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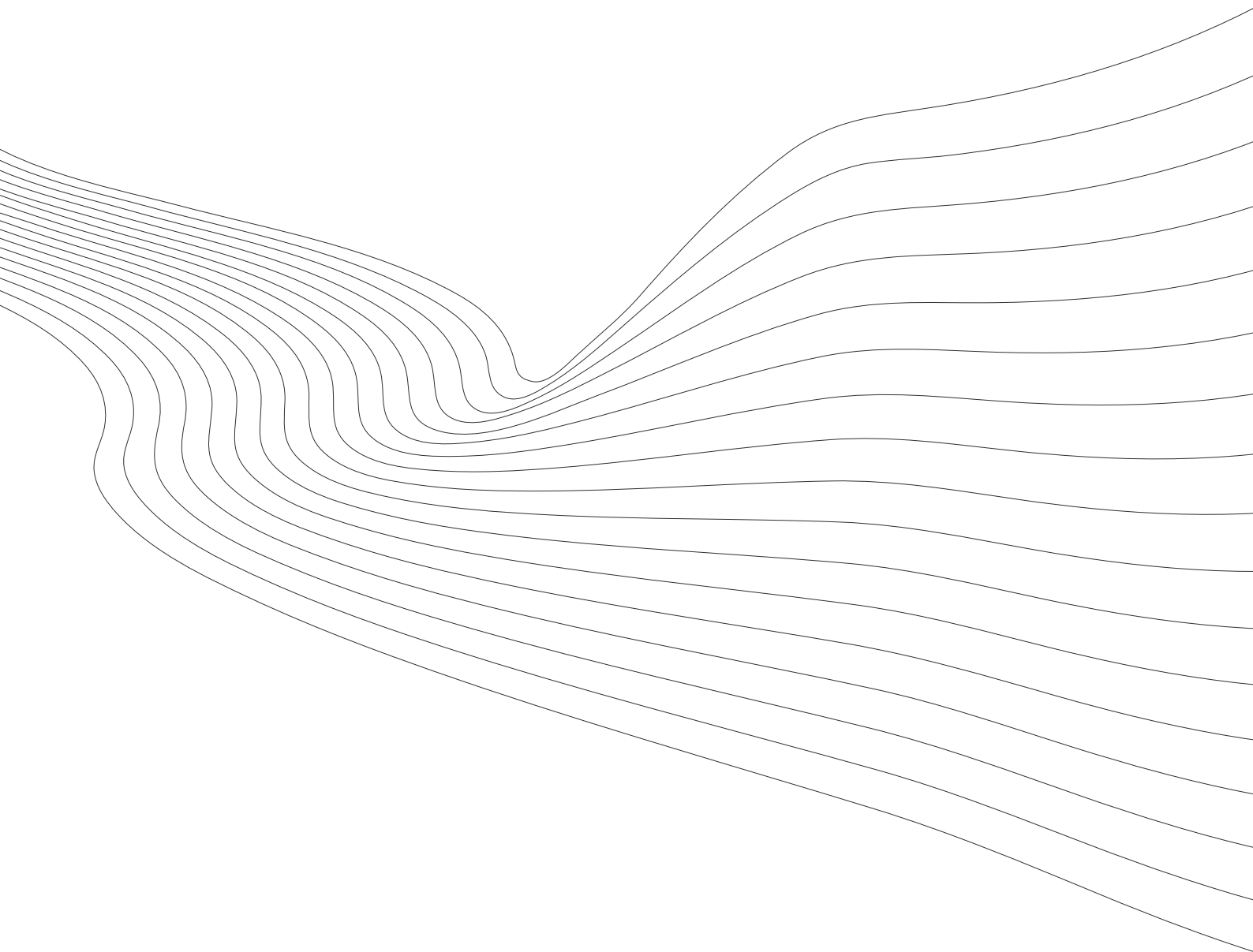
A real time Evaluation of Employment Forecasts in Switzerland

Michael Graff, Massimo Mannino and Michael Siegenthaler*

November 6, 2012

Abstract

We evaluate nowcasts and one- to four-quarter-ahead forecasts of Swiss full time equivalent jobs from 1998q1–2011q4, comparing forecasts of the KOF Swiss Economic Institute and of the State Secretariat for Economic Affairs with the outcome of the reference series. Both forecasts are biased downward, and they do not capture the trend of the reference series well. In addition, we show that the KOF Employment Indicator as well as the Employment Indicator of the Federal Statistical Office are useful to predict the evolution full time equivalent jobs with a lead of about one quarter.

