A financial conditions index for Switzerland

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1. Introduction

Freedman (1994) first proposed the construction of a monetary conditions index (MCI), arguing that the MCI, being a weighted sum of the short-term interest rate and the exchange rate, is preferable to the interest rate alone as an operating target for a small open economy. The brief experience of countries using the MCI as an operating target is limited to Canada and New Zealand. MCIs, however, continue to be calculated by central banks and international organisations as simple indicators for the stance of monetary policy.[2]

The recent high volatility in stock and property prices has renewed the interest in the role of asset prices for monetary policy. Diverging movements in equity and housing prices have raised concerns about the appropriate stance of monetary policy when markets are moving in different directions. To measure the offsetting influence between asset prices, the exchange rate and the interest rate, efforts have been made recently to extend the MCI to include other assets such as stocks or housing prices. Such measures, labelled the financial conditions index (FCI), have been constructed by Goodhart and Hofmann (2001) for the G7 countries and Mayes and Virén (2001) for 11 European countries. Their results are promising in the sense that they find that housing prices especially are helpful in providing additional information on future inflationary pressure.

The role of housing and stock prices in the monetary transmission mechanism in Switzerland has not been fully explored yet. Housing and stock prices are routinely monitored by the Swiss National Bank (SNB), yet they do not formally enter the SNB's models and indicators, one of which is the MCI. The objective of this paper is to expand the MCI into an FCI by adding housing prices. The weights of the FCI components are estimated with the medium-sized macro-model used by the SNB.

Section 2 briefly outlines the MCI and discusses how it can be extended to an FCI through the inclusion of alternative assets. Section 3 considers econometric issues important for the interpretation and construction of an MCI/FCI. Section 4 presents the empirical results. Section 5 concludes.

2. From the MCI to the FCI

The MCI is usually defined as:

$$MCI_t = \Sigma_i \, w_i \, (p_{it} - p_{i0})$$

where the p_{it} are directly or indirectly related to monetary policy actions. The MCI is the weighted sum of changes in the variables p_{it} from their values in a base period. The level of the MCI has no meaning, as the MCI is not stationary. A relationship of the following form is assumed for output or inflation:

$$y = f(p_1, \dots, p_s, X) \quad or \quad \pi = g(p_1, \dots, p_s, X)$$

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[1] Research Section, Swiss National Bank, caesar.lack@snb.ch. I would like to thank Andreas Fischer, Thomas Jordan, Enzo Rossi, Jean-Marc Natal, Samuel Reynard, Marcel Savioz and Marco Huwiler for helpful comments. The views expressed in this article are those of the author and do not necessarily reflect those of the SNB. This paper was prepared for the BIS Autumn Central Bank Economists' Meeting of 14-15 October 2002.

[2] See Hansson and Lindberg (1994) for Sweden, Jore (1994) for Norway, Lengwiler (1997) for Switzerland, Dennis (1997) and Nadal-De Simone et al (1996) for New Zealand, and Duguay (1994) for Canada.

with X representing other variables not related to monetary policy, but influencing output or inflation. The weights, w_i, of the MCI components are the partial derivatives of the respective variables in f or g, depending on whether the weights are based on output or inflation.

Although the definition of an MCI is quite general, in practice only two variables enter the MCI: the short-term interest rate (to capture effects of monetary policy through the interest rate channel) and the exchange rate (to capture effects through the exchange rate channel):

$$MCI_t = w_1(r_t - r_0) + w_2(e_t - e_0)$$

where r is the short-term interest rate and e the natural logarithm of the exchange rate. The ratio of the weights, w_1/w_2, is termed the MCI ratio. The higher this ratio is, the more important is the interest rate channel compared to the exchange rate channel in the transmission of monetary policy. For example, a 3:1 ratio indicates that a 1 percentage point interest rate change has three times the effect of a 1% change in the exchange rate.

An MCI can be constructed in real or nominal terms. Since it is mostly used for short-term comparisons, the difference is negligible. Usually, real variables are used to estimate an underlying model, while nominal variables are used for the construction of MCIs. The following strategies are used to estimate the weights of the MCI components:

- simulations in a structural macroeconometric model;
- estimation of a reduced-form aggregate demand equation;
- estimation of structural vector autoregression (VAR) systems.

Calculations based on structural macro-models are superior to the other methods because more variables are taken into account and, unlike in the reduced equation approach, structural shocks can be constructed. Most central banks, governments, and some international organisations have structural macro-models. Peeters (1998) and Mayes and Virén (1998) use the NIGEM model for Finland to calculate MCI weights, and the Organisation for Economic Co-operation and Development (OECD) bases the weights of its MCIs on the OECD Interlink Model.[3]

Most MCI estimations are, however, based on reduced-form aggregate demand equations. Reduced-form models usually consist of a demand equation relating the output (gap or growth) to the interest rate, the exchange rate and possibly some other explanatory variables. This approach has been chosen by most central banks publishing an MCI. The advantages of this approach are its simplicity and modest requirements concerning data and econometric modelling. The reduced-form approach suffers most from the criticisms in Eika et al (1996) detailed in Chapter 3.

VAR models impose only minimal structure and can also be used to calculate MCI weights. Their advantage lies in the fact that they are not based on a particular view of the transmission mechanism. Goodhart and Hofmann (2001) calculate FCI weights using structural VAR models.

Housing prices

The global upswing in stock prices in the 1990s and the sharp downturn since 2000, combined with strongly rising housing prices in many countries, have sparked interest in the role of asset prices for monetary policy. Equity and housing prices are natural candidates for the extension of an MCI to an FCI due to their links to monetary policy. While traditional MCIs only consider the interest rate channel and the exchange rate channel, the inclusion of other asset prices may improve the assessment of the monetary policy stance by accounting for wealth and balance sheet channel effects.

Like many other European countries, Switzerland experienced a housing bubble in the second half of the 1980s. The bursting of the bubble in the early 1990s led to serious problems in the banking sector.

