on a month-to-month basis)</td>
<td>1.911 *** (2.76)</td>
<td>2.062 *** (3.23)</td>
</tr>
<tr>
<td>EMU credit growth rate (in % p.a.)</td>
<td>0.048 *** (2.84)</td>
<td>0.042 ** (2.53)</td>
</tr>
<tr>
<td>monthly change of the real effective exchange rate index of the Euro (first differences)</td>
<td>-0.026 * (-1.89)</td>
<td>----</td>
</tr>
<tr>
<td>growth rate of the EuroStoxx 50 share price index (on a year-to-year basis)</td>
<td>----</td>
<td>0.011 *** (2.84)</td>
</tr>
<tr>
<td>annual growth rate of industrial production (own lag (-1), i.e. preceding month data)</td>
<td>0.851 *** (20.26)</td>
<td>0.817 *** (18.26)</td>
</tr>
<tr>
<td>AR (1) term</td>
<td>-0.406 *** (-4.23)</td>
<td>-0.407 *** (-4.21)</td>
</tr>
<tr>
<td>adjusted R²</td>
<td>0.804</td>
<td>0.813</td>
</tr>
<tr>
<td>standard error of regression</td>
<td>1.160</td>
<td>1.134</td>
</tr>
<tr>
<td>Durbin-Watson coefficient</td>
<td>2.083</td>
<td>2.108</td>
</tr>
</tbody>
</table>

T-statistics in parenthesis
*, ** and *** indicate significance of the regression coefficients at the 10 %, 5 % and 1 % level.

Table 5: Regression results for determinants of the ratio of firm capital investment to GDP in EMU (1995:Q2 – 2004:Q3, quarterly data)

<table>
<thead>
<tr>
<th></th>
<th>Specification (1)</th>
<th>Specification (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant term</td>
<td>18.509 *** (58.75)</td>
<td>17.929 *** (64.12)</td>
</tr>
<tr>
<td>3-month EURIBOR</td>
<td>0.172 *** (3.28)</td>
<td>0.200 *** (4.30)</td>
</tr>
<tr>
<td>EMU credit growth rate (in % p.a.)</td>
<td>0.179 *** (4.74)</td>
<td>0.109 *** (2.28)</td>
</tr>
<tr>
<td>real effective exchange rate index of the Euro (divergence from 100 points)</td>
<td>-0.025 *** (-3.10)</td>
<td>----</td>
</tr>
<tr>
<td>ratio of stock market capitalisation to GDP for EMU</td>
<td>----</td>
<td>0.018 ** (3.46)</td>
</tr>
<tr>
<td>AR (1) term</td>
<td>0.482 *** (3.09)</td>
<td>0.402 ** (2.38)</td>
</tr>
<tr>
<td>adjusted R²</td>
<td>0.871</td>
<td>0.873</td>
</tr>
<tr>
<td>standard error of regression</td>
<td>0.208</td>
<td>0.206</td>
</tr>
<tr>
<td>Durbin-Watson coefficient</td>
<td>2.256</td>
<td>2.111</td>
</tr>
</tbody>
</table>

T-statistics in parenthesis
** and *** indicate significance at the 5 % and 1 % level.
Empirical testing to explain the role of stock market wealth in private household consumption didn’t supply any results, but our regressions for changes in the ratio of firm capital investment to GDP show, that short-term interest rates and credit growth are the main determinants in the sample period 1995-2004 (see table 5). In addition to this, the ratio of stock market capitalisation to GDP and exchange rates are significant, but only in alternative regression specifications, not at the same time. The adjusted $R^2$ of 0.87 for both regressions and the Durbin-Watson coefficients indicate quiet reliable results (no first-order autocorrelation after AR(1) correction).

After having presented some theoretical foundations and empirical results for each of our FCI components, we are able to explain the construction of our FCI for EMU and compare it with the Goldman Sachs (GS) index. There are two main differences. First of all, we use our indicator of “stock market misalignment” instead of the GS measure of market capitalisation to GDP. The reason is twofold: On the one hand, the GS indicator shows nearly the same curve profile as the EuroStoxx 50 index itself, and therefore it delivers no additional information. On the other hand, it is quiet difficult to define an explicit value for an adequate stock market capitalisation in relation to GDP. Because of initial public offerings (IPOs), delistings, and the fact that the majority of EMU enterprises issuing shares (especially in Germany and France) is not quoted on any stock exchange, there is no obvious benchmark. Instead, we use the indicator of “stock market misalignment” (presented in section 3.2), because it conveys a reliable picture at least in the case of substantial overvaluation, and therefore should be preferred to alternative measures, like e.g. market capitalisation or annual percentage changes of the stock market index.