1 Introduction

In recent years, observers of economic activity found that employment growth in Switzerland has decoupled more and more from the business cycle. In particular, Switzerland has experienced an unusually large job growth in the last decade; the number of full time equivalent jobs grew from roughly 3 million in 1999 to 3.43 million in 2011. Even the 2007 to 2009 financial crisis and the resulting recession—from 2008 to 2009, real GDP dropped by 1.9%—just lead to a comparatively small kink in job growth, and the number of jobs came back on its growth path as soon as by the end of 2009. At the same time, GDP did not keep up with growth in the number of jobs. As a result, the growth rate of labor productivity between 2000 and 2010 was, in a historical perspective, unprecedentedly low (Siegenthaler, 2012). Moreover, there are indications that the cyclical responsiveness of unemployment to changes in the number of vacancies posted has declined (Stalder, 2010) and that the Swiss National Bank's (SNB) shift to a more inflation targeting policy in the late 1990s might have increased real-wage flexibility and lowered the so-called NAIRU (Kugler and Sheldon, 2010).

Some of these observations might be connected to the implementation of a free movement of persons treaty between Switzerland and the EU/EFTA states that gradually came into effect since 2002. Indeed, immigration into Switzerland's labor market has lately been exceptionally pronounced in an international perspective and has been the main feeder of the growth in the number of jobs (OECD, 2012).

Because of these shifts, uncertainty arose around the behavior of job growth in Switzerland. For economic forecasters employment became a particularly difficult variable to predict. Indeed, the situation gave rise to general doubts about the appropriateness of the different forecasts of employment in Switzerland.

The aim of this paper is thus to evaluate these different forecasts in the recent past. In particular, we examine forecasts of the KOF Swiss Economic Institute at the ETH Zurich regarding the number of full time equivalent (FTE) jobs of Switzerland and compare these forecasts with other forecasts of the same target variable, notably with simple autoregressive models, with two indicators from survey amongst firms—the KOF Employment Indicator (KOFEI) and the Employment Indicator of the Federal Statistical Office

(FSOEI)—, and with forecasts made by a group of experts from the government under the guidance of the State Secretariat for Economic Affairs (SECO).

To our knowledge, this paper is the first to systematically evaluate and compare the forecasts of labor market outcome variables in Switzerland. More generally, and somewhat surprisingly, there is so far practically no published evidence of systematic evaluations of labor market forecasts.[1] Moreover, this study is also the first to compare the accuracy of the KOF forecasts with those of the SECO, and to compare the predictive contents of the indicators KOFEI and FSOEI.

Importantly, the entire exercise is done in a simulated real-time set-up, i.e. for every point in time we utilize historical data vintages reflecting available information at the time of forecasting. The use of real-time forecasts is mandatory since the relevant employment data are subject to revisions. As has been shown in several studies (cf. Croushore, 2005, 2011; Graff and Sturm, 2012; Orphanides, 2001), using real-time data instead of latest-available data is essential when evaluating the accuracy of forecasts. Table 1 illustrates our real-time data table with forecast vintages regarding FTE jobs (in thousands).

The evaluation confirms that forecasts of the dynamics of employment have been fairly inadequate. For the period under consideration, neither the SECO nor the KOF forecasts of employment growth are optimal. They are biased, and standard accuracy statistics indicate significant forecasting errors.