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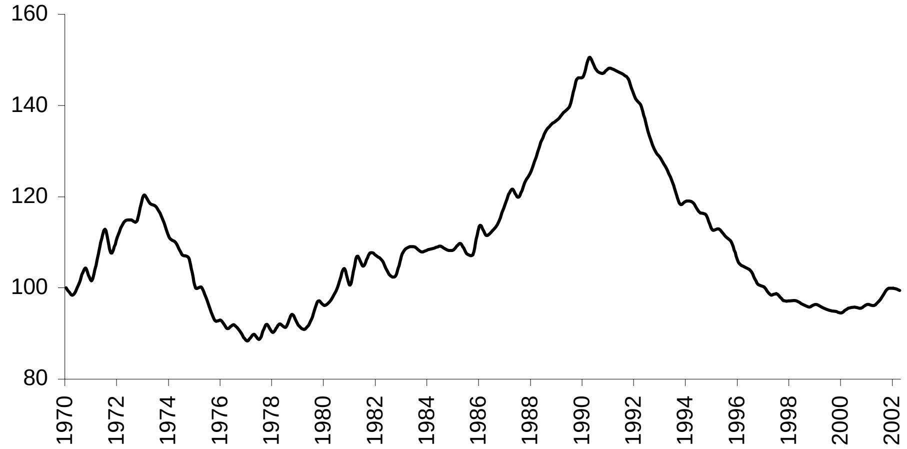
3 See *OECD Economic Outlook* 59 (June 1996), p 31.

Graph 1 shows the long process of deflation in the housing sector in the 1990s. Housing prices[4] (deflated by the CPI) bottomed out in 2000 below their 1970 level.

Graph 1

Real housing price index



By international standards, Swiss property prices remain high even after the strong decline beginning in 1991. Switzerland is a densely populated country and land is scarce. Contributing to the high price level is the non-competitive construction sector, which profits from a high degree of protection and regulation. Further reasons include the high quality standards and large amount of conveniences usually demanded by occupants. The financing of costly real estate is offset by low mortgage rates. Swiss short-term and long-term interest rates are usually considerably lower than comparable eurorates. The low and stable interest rates, the easy availability of mortgages, a high degree of job security, and the deductibility of interest rate payments on mortgages from taxable income encourage Swiss homeowners to take on large debts.

Credit granted to households in Switzerland was almost 100% of gross domestic product (GDP) in 1993 (Graph 2). This is a larger fraction than in any other country, including the United Kingdom, the United States and Japan.

The Swiss debt market is heavily collateralised: 73% of total loans to the non-government sector are backed by real estate collateral. This again is more than in any other country: the share of real estate collateral is around 60% in most English-speaking countries and Sweden and lower in the remaining countries (Borio (1995), Table 16). The large fraction of real estate collateral implies that the high indebtedness of the Swiss private sector is mainly due to the purchase of property and houses. Swiss homeowners are therefore highly leveraged to housing prices. This suggests that housing prices are a good means for capturing wealth channel effects of monetary policy.

Switzerland also boasts a record stock market capitalisation in relative terms.[5] However, a significant fraction can be assumed to be held by foreigners. Direct holdings of shares by individuals are probably less common than in the United States. The indirect holdings of shares through public and private pension funds are believed to be larger than the direct holdings. Furthermore, because the return of pension funds (at least in the short and medium term) is fixed in nominal or real terms and independent of the actual performance of the underlying assets, the influence of stock market

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4 Housing prices depicted in Graph 1 and used in the following estimations are constructed from equally weighted prices of apartments, rented flats, houses, industrial space and office floorspace (see the appendix for details). The index therefore not only measures housing prices in a narrow sense, but also includes property prices. However, the overall evolution of the components is very similar.

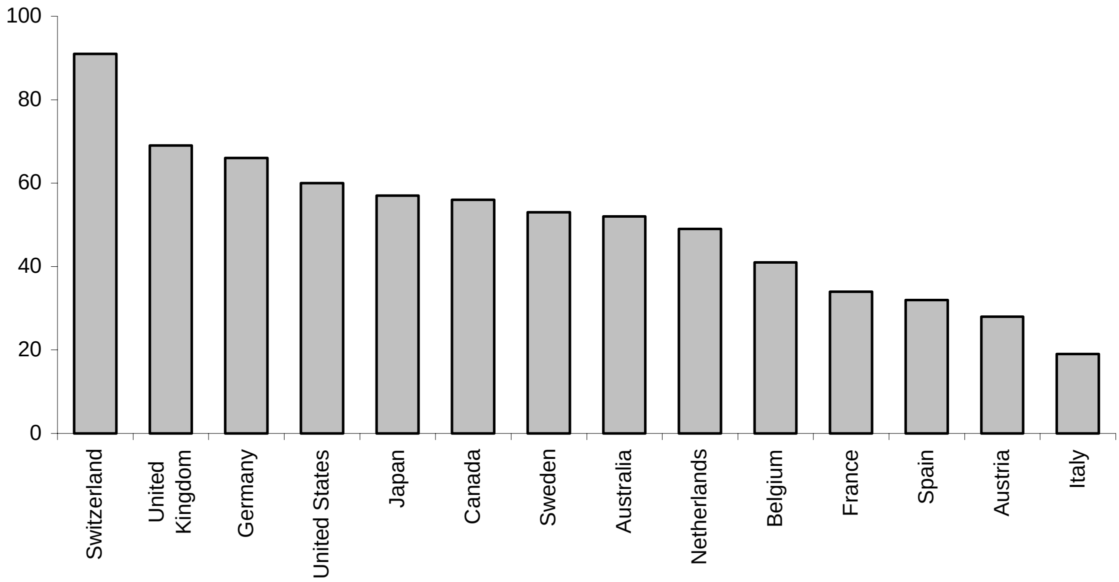
5 In 1999, stock market capitalisation was 320% of GDP in Switzerland, 230% in the United Kingdom, 150% in the United States and 70% in Germany (Rajan and Zingales (2000)).

fluctuations on future rents is not immediately obvious to the individual. Therefore, the wealth effect through equity prices is probably smaller and more difficult to trace than the effect of housing prices. In Fischer et al (2001), housing prices were found to be more robust and significant than stock market prices in predicting economic activity and in improving the empirical fit of a Taylor rule. The analysis in this paper therefore focuses solely on housing prices as an additional asset in the MCI.

Graph 2

Credit to households, 1993

As a percentage of GDP



Source: Adapted from Borio ((1995), Tables 2 and 4).

3. Preliminary thoughts on the construction of an MCI/FCI

Before going into the details of the estimation and calculation of an FCI for Switzerland, some problems highlighted by Eika et al (1996) are addressed in this section.

3.1 Stationarity

Using a macro-model, MCI/FCI weights are calculated from the effects of simulated shocks. The order of integration is important because it affects the nature of the simulated shock (permanent or transitory) and the measurement of its effects on output or prices. Assumptions on the order of integration are implicitly made in calculating and interpreting any MCI, yet they are problematic and not always transparent.