The second difference is the inclusion of our “credit gap indicator” (see section 3.3), because we have seen that high credit growth rates are a good leading indicator of incipient stock market overvaluation. In exchange for this inclusion, we drop the GS indicator for long-term interest rates from the FCI. As our empirical evidence and the work of the ECB (2002B) on the monetary transmission mechanism in EMU have shown, short-term interest rates are gaining more and more importance.

In analogy to the seminal paper of Mayes and Viren (2001), the weights in our FCI resemble the empirical values derived via regression analysis. The results of all five regression specifications were assembled, relative magnitudes of regression coefficients for each FCI component were calculated and put together with the help of theoretical deliberations; e.g. in table 3 the sum of the four regression coefficients (ignoring signs, without the lagged production growth) is 0.779, the coefficient for share price misalignment is 0.021 (for the exchange rate component 0.097), so the relative empirical weight from this regression for share prices is 0.021 / 0.779 = 2.7% (for exchange rates 12.5%). Finally, this leads us to the FCI weights of 2.5% and 10%. Against these results, the weighing of short-term interest rates and credit growth differs more from specification to specification, but both components together have a relatively stable weight.
Finally, figure 7 presents our FCI together with the one of GS. The baseline value of both indices is 100, i.e. all components are in line with fundamentals. Index values below 100 indicate “expansive” financial conditions in Euroland, index values above 100 point to “restrictive” financial conditions. Of course, what is most important isn’t the absolute index value, but its evolution over time. The differences in FCI components and their weights are shown in table 6.

<table>
<thead>
<tr>
<th>components of the FCIs</th>
<th>weights in the GS FCI</th>
<th>weights in our new FCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>deviations of real 3-month money market rates from their average of 1.5 %</td>
<td>33.75 %</td>
<td>67.5 %</td>
</tr>
<tr>
<td>deviations of real 10-year government bond yields from their average of 2.8 %</td>
<td>53.75 %</td>
<td>-----</td>
</tr>
<tr>
<td>“credit growth indicator” (nominal credit growth minus nominal GDP growth)</td>
<td>-----</td>
<td>20 %</td>
</tr>
<tr>
<td>real effective exchange rate index of the Euro</td>
<td>10 %</td>
<td>10 %</td>
</tr>
<tr>
<td>stock market capitalisation (% of GDP)</td>
<td>2.5 %</td>
<td>-----</td>
</tr>
<tr>
<td>indicator of “stock market misalignment”</td>
<td>-----</td>
<td>2.5 %</td>
</tr>
</tbody>
</table>

4.2 Monetary policy implications

The first impression from the two FCIs is, that financial conditions in EMU were more or less “neutral” when the ECB took over office in January 1999. Due to an accelerating upward trend in share prices, rapid credit growth and the devaluation of the Euro, financial conditions became looser and looser during the course of 1999 and especially the first half of 2000. Monetary policy too was expansive at that time, which is mirrored in the interest rate cut from 3.0 to 2.5 % of April 1999. In the aftermath of the stock market crash, financial conditions started to tighten, reaching their “neutral” value again by mid-2003. Since then, despite an ECB policy of low in-
terest rates (2.0% since June 2003) financial conditions haven’t become any looser. This is due to the substantial appreciation of the Euro, not only against the US Dollar but also against the broader real effective exchange rate index of EMU’s 23 biggest trade partners, which leads to a tightening of financial conditions. This dual problem of very high share price volatility and exchange rate volatility since the beginning of 1999 is shown in figure 8, where percentage changes on a year-to-year basis of the real effective exchange rate index of the Euro and of the EuroStoxx 50 are presented.