We also find that the initial, purely model driven KOF forecasts are not significantly improved (neither worsened—which is to some degree reassuring), when expert judgments are considered in the course of making the forecasts. Furthermore, the evaluation indicates that the KOF Employment Indicator and the Federal Statistical Office Employment Indicator are useful to make predictions regarding FTE jobs, since both indicators precede the reference series by one quarter. Since the KOF as well as the SECO forecasts systematically underestimated growth in the number of FTE jobs, it seems that both forecasting institutions struggled to perceive and incorporate the

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[1]Exceptions are the conference volume edited by Neugart and Schönmann (2002), a reader that focuses on forecasting methodology rather than ex post accuracy evaluations, as well as, more recently and more to the point, Stekler (2011) on the US labor market.

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shifts in the dynamics of employment in Switzerland.

The rest of the paper is structured as follows. A detailed description of the data together with a description of the reference series at which the respective forecasts were aimed is presented in section 3. Section 4 discusses our statistical methods used to evaluate the forecasts. We devote sections 5 and 6 to present and discuss the results of the the study.

TABLE 1 ABOUT HERE

2   The KOF macroeconometric model

The KOF labor market forecasts referred to have been generated with the KOF macroeconometric model.[2] This model is the backbone of KOF's regular quarterly forecasts for the Swiss economy. As usual in macroeconometric forecasting on a large scale, the approach is eclectic in that the first-run model results (*Nullprognose*) are subjected to expert judgment, modified if considered necessary, and the model is re-run until the output converges to a macro scenario that is not only consistent according to national accounting rules but also plausible to the business cycle experts at KOF. In most instances, it takes no more than three rounds to arrive at the final forecast.

The KOF model is a medium-scale structural macroeconometric model comprising 317 equations, 41 of which are stochastic. The remaining equations are identities and technical relations. The stochastic equations feature long-run cointegrating relations as well as short-run dynamics. The model adheres to the Keynesian approach, which is also used in various policy-making institutions as, for example, the Swiss National Bank.[3] In line with other models in this tradition, the KOF model distinguishes between the long-run properties governed by aggregate supply, and the short-run dynamics that are largely demand-determined. The model is sub-divided into

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[2]This section is a abbreviated and modified version of the description of the KOF macroeconometric model in Frick et al. (2012). See Stalder (1991) for a detailed account of the first version of the model.

[3]For the Swiss National Bank's macro model, see Stalder (2001). Vetlov and Warmedinger (2006), Ciccarelli et al. (2006), Angelini et al. (2006) and Boissay and Villetelle (2005) provide a description of the German, Dutch, Italian, and French blocks, respectively, of the ESCB multi-country model, which builds on previous modeling work on the Area Wide Model described in Fagan et al. (2005). Furthermore, Laxton et al. (1998) outline the IMF structural multi-country macroeconometric model.

four main closely interrelated blocks: the supply-side block, the demand-side block, the household-income block, and the monetary block.

The supply-block, determining potential output, combines the following three features: the use of a vintage production function, monopolistic competition in the goods market, and the use of business tendency survey data collected at the individual firm level reflecting tensions in the goods and labor markets. The latter feature plays an important role in determining wage-price dynamics.

In the demand-side block, the components of total output are determined allowing for short-run deviations from long-run output. Such deviations, however, trigger wage and price adjustments in the aggregate supply block that bring the model back to the long-run equilibrium path.

In the household-income block, disposable household income is determined, which is the main factor for consumption decisions of households. Finally, the monetary block of the model contains equations for exchange and interest rates. In this block, a connection to foreign (German) interest rates is established through the interest parity condition.

Importantly, Switzerland is a small open economy so that the Swiss business cycle is to a large degree triggered by the world economy, and in particular by the economic situation in its largest trading partners in the EU: Germany, France, Italy and the UK. The KOF model reflects this link, showing high sensitivity to the exogenous variables for the international economy.

The basic structure of each block as well as the major interaction channels between these four blocks are presented in figure 1. When presenting each block, we distinguish between the following groups of variables: first, the block-specific endogenous variables which are determined in the corresponding block; second, the endogenous variables determined elsewhere that serve as the explanatory variables in the stochastic equations of a given block; third, the exogenous variables specified outside the model. For example, for the demand-side block the endogenous variables modeled within this block are the demand-side components of GDP: private consumption, private residential and non-residential investment, inventory investment as well as exports and imports (both of goods and services). The endogenous variables supplied from the rest of the model are as follows: real disposable income, short- and long-term domestic interest rates, prices (both domestic

and foreign), unemployment and private investment in equipment and machinery. In turn, the main output of the demand-side block is the total value of GDP representing a general level of domestic economic activity, which is supplied to the remaining three blocks. The third group representing exogenous variables is given by the world activity (measured as a weighted average of GDP in Europe, the USA and Japan), public expenditure, public construction and the size of the population.