To highlight this issue, consider the stylised response of a time series to a shock, illustrated in Graph 3: the first time series (i) is I(1) with the shock having a permanent effect, the second (ii) corresponds to the first derivate of (i) and is stationary with respect to the shock considered, and the third (iii) is the second derivate of (i).

The response of the first time series to a shock is best measured as the shift of the level of the series. This measure (a) is independent of the chosen time horizon if the horizon is long enough. An alternative, but imperfect measure is (b), measuring the growth rate attained during this shift. Measure (b) depends on the timing; if measured too early or too late, no effect is found. Even more problematic is the case of an overdifferenced time series (iii), as the signs of the measured effect change depending on the chosen horizon. Therefore, effects of permanent shocks to non-stationary time series should best be measured using levels. Table 1 shows an overview of a unit root and stationarity test for the relevant Swiss variables covering the 1973:1-2002:1 period.

Graph 3

Stylised impulse response function

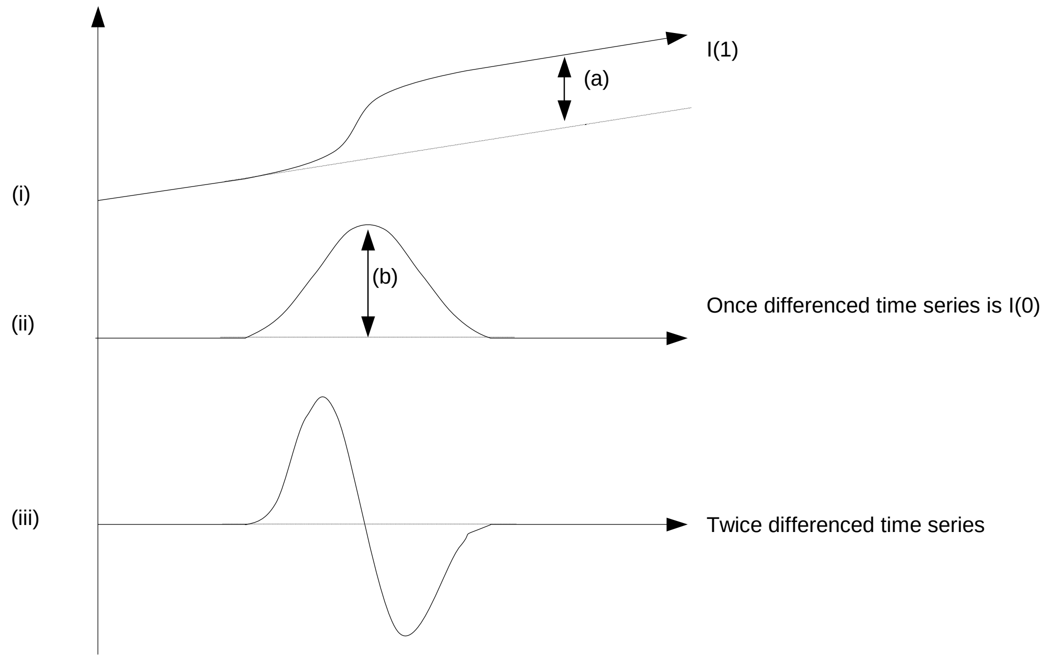


Table 1

Overview of unit root and stationarity tests

	ADF unit root test	KPSS stationarity test
log(CPI)		***
CPI annual inflation	***	
log(real housing prices)		**
Annual real housing price changes	**	
log(real GDP)		
Annual real GDP growth	***	
log(real exchange rate)	*	
Annual real exchange rate changes	***	
Real short-term interest rate	***	**
Nominal short-term interest rate	**	*

Note: ADF unit root test (with automatic lag length selection according to the Schwarz info-criterion) and stationarity test of Kwiatkowski et al (1992) using the Bartlett kernel estimator and Newey-West automatic bandwidth selection. Trends are included for CPI inflation and the level variables. Details about the variables can be found in the appendix. The time period is 1973:1-2002:1 using quarterly values.

* Denotes rejection at the 10% level. ** Denotes rejection at the 5% level. *** Denotes rejection at the 1% level.

3.2 Measuring the output and price effects of shocks

Assumptions about the order of integration of output and prices strongly affect the measurement of the effects of simulated shocks.

Consumer price index (CPI) inflation seems to be trend-stationary in Switzerland. If inflation is trend-stationary, shocks only have temporary effects.[6] The reaction to shocks and therefore the MCI/FCI weights will then strongly depend on the measurement horizon. A better alternative to measuring inflation effects is to measure the CPI level effect of a shock.[7] Trend-stationarity of the inflation rate is sometimes rejected in other countries where inflation is assumed to be I(1).[8] Only in that case is it useful to measure inflation effects. In this investigation both inflation-based and CPI-level-based weights are calculated.

The unit root test finds the logarithm of output to be either I(1) or trend-stationary. If output is trend-stationary, basing MCI/FCI weights on output growth effects is questionable, as the initial output growth effects of a shock have to reverse after some time in order for output to return to its equilibrium.[9] The estimated growth effects will therefore strongly depend on the horizon chosen and will be wrongly signed at some horizons. Note that, in the structural VAR literature, output neutrality with respect to monetary policy shocks (which is about equivalent to assuming output to be stationary) is a common assumption for the identification of monetary shocks. If output is trend-stationary, output effects should best be measured by the output gap (which is equivalent to measure (b) in Graph 3) or even the integrated output gap (equivalent to (a) in Graph 3). Only if output is I(1) does it make sense to measure growth effects. The uncertainty about the correct assumption about the order of integration of output is one reason why FCI ratios will not be based on output effects, but on price effects.

3.3 Simulating shocks to the exchange rate, housing prices and the interest rate

Assumptions about the order of integration of the exchange rate, housing prices and interest rates determine the nature of the simulated shocks. Different weights and a different interpretation of an MCI/FCI will result, depending on whether permanent or transitory shocks to exchange rates, housing prices, and interest rates are simulated.

The stationarity and unit root tests find the real exchange rate to be either I(1) or trend-stationary.[10] It is well known that deviations from exchange rate equilibria are extremely persistent. It can therefore be preferable to treat the real exchange rate as I(1). This assumption fits the Swiss case well, because the appreciation of the Swiss franc can be viewed as a series of one-time permanent shocks. Consequently, for the calculation of FCI weights in Section 4, a *permanent* shock to the exchange rate is simulated.

Real housing prices, ie housing prices deflated by the CPI, are found to be I(1). To calculate the weight for housing prices, permanent shocks are therefore applied to housing prices. The unit root assumption in the real exchange rate and real housing prices is consistent with the market efficiency hypothesis that asset prices follow a martingale.