Figure 8: Changes in the EuroStoxx 50 and the real effective exchange rate of the Euro (EWK-23)

As concerns financial conditions in EMU (and in the Euro candidate countries in the years 1995-98), share prices and exchange rates nearly always worked in the same direction. Three periods are worth a closer look. In 1997, rising share prices and a devaluation of the currencies in the ECU basket (especially the Italian Lira and the Spanish Peseta) worked expansive, especially for those economies that were able to boost their exports due to misaligned exchange rates. In 1999, share price and exchange rate trends have shown the same pattern again, with the important difference that the boost unfolded by those very expansive financial conditions promoted economic growth in all EMU countries alike, including Germany and France, because there now was a single currency, the Euro.

In 2002/03, we had a totally different picture with falling share prices and a revaluation of the Euro, causing a considerable tightening of financial conditions in EMU, despite an expansive stance of ECB monetary policy. Summing up these results from the last ten years, it seems as if there have been times of high asset price fluctuations (share prices and exchange rates), which were reinforcing each other or at least worked in the same direction, interrupted by shorter periods (1995/96, 1998 and hopefully again since end-2004) showing lower asset market volatility. The best combination – from the point of view of monetary policy, i.e. expansive (restrictive) exchange rate movements in combination with restrictive (expansive) share price movements, cancelling out each other’s influence on the overall financial conditions – hasn’t been seen in
EMU for more than ten years. Therefore, in times of low, stable inflation and high financial market volatility standard concepts, be it inflation targeting, Taylor rules, or monetary targeting are no longer useful for setting an appropriate course of monetary policy, that mitigates the consequences of a drastic change in financial conditions in due time ex post, or even better hinders the build-up of considerable asset price misalignments ex ante.

Using the information conveyed by a FCI may help the ECB during future periods of extreme asset price movements, which are sure to come sooner or later again. An earlier monetary tightening in 1999 and an earlier and more progressive monetary expansion in 2001/02 could have dampened the business cycle, leading to a faster recovery and higher GDP growth again in 2003/04. This is shown in figures 9 & 10, comparing the reaction of the ECB and the US Federal Reserve to the stock market crash starting in early 2000. For simplicity, we only compare the 3-month money markets rates in the United States and EMU with the stock market indices (EuroStoxx 50 for EMU and Standard & Poor’s 500 for the US). Monetary easing by the ECB began as late as mid-2001, 12 month after the EuroStoxx started to fall, and it took until June 2003 to reach the interest rate low. Whereas in the US the Fed monetary easing started about six month earlier, it was stronger (interest rates falling from 6.5 % to 1.0 %) and it was faster.

Figure 9: The development of the EuroStoxx and 3-month money market rates (EURIBOR) in EMU

Figure 10: The development of the Standard & Poor’s 500 share price index and 3-month money market rates in the USA
Unfortunately, standard concepts of monetary policy didn’t reveal this need for immediate action, as can be seen in figure 11, where two alternative indicators of the degree of monetary policy expansion or restriction are presented. The first one is the difference between the 3-month money market rate in EMU and the Taylor interest rate (from section 2). The second one is a simple, but effective measure of the monetary policy stance, obtained by subtracting the real GDP growth rate from the real 3-month money market rate (EURIBOR minus HICP inflation). The latter is based on the assumptions of growth theory that all relevant economic variables should grow at the same rate, i.e. a “neutral” monetary stance is given, when the real GDP growth rate equals the real short-term interest rate. Both indicators move broadly in line during our sample period 1996-2004. Two things are worth noting: According to figure 11, the ECB monetary policy seemed to be extremely expansive in 2004, giving a totally wrong signal when compared with the FCI results. This degree of monetary easing was urgently needed to compensate for the rapid revaluation of the Euro. On the other hand, during the stock market boom period in 1999 and spring 2000 both indicators show, that monetary policy has been too expansionary. As for this, the second indicator of “monetary policy stance” signalled this “over-expansion” six month earlier and more drastically.