FIGURE 1 ABOUT HERE

Accordingly, of the model variables related to the labor market, population, working age population and the actual labor force (an empirically determined fraction of the former) are exogenous—the number being provided by the KOF labor market expert. The other labor market variables are jointly determined in the supply, household income and aggregate demand blocks.

3 Data

3.1 KOF forecasts and the reference series

KOF published forecasts regarding both FTE jobs twice a year (in the first and third quarter) until 2007q3. Since 2007q4, forecasts of FTE jobs are published on a quarterly basis. These forecasts appear in the KOF Bulletin. Data with all the vintages of the KOF forecasts of FTE jobs are available semi-annually between 1998q1 and 2007q3 and quarterly from 2007q4–2011q4, which yields a sample size of 37 observations for nowcasts.

The reference series that KOF aims to forecast is seasonally adjusted FTE jobs according to the the Job Statistics, which is administrated by the FSO. The FSO collects data in form of surveys from companies listed in the Business and Enterprise Register of Switzerland. A part of the survey encompasses the amount of full time equivalent jobs a company provides. An employee is listed in the statistics if she or he works at least six hours per week in a company that is part of the secondary or tertiary sector. Enterprises are randomly selected from the Business and Enterprise Register. For example, in 2005 a sample of 62,800 enterprises of the register had to participate in the JOBSTAT survey. This corresponds to 16 percent of

all businesses and enterprises of the secondary and tertiary sector and 59 percent of total employment.

Each time a forecast is made, data of the previous quarter are available and published by the FSO. Hence, nowcasts—reflecting predictions of the current quarter we are in when the forecasts are made—can be made using the first vintage of the data for quarter $t - 1$.

Rather than comparing the amount of FTE jobs in levels, our forecast evaluation is made with reference to quarter-on-quarter growth rates of FTE jobs. The reason behind this approach lies in the problem of building an appropriate real-time level reference series for FTE jobs with the JOBSTAT data. To understand the issue, some further comments on the series of the Job Statistics are needed.

As mentioned, the JOBSTAT is based on enterprises drawn from the Business and Enterprise Register. The register itself is based on the results of the business census which is also conducted by the FSO. Since 1991 a census was conducted in the third quarter of 1995, 1998, 2001, and 2005. Each time a business census is made, the Business and Enterprise Register is updated to cover the new full sample of enterprises in Switzerland. This implies that the basis from which enterprises are sampled for the JOBSTAT survey is updated with considerable lag. For example, all enterprises that started up after the third quarter of 1991 were not considered in the JOBSTAT until the results of the census of 1995q3 became available in late 1996.

The time lag in the representativeness of the firm sample would pose no problems to the representativeness of the statistics if job growth in new enterprises were equal to job growth in old enterprises covered by the JOB-STAT. However, start-ups generally display higher job dynamics than existing enterprises or enterprises that have to close down. As a result, the JOB-STAT regularly underestimated the dynamics of job growth in Switzerland and, hence, upward revisions of the figures of the JOBSTAT were necessary each time the results of a new business census became available. These revisions generally affected all published figures of FTE jobs between the benchmark figures from the latest and second latest business census. In particular, to fit the old series to the new benchmark figure of the census, the FSO (slightly) increased the trend growth rates of the old vintage between the two benchmark figures from the two censuses. The cyclical pattern of old vintage was left unaltered—i.e. imposed to the new series. Thus,

quarter-on-quarter growth rates of both vintages are very similar, except for the slightly different trend. Among other things to overcome the inappropriateness in the long-run dynamics of the JOBSTAT series, the FSO revised in 2007 its method to update the Business and Enterprise Register. Since then, the register is updated each year using administrative data. Hence, representativeness of the firm sample underlying the JOBSTAT is ensured since 2007.