Interest rates are often treated as stationary variables, yet stationarity of the nominal and real interest rate is rejected. If interest rates are stationary, only temporary shocks can be applied to interest rates. The traditional MCI interpretation, however, implies permanent shocks to the interest rate and therefore implicitly assumes non-stationary interest rates. In order to be comparable to other MCI/FCI investigations, interest rates are therefore also assumed to be I(1). Under this assumption, the

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[6] This corresponds to the case where inflation is depicted by (ii) in Graph 3.

[7] This corresponds to measuring (a) using the CPI.

[8] This corresponds to inflation being the time series as depicted by (i) in Graph 3.

[9] This corresponds to output being described by the time series in (ii) and output growth by (iii).

[10] The trend is due to the annual appreciation by 0.7% on average over the past 25 years. This trend is regarded by the SNB as a structural appreciation.

FCI ratio can then be interpreted as indicating how much interest rates have to be changed permanently to offset a permanent change in the exchange rate or in housing prices.[11]

Note that, by implicitly assuming non-stationarity of the components, an MCI/FCI which is the sum of these components is also non-stationary and should therefore not be used for long-term comparisons.

3.4 Interpretation of the MCI

In the traditional MCI setting, it is assumed that both the interest rate and the exchange rate are determined largely by monetary policy. The Swiss franc is, however, not always driven by monetary policy actions. The Swiss currency is used internationally as a denomination of assets and debts and remains a safe haven in times of crisis. The SNB has only a reduced influence on exchange rate movements. If the SNB tried to target an MCI as an operational target, this would result in large swings of the short-term interest rate, where the zero lower bound (ZLB) could become binding. Ruling out interventions, the SNB would probably not always succeed in maintaining the targeted MCI. The short-term rate is thus the only feasible operating target. Thus, the Swiss MCI is not only a measure of "monetary" conditions, ie conditions which are entirely or mainly induced by monetary policy, but it is a relatively broad measure of "overall" demand conditions and must be interpreted accordingly.

3.5 Endogeneity

Although it was argued that the exchange rate is to a certain extent an exogenous variable, there still remains an endogeneity problem. On the one hand, the MCI weights should be interpretable as structural weights for policy purposes, ie they should answer the question of how large an interest rate shock needs to be to offset an exchange rate shock. For that purpose, the weight of the interest rate should be based on the effect of a *structural* interest rate shock, ie a shock which also allows exchange rates (and housing prices in the case of an FCI) to react. On the other hand, I define a *"restricted"* interest rate shock to be a shock where the exchange rate and housing prices are *not* allowed to react. Concerning the exchange rate and housing prices, policymakers are probably interested in the effects of restricted shocks, ie assuming no change in the interest rate.

The estimated MCI weights depend strongly on whether structural or restricted shocks are applied to a model. For the *interpretation* of the MCI weights for monetary policy purposes, a *structural* monetary policy shock, restricted exchange rate, and restricted housing price shocks are relevant. However, for the *construction* of the MCI or FCI, only restricted shocks must be used. Only then can the MCI/FCI be calculated as a weighted sum of changes in variables relative to a base period.[12] Therefore, *different weights* for policy analysis and for the actual construction of the index must be used.

To illustrate the difference between structural and restricted shocks, suppose monetary policy is tightened by raising interest rates. This leads to an appreciation of the domestic currency. If the interest rate component enters the index weighted according to its structural effect, a reaction of the exchange rate is expected and already accounted for. However, the exchange rate reaction also enters the index. Thus, the exchange rate reaction to the change in interest rates is accounted for twice. To avoid this, a weight of the interest rate component has to be used which corresponds only to the pure interest rate effect through the interest rate channel. A structural interest rate shock is simply a linear combination of a reduced interest rate shock, a reduced exchange rate shock and a reduced housing price shock.

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[11] If interest rates are assumed to be stationary and temporary shocks to the interest rate are simulated to calculate weights, the FCI ratio must then be interpreted as indicating how long and by how much interest rates have to deviate from an equilibrium in order to offset a permanent shock to the exchange rate or to housing prices. This would result in a different (more difficult, but maybe more useful) interpretation of the MCI/FCI. This view of monetary policy would go along the lines of Borio and Lowe (2002), who view monetary disequilibria as *cumulative* processes, ie integrals of deviations from an equilibrium over time.

[12] An MCI or FCI could in principle also be calculated using the structural interest rate shock weight. This, however, would imply that the index cannot be calculated as the sum of the changes of its components. A change in the interest rate would then imply a certain change in the exchange rate to have the full structural effect. Only the deviation of the actual exchange rate from the implied reaction of the exchange rate to the structural shock would then have to be added to the MCI or FCI.

3.6 Dynamics, parameter constancy and omitted variables

FCI ratios will be based on the effects of shocks on prices. For inflation effects, a horizon of 12 quarters is chosen, which is consistent with the SNB's inflation forecast horizon. However, differing weights result at other horizons. A horizon of 36 quarters seems adequate for calculating effects on the level of the CPI.

The parameter constancy issue is dealt with by the inclusion of several dummy variables in the macro-model. The omitted variables problem is undoubtedly less important in a macro-model than in a reduced-form equation or in a VAR.

Concerning housing prices, there could be a potential bias towards an overestimation of the housing price effect, because the model contains neither money, nor credit variables, nor stock prices, which are probably all positively correlated with housing prices. Effects of money, credit or stock prices not accounted for by the model might thus be wrongly attributed to housing prices. Furthermore, housing prices move with a very low frequency. Other, yet unexplained, low-frequency movements might also be (erroneously) attributed to housing prices, which could bias the results.

4. Constructing an FCI for Switzerland

The current Swiss monetary policy concept, which was introduced in 2000, is based on three elements. One element is the definition of price stability as a rate of inflation below 2% measured by the CPI. Another element is the use of three-month Libor as an operating target. Three-month Libor is controlled by repo operations with a maturity from one day up to three weeks. The main element of the strategy is the inflation forecast, which is published twice a year. The inflation forecast extends 12 quarters into the future, yet the internal range of the forecasts extends even further into the future as it may take more than three years until the full effects of monetary policy actions have set in.