![Figure 11: Two alternative measures for the degree of restriction or expansion of monetary policy in EMU](image)

Comparing the results of the Taylor rule, “monetary policy stance” and the FCI, the following valuation on the ECB’s monetary policy during the stock market collapse emerges: Starting with the interest rate cut of December 2002 to 2.75%, monetary policy became expansive according to the Taylor rule. This rate cut seemed to be motivated by the fact, that in November 2002 the US Dollar exchange rate surpassed the psychological level of 1 €. The interest rate cut of March 2003 to 2.5 % seems to be a reaction to the lowest level of the EuroStoxx since the boom started in 1997, which was reached in the same month. Finally, after the June 2003 interest rate cut to 2.0 %, ECB monetary policy was expansive according to the “policy stance indicator” too. The motivation might have been credit growth rates (and with it M3 growth rates), which have been...
quiet subdued below 5% p.a. since October 2002. The final results were real short-term interest rates around zero in the years 2003/04. In “normal” times this low level would have been regarded as being too expansive, as e.g. the Taylor rule shows for 2004. But according to our FCI, this monetary easing was quiet reasonable, with the help of hindsight it even should have started 12 month earlier.

Since the turn of the year 2004/05, ECB monetary policy seems to be in line with overall financial conditions in EMU, but it is by no way expansive, monetary policy is more or less “neutral” according to the FCI values between 99,5 and 100. Therefore, to advise an interest rate policy heading for faster economic recovery in EMU, we translate the results from our FCI (with the basis of 100) into a guideline for an appropriate “monetary policy course” (MPC), by constructing a simple indicator – not a policy rule – for measuring the degree of expansion or restriction of monetary policy in times of high financial market volatility. It is calculated as follows:

\[
\text{MPC} = \text{“stance of monetary policy” (i.e. EURIBOR – HICP inflation – GDP growth)} - 0,2 \text{ “credit indicator” (i.e. EMU credit growth – GDP growth – GDP deflator – 3 %)} + 0,1 \text{ (index of the real effective exchange rate of the Euro – 100)} - 0,025 \text{ “indicator of stock market misalignment” (see section 3.2)}
\]

The result is more or less the same as if one drops the short-term interest rate indicator from our FCI (divergence from its long-run average value) and replaces it by the “stance of monetary policy” indicator. The weights of the other three components are exactly the same, with the exception that in the FCI the weights sum up to 100%, whereas in the MPC the “stance of monetary policy” indicator presents the benchmark case (with a weight of 100%) in times of “normal” financial market conditions, which is augmented by the three other factors in the case of high financial market volatility. The “credit indicator” is calculated in analogy to the “credit gap indicator” before, but additionally its long-term average of 3% p.a. is subtracted to bring its definition in line with those of the exchange rate and stock market component (defined as divergence from a benchmark too). Remark that the plus and minus signs are exactly opposed to those in the regression results from tables 4 & 5, because e.g. higher credit growth rates are favourable for industrial production growth (positive coefficient), which means that they result in looser overall financial conditions (negative coefficient for the MPC), given the stance of monetary policy.

The result can be seen in figure 12, confirming monetary policy being adequate at the turn of the year 1998/99, when the ECB took over the responsibility for monetary policy in EMU. It got looser and looser in the second half of 1999 and in the first quarter of 2000, thereafter tightened again and became too restrictive in 2003. Sine then a course of moderate expansion seems quiet adequate and there is no need for further raising central bank interest rate until GDP growth gains momentum; maybe even a 50 basis points rate cut would be justified according to our results.
5. Conclusion

We have demonstrated that the science of conducting monetary policy, especially for a new institution like the ECB, hasn’t become any easier during the last couple of years, despite inflation rates are low and stable since the start of EMU. Highly volatile asset prices pose considerable challenges for monetary policy makers, especially since the stock market rally started in 1997. The interrelations and transmission channels between asset price inflation, real economic activity, financial conditions and monetary policy (targeting consumer price inflation) are by now not well understood.

It is the duty of monetary macroeconomists to search for theoretical foundations, empirical results and policy recommendations, which help to solve and overcome these problems. This paper has tried to present a Financial Conditions Index (FCI) as a guideline – not a rule – to monetary policy making in times of low, stable inflation and high financial market volatility, with the main focus on stock markets and currency markets. An inclusion of housing markets seems desirable, but due to data restrictions isn’t possible yet for EMU as a whole, but maybe in the UK.

Although the academic discussion on how monetary policy should respond to asset price movements seems far from reaching consensus on adequate indicators and measures to be taken once a stock market bubble is identified, the consideration of a FCI at least as an additional indicator may avoid a part of the social loss which results, when asset price bubbles are allowed to grow for too long and then burst abruptly.
References


ECB 2003. Structural factors in the EU housing markets, ECB study, March