This brings us to the reasons why our analysis is done referring to growth rates of of FTE jobs rather than the levels: prior to 2007, the exact moments when KOF accounted for the level shifts in the reference series are not detectable—among other reasons because some data adjustments were made manually before the FSO officially published the results of their revisions.[4] Therefore, a proper real-time analysis with the level data before 2007 is problematic, since the amount of FTE jobs that KOF actually aimed to forecast is not entirely reproducible for each observation. Moreover, the manual adjustments of the KOF experts might imply that the actual reference series of KOF was in some instances slightly different from the reference series of the other forecasts predicting FTE jobs that we examine in this paper. Both problems are clearly less prevalent in the first-differenced series because the growth rates are only slightly affected by data revisions.

A further comment on our reference series is in order. The Job Statistics has undergone another revision in 2010, when it switched to the so called NOGA 2008 industry classification, which fulfills the requirements of the Statistical Classification of Economic Activities of the European Union (NACE), revision 2. The data before were released according to the NOGA 2002 classification (NACE, revision 1.1). The effect of the change in the classification are visualized in figure 2. The changes affect the level as well as the dynamics of the series.

FIGURE 2 ABOUT HERE

This time, the point in time when the KOF experts implemented the data revision is known. During the period 1998q1 and 2010q2 the reference series of KOF was the series according to the old classification. Starting in

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[4]Such *ex ante* adjustments were possible, as the results of the business census were made available before the JOBSTAT was updated.

2010q3 and onwards, KOF aimed to predict the figures according to the new NOGA 2008 classification. Consequently, we use quarterly growth rates of FTE jobs according to NOGA 2002 as reference series for the period 1998q1–2010q2 and FTE jobs according to NOGA 2008 as reference series for the period 2010q3–2011q4.

3.2 Other forecasts of job growth in Switzerland

In our forecast evaluation, we compare the forecasts of the KOF macroeconometric model with several alternative forecasts of FTE jobs. First, the forecasts of the model are compared with simple forecasts from two autoregressive models of FTE jobs. Second, unadjusted forecasts produced by the KOF macroeconometric model (KOF *Nullprognose*) are compared with the modifications and adjustments of the *Nullprognose* (KOF final forecasts), which are made by KOF business cycle experts.

The KOF final forecasts are usually generated during two meetings, where results from the KOF *Nullprognose* and the first revised forecasts are discussed and occasionally modified. The modifications concern all variables that are relevant for the model (i.e. are not restricted to variables of the labor market). Often, these adjustments are made because of qualitative judgments of the economists involved in the forecasting exercise. Since data of the *Nullprognose* are only available starting in 2007q3 we compare the *Nullprognose* with the final forecasts for the period 2007q3–2011q4 which yields a sample size of 17 observations for nowcasts.

Second, the KOF forecasts are compared with forecasts made by a group of experts from the government under the guidance of SECO. These experts comprise economists from the SECO itself, the Swiss Federal Customs Administration, the FSO, the Federal Department of Finance and the SNB. Since the predictions from the State experts (henceforth just SECO forecasts) are published quarterly in terms of the *annualized* growth rate of FTE jobs (nowcasts) and the subsequent year (one-year-ahead forecasts), we adjust our data so that they are comparable with SECO data.[5] In this

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[5]For the amount of FTE jobs the KOF annualized forecast is represented by the average of the four quarterly forecasts of a particular year of the level data, i.e. in 2010q1 the annualized forecast for the year 2010 is formed by taking the average of the nowcast (2010q1), the one-quarter-ahead forecast (2010q2), the two-quarter-ahead forecast (2010q3), and the three-quarter-ahead forecast (2010q4) of the level data. Afterwards, the predicted growth rate with respect to the previous year is calculated.

study, we only compare annualized nowcasts made in the first quarter and annualized nowcasts made in the third quarter.

In the following sections we refer to the annualized nowcasts for ease of understanding simply as "forecasts". We expect to obtain lower forecast errors for forecasts made in the third quarter since information regarding the two previous quarter is already available. Data of SECO forecasts are available starting in 2001q3 and are hence evaluated and compared with the KOF forecasts from 2001q3 until 2011q4. Since the forecasts are annualized growth rates, we only obtain a sample size of 11 observations.