4.1 The macro-model used by the SNB

The SNB bases its inflation forecast on several models and indicators. Apart from VAR models and a small structural model, an important model for forecasts and simulations is a medium-sized structural model of the Swiss economy. The macro-model used by the SNB, described in detail by Stalder (2001), is a quarterly structural model with 30 stochastic equations. The model consists of an aggregate demand part, a supply block and a monetary block. Long-term dynamics are captured through error correction terms. The CHF/EUR exchange rate depends on the spread between Swiss and euro short- and long-term interest rates, the balance of the external account, and the difference of the lagged real exchange rate from a PPP measure. The short-term interest rate is determined by a Taylor-type rule depending on inflation, European short-term rates, the output gap, and unemployment. The EUR/USD exchange rate is treated as an exogenous variable. Expectations are not model-consistent, ie long-term interest rates are not the mean of shorter-term rates and the exchange rate is not determined by the uncovered interest rate parity. Changes in long-term interest rates are a function of changes in European and Swiss short rates and of the interest rate differential between German and Swiss rates. The elasticity of the long-term rate to the short-term rate is 0.2, ie a 1 percentage point change to the short rate translates into a 0.2 percentage point change in long rates. Apart from their exchange rate effect, short-term rates do not affect real variables; the interest rate channel works only through the long-term interest rates. Data for estimation have been available since 1980.

4.2 Adding housing prices

To extend the MCI into an FCI, housing prices have to be integrated into the model. This is done by adding housing prices as an endogenous variable. A housing demand equation relates housing price inflation to past housing inflation, long-term interest rates, and growth of total real demand. Apart from the autoregressive coefficient, the coefficients are not significant, but correctly signed. On the one hand, housing prices are expected to have an effect on consumption and investment through the wealth or credit channel. On the other hand, they also influence sector prices. Specifically, housing prices enter the following equations:

- Wealth effects affecting private consumption are difficult to establish. Housing prices are found to enter the consumption equation with a non-significant short-run elasticity of 0.24. Private consumption is about 60% of domestic demand.
- However, significant effects on investment are found. They can be explained by a credit-channel-type effect where rising house and property prices allow or even stimulate further investment, whereas falling prices restrict investment. The effects are limited to the construction sector. Instead of a credit channel effect, this could also be explained by a virtuous (or vicious) circle in construction and a tendency to boom and bust behaviour. Housing prices deflated by the CPI enter the business construction equation with a non-significant short-run elasticity of 0.18 and a highly significant long-term coefficient of 0.86 in the error correction term. The short-run elasticity of housing investment is 0.10 and the long-run coefficient is 0.14, neither of which is significant. Business construction is about 2% of domestic demand and housing investment is about 5% of domestic demand.
- Housing prices are also related to the construction price index with a significant coefficient of 0.18 in the short run and 0.16 in the long run and to the housing rent price index with a non-significant short-run elasticity of 0.06 and a highly significant long-run coefficient of 0.19.

4.3 Simulation of shocks

To calculate FCI weights, adverse shocks to the interest rate, the EUR/CHF exchange rate, and housing prices are simulated.[13] The size of the shocks is 1 percentage point for the interest rate and 1% for the exchange rate and housing prices. As most variables enter the model in nominal terms and the FCI is mainly used for short-term comparisons, shocks to nominal variables are simulated.

Based on the stationarity discussion in the previous section, permanent shocks are simulated. After the first period where the shock sets in, the shocked variable is exogenised and forced to follow the path forecasted by the model if there had been no shock, although on a level which differs by the size of the initial shock.[14] The reactions of prices and output are then calculated as the difference to a base scenario where no shocks are assumed.[15]

To gain an understanding of the endogeneity problem, “structural” and “restricted” shocks are applied to the interest rate. A structural shock allows the exchange rate and housing prices to react to the interest rate shock, whereas, in the case of a restricted interest rate shock, exchange rates and housing prices are exogenised and forced to follow the path of the no-shock base scenario. For the exchange rate and housing prices, only restricted shocks are applied and the other two FCI variables are forced to follow their base path. Simulating a restricted shock of 1 percentage point to short-term rates is equivalent to simulating a 0.2 percentage points shock to long-term rates, because, apart from the effect on exchange rates and long-term rates, the short-term interest rate plays no role in the model.

4.4 Reaction of output and prices

Graph 4 shows impulse response functions of annualised quarterly inflation, the CPI, annualised quarterly real growth, and real output.

The effect of a structural interest rate shock on prices or output is significantly larger than the effect of a restricted interest rate shock. This implies that only a small fraction of the overall effect of a structural interest rate shock is due to the pure interest rate channel through long-term rates on consumption or investment; most of the structural interest rate shock effect is due to the reaction of the exchange rate

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[13] A shock to the euro exchange rate is equivalent to a shock to the total external value of the Swiss franc as the only other exchange rate variable in the model is the exogenous dollar exchange rate, which is fixed in relation to the euro.

[14] Note that, contrary to an impulse response analysis in a VAR system, no autoregressive dynamics of the shocked variable after the first simulation period are allowed.

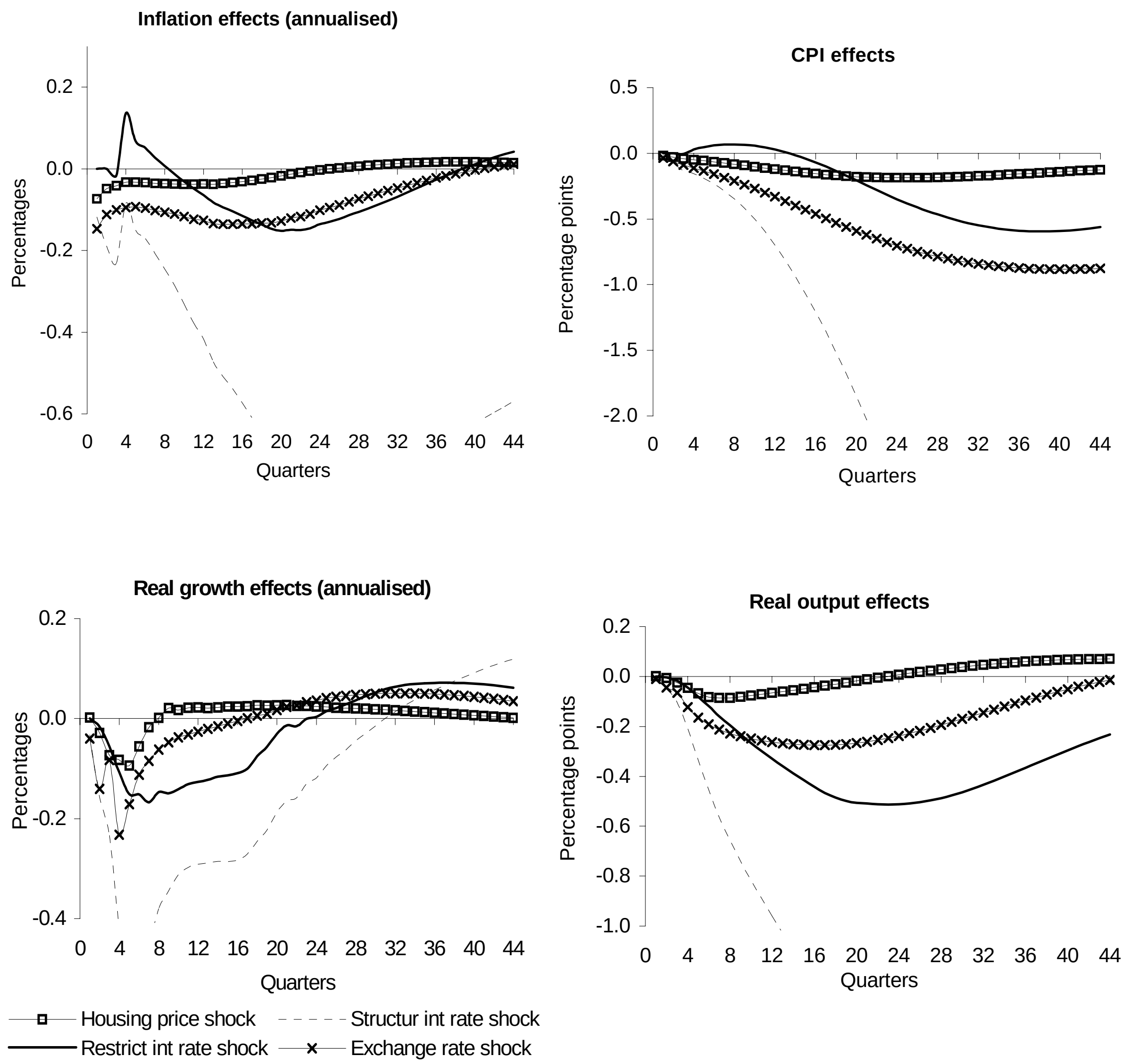
[15] Strictly speaking, the reaction of the simulation depends on the starting point of the simulation. However, differences due to different starting dates of the simulations have been found to be small, therefore the simulation arbitrarily starts in the first quarter of 1996.

and therefore to the exchange rate channel. The result is not surprising given that imports are more than 40% of GDP in Switzerland.

The spike in inflation three quarters after an adverse interest rate shock occurs because housing rents are indexed to long-term rates by law: a change in mortgage rates by 1 percentage point translates into a change in housing rents of 8-12%. A rise in short-term rates leads to a rise in long-term rates, which in turn increases housing rents. Housing rents represent about 20% of the CPI. This link seriously undermines the effects of monetary policy during the first quarters after a change in monetary policy.

Graph 4

Impulse response functions



4.5 FCI weights

FCI weights are based on inflation effects and CPI level effects and not on output effects for several reasons. First, as already mentioned, if output is trend-stationary, growth effects cancel out over time and the estimated weights will strongly depend on the horizon selected. Indeed, in the long run, the simulated shocks are neutral with respect to real output, and, consequently, real output growth reverses signs (see Graph 4). Second, when relying on growth effects, direct price effects of an exchange rate shock through import prices, which are important in Switzerland, are neglected. Third, an adverse housing price shock, although having the desired effect of lowering inflation, soon increases GDP growth rates through its supply side effect by lowering investment costs, which yields a wrong sign of the housing price component in the FCI. Table 2 summarises the calculated weights. The effect of an exchange rate shock is normalised to 1.

Table 2

Relative effects on inflation and prices

	Effect of interest rate shock	Effect of exchange rate shock	Effect of housing price shock
Structural shock based on inflation effects at $t = 12$	3.5	1	–0.28
Structural shock based on CPI level effects at $t = 36$	5.3	1	–0.18
Restricted shock based on inflation effects at $t = 12$	0.6	1	–0.28
Restricted shock based on CPI level effects at $t = 36$	0.7	1	–0.18

4.6 Structural and restricted ratios

Independent of whether the weights are based on inflation or price level effects, the estimated weights are quite similar. A structural interest rate shock at a horizon of 12 quarters has a 3.5 times larger effect on inflation than an exchange rate shock, or, at a horizon of 36 quarters, has a 5.3 times larger effect on the CPI level than an exchange rate shock. The relative weight of housing prices is –0.18 (based on the CPI level) or –0.28 (based on inflation). The effects of a restricted interest rate shock are about six to seven times smaller than the effects of a structural interest rate shock. A restricted interest rate shock is simulated with the exchange rate not being allowed to react to the interest rate change. It is a well known feature of the macro-model used by the SNB that monetary policy mainly works through the exchange rate.

The obtained weights for the reduced interest rate shock critically depend on the transmission of shocks from the short to the long rate. In the model, the short-term rate works only through long-term rates and the exchange rate. A restricted short-term rate shock therefore only works through the long-term rate. The estimated elasticity of the long-term rate to the short-term rate is 0.2. A full 1:1 transmission of short- to long-term rates would increase the effect of the restricted interest rate shock fivefold and thus result in a restricted MCI ratio of about 3:1.