Third, the forecasts of the KOF macroeconometric model are compared with predictions of two short-run indicators of FTE jobs available in Switzerland: the KOFEI and the FSOEI. Both indicators are conceptually similar—i.e. are based on business tendency surveys—and aim to predict the quarterly year-on-year growth rate of FTE jobs.[6]

The KOFEI is computed from the results of KOF business cycle surveys of firms in nine economic sectors, which cover 85% of private employment in total. In these surveys, enterprises are asked how they judge their current stock of employees (too high, too low, or adequate) and how they plan to change the stock in the next three months (up, down, or unchanged). These two qualitative judgments are averaged, and a weighted average of all responses yields the co-called balanced indicator.[7] The KOFEI takes a value between -1 and $+1$ where a negative value indicates an expected decline in employment, zero no expected changes in employment, and a positive value an expected increase in employment.

The FSOEI is also based on answers to a survey question. Companies are asked if they plan to downsize their staff, increase their staff, or make no changes for the following quarter (indicator *voraussichtliche Beschäftigungsentwicklung*). The question is part of the questionnaire of the job statistics discussed above. Hence, the indicator covers a large sample of enterprises in the secondary and tertiary sectors in Switzerland. The FSO computes an indicator from the survey results which takes a value between

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[6]Siliverstovs (2009) provides a discussion about the usefulness of employment indicators for short-run forecasts of employment in Switzerland. With respect to the KOFEI he finds that "inclusion of the KOF Employment Indicator leads to a substantial improvement in prediction accuracy of both point and density forecasts compared to the performance of a benchmark autoregressive model".

[7]http://www.kof.ethz.ch/en/indicators/employment-indicator/

0.5 (reduction) and 1.5 (enhancement) where 1 indicates a maintenance of the current staff. The FSO publishes FSOEI results quarterly. We treat results of the FSOEI published at quarter t as nowcasts for that quarter.[8]

However, we also try the FSOEI as well as the KOFEI nowcasts for one-quarter-ahead forecasts to see whether the two indicators are able to make a prediction not only regarding the current quarter we are in (nowcasts) but also for the subsequent quarter (one-quarter-ahead forecasts). Since both indicators use different units of measurement we standardize all data used in this comparison (KOF forecasts, KOFEI, FSOEI, and the reference series) in order to compute forecast accuracy statistics and to facilitate visual comparison. Data of the FSOEI are available starting in 2004q2; therefore we analyze and compare nowcasts and one-quarter-ahead forecasts of the KOFEI, the FSOEI, and the KOF from 2004q2 until 2011q4. This yields 24 observations for nowcasts.

4 Statistical Methods

In order to evaluate nowcasts and forecasts for the amount of FTE jobs, we refer to the tools described in this section.

4.1 Econometric methodology

We denote forecast errors as:

$$e_{t+h,t} = Y_{t+h,t} - \hat{Y}_{t+h,t}, \tag{1}$$

where Y_{t+h} represents the reference series and $\hat{Y}_{t+h}$ h-step-ahead forecasts. A key property of optimal forecasts is that the forecast errors are expected to be zero and hence unbiased:

$$E(e_{t+h,t}) = 0 \tag{2}$$

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[8]The labeling of the indicator is partly misleading and may be part of the reason why the indicator has not gained much public attention despite its appealing concept and its broad coverage. For example, the FSO publishes the results of the indicator that aims to predict employment in 2011q1 as "expected" employment dated 2010q4—i.e., the point in time when the survey was made. However, it released these results only by the end of February 2011. In our forecast comparison, we oriented ourselves at the *time of publication* in order to obtain comparability with the other forecasts. Hence, the FSOEI published by the end of February 2011 was considered as nowcast for 2011q1.