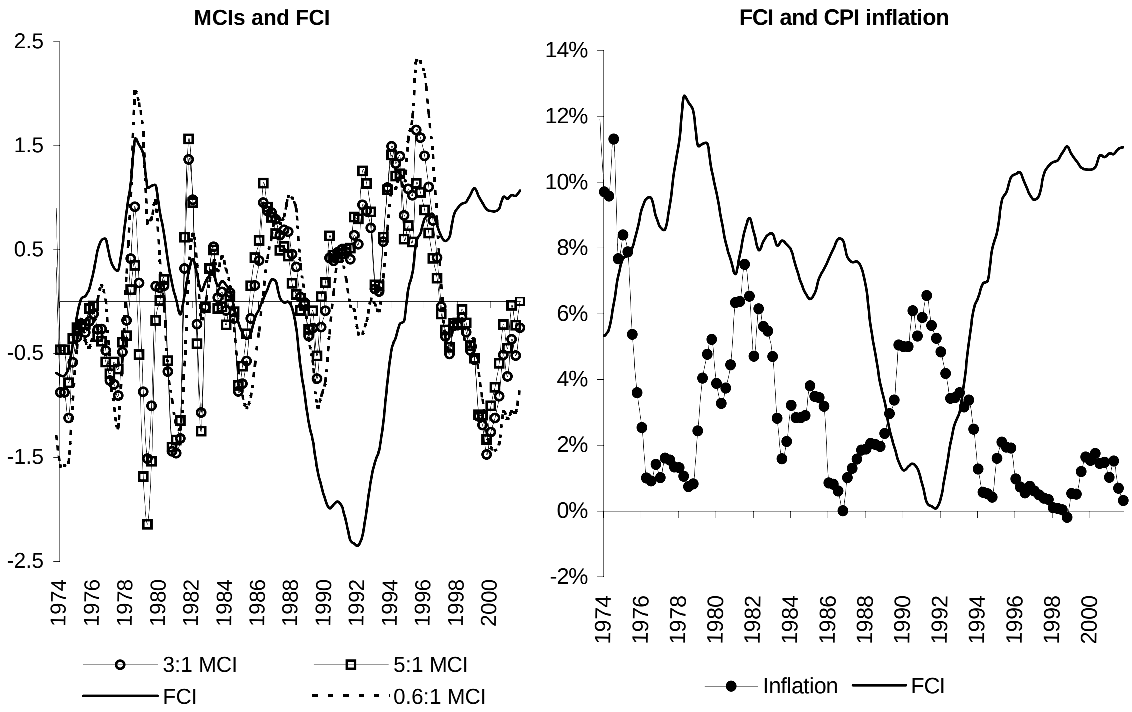
4.7 Assessing the FCI

The MCI with weights of 3:1 and 5:1 from Lengwiler (1997), an MCI using the weights of 0.6:1 and the FCI with weights of 0.6:1:0.28 (the ratio based on inflation effects) are compared in Graph 5 (left-hand panel). To facilitate a long-run comparison, *real* values are used. The inverse correlation of the FCI with inflation, at least since 1986, is striking (Graph 5, right-hand panel). Note that, although real variables are used, due to structural breaks and non-stationarities, comparing levels is problematic. However, it is appropriate to interpret changes in the MCI/FCI as changes in the stance of monetary policy.

The three MCIs do not differ significantly as they are mostly driven by exchange rate fluctuations. However, the FCI is mainly determined by housing price movements. The MCIs, on the one hand, and the FCI, on the other, deviate strongly from each other after about 1985; while the MCIs show a significant tightening of monetary policy from 1985 to 1987, the FCI barely moves, because the rising value of the Swiss franc is offset by rising housing prices. The FCI then indicates a record expansion of monetary conditions lasting well into the year 1991. The rise in inflation starting in 1987 and peaking in 1991 is better explained by the FCI than by the MCIs, which only show a moderate expansion lasting from 1986 to 1989. The deterioration of monetary conditions indicated by the rise of the FCI starting in 1992 and lasting until 1996 is more marked than the deterioration indicated by any of the MCIs. Furthermore, contrary to the MCIs, the FCI stayed very high throughout the second half of the 1990s, indicating a tight stance of monetary policy, which can well explain the record low inflation rates prevailing in Switzerland since 1994, despite strong GDP growth in 1999 and 2000.

Graph 5

MCIs, FCI and CPI inflation



Note: The MCIs and the FCI are moving averages over three quarters, normalised, using real variables and detrended exchange rate and housing prices.

Table 3 presents a more systematic assessment of the forecasting power of the MCIs and the FCI. The change in annual inflation between *t* and *t* – 12 is regressed on the annual change in oil prices in Swiss francs (to account for supply side effects), annual German real growth (to account for non-monetary demand side effects), and annual differences of the MCI and FCI at horizons of $t = -10$, −6, −2 (because not only changes at $t = -2$ can be expected to influence inflation, but also, to a lesser degree, changes at a closer horizon).

Almost all the MCI and FCI coefficients are correctly signed and many are significant. The adjusted R^2 of the regressions including the MCIs improves with an increasing exchange rate weight. The regression including the MCI with the largest relative weight on the exchange rate (0.6:1) is superior to the other MCIs, as all three lagged MCI coefficients are highly significant and the R^2 is highest among the MCIs. Using the FCI instead of an MCI improves the fit further. The inclusion of housing prices clearly increases the forecasting performance for inflation. However, the good performance of the new MCI and the FCI is largely due to the inclusion of lags at time *t* – 6 and *t* – 2 which are below the target horizon, while the coefficient at lag 10 is relatively less significant. This is due to the large weight of the exchange rate, which has its largest effect on inflation at short lags. By contrast, the 3:1 and even more the 5:1 MCI give a larger weight to the real rate, which affects inflation only after longer lags so that longer lags are more significant.

Disregarding housing prices, the estimated MCI ratios of about 0.6:1 (based on inflation effects) or 0.7:1 (based on CPI level effects) are well below the 3:1 and 5:1 ratios currently applied by the SNB (Lengwiler (1997)). Although an MCI ratio below 1 seems probably too low, a ratio between 1 and 3 for Switzerland might not be unreasonable. Many studies find MCI ratios between 1 and 3 for countries which are less open than Switzerland. Ericsson et al (1998, p 36) present a comprehensive overview of estimations of MCI ratios. For Switzerland, the authors list two MCI ratios: 6.4 (by Deutsche Bank) and 1.7 (by JP Morgan). JP Morgan assigns ratios of below 1 to Belgium (0.4) and the Netherlands (0.8). The median values of the listed results for Spain (which is certainly less open than Switzerland) and Sweden (which has a comparable import share of GDP to Switzerland) are both 2.

Table 3

OLS regression of changes in inflation on changes in the MCI and FCI

	Variable	Coefficient	*t*-statistic	Probability
5:1 MCI Adjusted R^2: 0.32	Δ 4*MCI*(–10) Δ 4*MCI*(–6) Δ 4*MCI*(–2)	–0.042 –0.010 0.004	–2.13 –0.41 0.17	0.036 0.681 0.865
3:1 MCI Adjusted R^2: 0.34	Δ 4*MCI*(–10) Δ 4*MCI*(–6) Δ 4*MCI*(–2)	–0.085 –0.056 –0.035	–2.91 –1.63 –1.12	0.005 0.107 0.268
0.6:1 MCI Adjusted R^2: 0.42	Δ 4*MCI*(–10) Δ 4*MCI*(–6) Δ 4*MCI*(–2)	–0.131 –0.132 –0.166	–3.25 –3.04 –3.91	0.002 0.003 0.000
FCI Adjusted R^2: 0.60	Δ 4*FCI*(–10) Δ 4*FCI*(–6) Δ 4*FCI*(–2)	–0.054 –0.114 –0.156	–2.15 –3.90 –5.78	0.034 0.000 0.000

Note: Dependent variable: change in annual inflation between *t* and *t* – 12. "Δ4" denotes relative annual changes. Sample: 1977:2-2002:1. Other variables included in the regression, but not listed here, are a constant, annual oil price inflation (in Swiss francs) at time *t* and annual German real output growth at time *t* – 10, all of which are significant and correctly signed. The MCI and FCI are not normalised and the size of the coefficients is therefore not comparable.

As opposed to most other studies, the estimated MCI ratios in this investigation are based on price effects and not on output effects. MCI ratios based on real growth would be larger than those based on prices: as Graph 4 (bottom left-hand panel) shows, the growth effect of a restricted interest rate shock is larger than the effect of an exchange rate shock after a horizon of five quarters, resulting in MCI ratios of 0.4:1 at four quarters, 2.4:1 at eight quarters and 4.9:1 at 12 quarters.

The main reason why inflation-based ratios are lower than growth-based ratios is the link of housing rents to interest rates, which considerably weakens the effects of changes in the interest rate. A second important reason lies in the fact that, in the macro-model used at the SNB, interest rate changes work mainly through the exchange rate and only to a small degree through the pure interest rate channel via long-term rates on investment and consumption, which results in a relatively weak estimated effect of a restricted interest rate shock in relation to a structural interest rate shock or an exchange rate shock.

Table 4 compares the FCI ratios found for Switzerland with those put forward by Goodhart and Hofmann (2001) and Mayes and Virén (2001) for other countries. The macro-model suggests that the weight of housing prices should be 18% or 28% of the weight of the exchange rate. While Goodhart and Hofmann find a weight for housing prices which is (on average) substantially larger than the weight of the exchange rate, Mayes and Virén find a relative weight of about 70%, which is still more than twice the housing price weight found for Switzerland. The low relative weight of housing (compared to the exchange rate) can be attributed to the important role of the exchange rate channel in Switzerland and does not necessarily mean that housing prices are not important in Switzerland. Comparing the weight of interest rates with the weight of housing prices yields less divergent results across studies: the weight of housing prices is always below the weight of the interest rate and amounts to 25-85% of the weight of the interest rate.

Table 4

Comparison of FCI weights

	Effect of interest rate shock	**Effect of exchange rate shock**	**Effect of housing price shock**
Restricted shock macro-model based on inflation effects at $t = 12$	0.6	1	0.28
Restricted shock macro-model based on CPI level effects at $t = 36$	0.7	1	0.18
Goodhart and Hofmann (2001) reduced-form approach	3.3	1	1.5
Goodhart and Hofmann (2001) VAR approach	4.3	1	3.7
Mayes and Virén (2001) reduced-form approach	1.7	1	0.7

Note: The weights of Goodhart and Hofmann (2001) are average weights for seven countries. The weights of Mayes and Virén (2001) are the median of eight different estimation methods using a panel consisting of five European countries. Both studies also include share prices, which are ignored here.

5. Summary and conclusions

By including housing prices in the medium-sized structural macro-model used by the SNB, an FCI for Switzerland was constructed. Housing prices increase the predictive power for inflation of the new FCI compared to traditional MCIs. Normalising the weight of the exchange rate component to 1, a weight of the interest rate of below 1 and a weight of housing prices of 0.18 or 0.28 are found.

Swiss inflation during the past 15 years is well explained by the FCI. The FCI indicates a slightly expansionary or neutral stance during the first half of the 1980s and a strong expansion starting in 1986, thereby better explaining the increase in inflation rates from 1987 to 1991 than the MCIs. The fall in housing prices from the peak of the bubble in 1991 until the trough in 1999 implies a stronger tightening of financial conditions and a more restrictive monetary policy stance than indicated by the MCIs, which could explain the persistently low inflation rates experienced since 1994.

The estimated MCI ratios are lower than the ratios found by Lengwiler (1997). The main reason is that weights are based on inflation and not on output effects. The link of housing rents to interest rates dampens the impact of interest rate changes. Furthermore, direct price effects of an exchange rate shock through import prices are neglected when using output effects. Policymakers in an open economy should therefore be aware that “monetary conditions” may differ depending on whether one has in mind inflation or growth. Another reason for the low estimated MCI ratios lies in the modelling of the transmission mechanism in the macro-model, where a change in interest rates mainly works through the exchange rate channel.

The macro-model suggests that only long-term interest rates matter for the pure interest rate channel. One issue for further exploration might be the addition of the long-term interest rate to the MCI and FCI or even the replacement of the short-term interest rate by the long-term interest rate in the MCI and FCI.

A further important issue is the differentiation between a structural and a restricted interest rate shock. While weights based on structural shocks may be used for policy analysis, different weights based on restricted shocks are necessary for the construction of an MCI and FCI. The weights needed for construction should not be used for policy analysis. Policymakers should be aware of the difference.

Stationarity assumptions are crucial for the construction and interpretation of an MCI or FCI. Depending on the underlying assumptions, different results and interpretations can be obtained.

Summing up, while constructing an FCI for Switzerland, many conceptual and econometric questions are raised, but not many can be answered satisfyingly. On the surface, an MCI or FCI seems to be innocuous and easy to understand. However, this simplicity may be deceptive and dangerous, as it may induce policymakers to rely too strongly on the MCI or FCI. Policymakers ought to be aware of the deficiencies of such indices, namely that they are intricate objects and are based on strong assumptions. The low importance of the MCI in Swiss monetary policy seems fully justified. A deeper understanding of the MCI and FCI could still be useful.

One insight is that housing prices probably contain useful information for identifying the stance of monetary policy. However, the MCI or FCI framework seems too restrictive an environment for addressing this question. Further investigation is necessary to identify the actual role of housing prices in the transmission mechanism of monetary policy in Switzerland.

Data appendix

Variables		Source
Consumer prices	Seasonally adjusted, end of period	Bundesamt für Statistik (Federal Office of Statistics)
Oil prices	In Swiss francs, average of period	SNB
Housing prices	Constructed by aggregating the mean of quarterly growth rates of the following sub-indices: office floorspace (*Büroflächen*), apartments (*Eigentumswohnungen*), houses (*Einfamilienhäuser*), industrial space (*Gewerbeflächen*), new and old rented flats (*Mietwohnungen*)	Wüest & Partner
Short-term interest rate	Three-month Libor, end of period	SNB
Real GDP Germany	Seasonally adjusted	SNB
Exchange rate	Real export-weighted exchange rate, end of period	SNB

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