This is assessed by regressing the forecast errors on a constant term:

$$e_{t+h,t} = c \qquad (3)$$

If the forecast errors are non-Gaussian and not independent and identically distributed (i.i.d.) we have to be sure that any serial correlation in the disturbance is appropriately modeled. To get around this we follow Diebold and Lopez (1996) who suggest to adjust for serial correlation in the forecast errors by including MA(h-1) disturbances:

$$e_{t+h,t} = c + \epsilon_{t+h} + \theta_1 \epsilon_{t+(h-1)} + \theta_2 \epsilon_{t+(h-2)} + \dots + \theta_{h-1} \epsilon_{t+1}, \qquad (4)$$

where ϵ is i.i.d. with zero mean and variance σ^2.

Furthermore, optimal one-step ahead forecast errors are white noise and unforecastable (Equation 5) while optimal h-step ahead forecast errors are, due to the use of overlapping data, serially correlated but at most MA(h-1) (Equation 6) using information available at the time the forecast was made (Diebold and Lopez, 1996):

$$e_{t+h,t} = \epsilon_{t+h,t} \qquad (5)$$

$$e_{t+h,t} = c + \epsilon_{t+h} + \theta_1 \epsilon_{t+(h-1)} + \theta_2 \epsilon_{t+(h-2)} + \dots + \theta_{h-1} \epsilon_{t+1} \qquad (6)$$

Mincer and Zarnowitz (1969) suggest to run a regression of the following form to assess the optimality of forecasts:

$$e_{t+h,t} = \alpha_0 + \sum_{i=1}^{k-1} \alpha_i x_{it} + \epsilon_t, \qquad (7)$$

where ϵ_t is i.i.d. with zero mean and variance σ^2. The null hypothesis is that all α's are zero which implies that the error terms are unforecastable. In our particular case the relevant regression is:

$$e_{t+h,t} = \alpha_0 + \alpha_1 Y_{t+h,t} + \epsilon_{t+h,t}, \qquad (8)$$

where optimality corresponds to $(\alpha_0, \alpha_1) = (0,0)$. Again, if the forecast errors are serially correlated we have to adjust for it accordingly. Equation

8 can be rewritten in an intuitively assessable way as:

$$Y_{t+h} = \beta_0 + \beta_1 \hat{Y}_{t+h,t} + \epsilon_{t+h,t} \tag{9}$$

If the forecasts are optimal, we expect $(\beta_0, \beta_1) = (0, 1)$ in which case we get:

$$Y_{t+h} = \hat{Y}_{t+h,t} + \epsilon_{t+h,t} \tag{10}$$

4.2 Forecast accuracy evaluation

The accuracy of the forecasts are measured by various common forecast evaluation statistics such as the root mean squared error (RMSE), the mean error (ME), the mean absolute error (MAE), and the Theil U statistic. The Theil U statistic always lies between zero and one, where zero indicates a perfect fit. Moreover, it can be divided into three components: 1) The bias proportion shows how far the mean of the forecast is from the mean of the reference series. 2) The variance proportion reveals how far the variation of the forecast is from the variation of the reference series. And 3) the covariance proportion measures the remaining unsystematic forecasting errors (Pindyck and Rubinfeld (1998)). A good forecast has the characteristics of small bias and variance proportions but high covariance proportion. Furthermore, we make use of the Diebold and Mariano (1995) statistic for comparing the predictive accuracy between two competing forecasts. If we define the forecast errors similar to Equation 1 such that:

$$(y_t - f^a_{t+h,t}, y_t - f^b_{t+h,t}) = (e^a_{t+h,t}, e^b_{t+h,t}), \tag{11}$$

where $(f^a_{t+h,t}, f^b_{t+h,t})$ is a pair of h-step-ahead competing forecasts then the test is based on the null hypothesis:

$$E[L(e^a_{t+h,t}) - L(e^b_{t+h,t})] = 0, \tag{12}$$

where the loss function $L(\cdot)$ provides the metric for evaluation of forecast accuracy. Our loss function is the quadratic function $L(e) = e^2$ and the loss differential is defined as:

$$d_{t+h,t} = L(e^a_{t+h,t}) - L(e^b_{t+h,t}) \tag{13}$$

If $d_{t+h,t}$ is a covariance stationary series then the sample distribution of the sample mean loss differential is:

$$\sqrt{T}(\bar{d} - \mu) \sim N(0, f) \tag{14}$$

where

$$\bar{d} = \frac{1}{T} \sum_{t=1}^{T} [L(e_{t+h,t}^a) - L(e_{t+h,t}^b)] \tag{15}$$

is the sample mean loss differential, f the variance of the sample mean loss differential, μ the population mean loss differential, and T specifies the number of forecasts available for a given horizon h. Hence, under the null hypothesis of zero population mean loss differential, the standardized sample mean loss differential has a standard normal distribution:

$$B = \frac{\bar{d}}{\sqrt{\dfrac{\hat{f}}{T}}} \sim N(0, 1) \tag{16}$$

where $\hat{f}$ is a consistent estimator of f while B is called the Diebold-Mariano test statistic.

Finally, we also estimate benchmark real-time autoregressive models and compare their forecasting performance to the other forecasts. In particular, we estimate simple AR(1) and AR(2) models of the quarterly growth of FTE jobs. As mentioned in Section 1 when KOF is conducting forecasts at time t, it always has past data available until $t-1$ (on a quarterly base). Therefore, the forecasts for period t represent nowcasts of KOF while forecasts for $t+1$ represent one-quarter-ahead forecasts. Our benchmark models are estimated in a similar way. We only use data that were available when the forecast was made and predict the next two quarters. Hence, we compare one-quarter-ahead and two-quarter-ahead forecasts of our benchmark models with the KOF nowcasts and the one-quarter-ahead forecasts.

5 Results

Table 2 provides forecast accuracy statistics of the KOF forecasts regarding the amount of full time equivalent (FTE) jobs over different forecast horizons. We obtain a mean absolute error of 0.28% for the KOF nowcasts

and 0.33% for one-quarter-ahead forecasts. Clearly, as indicated by Theil's U and R^2, the further away the forecast lies from t, the worse is the fit of the trend of the reference series. However, the RMSE and the MAE do not substantially increase as the forecast horizon rises, but they already start from a relatively high level. Apparently, KOF faces substantial difficulties to nowcast growth in FTE jobs. 30% of all nowcasts show the "wrong" sign[9]. The number of wrong signs is not significantly larger for four-quarter-ahead forecasts where 39% of all forecasts are affected by this flaw.

TABLE 2 ABOUT HERE

Table 3 contains Mincer-Zarnowitz regressions (Equation 7) of the KOF forecasts. The regressions show that the KOF nowcasts and all h-quarter-ahead forecasts are biased and not optimal. Essentially, KOF underpredicts average growth of FTE jobs. This finding is illustrated by figure 3 which displays the KOF one-step-ahead forecasts together with the reference series (FTE jobs). Most of the KOF forecasts are significantly too negative, in particular since 2006.

TABLE 3 ABOUT HERE

FIGURE 3 ABOUT HERE

When comparing the KOF nowcasts and one-quarter-ahead forecasts with forecasts of two autoregressive models of order one and order two, there is no evidence that the KOF forecasts are more accurate. Our estimations even suggest that the one-quarter-ahead forecasts of the AR(2) model actually encompass the KOF one-quarter-ahead forecasts (with a p-value of 0.06). The forecast accuracy statistics of the comparison with both autoregressive models are displayed in table 4. The root mean squared error and the mean absolute error generally favor the AR(2) model over the KOF forecasts. Furthermore, nowcasts of the autoregressive model of order two appear to be significantly more accurate under quadratic loss than the KOF nowcasts (cf. table 5). These results indicate that the continuously updated

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[9]"Wrong" sign denotes predictions of a positive quarterly growth rate for a particular quarter, whilst the realized growth rate was negative, or vice versa.

AR models can cope better with changes in the trend growth of the reference series.

TABLE 4 ABOUT HERE

TABLE 5 ABOUT HERE

The SECO forecasts are not substantially different. Table 3 shows that they are biased and not optimal, too. Table 6 compares the accuracy of the SECO and the KOF forecasts over the two relevant forecast horizons. Recall that when comparing the SECO and KOF forecasts, the forecasts represent a prediction of the *annualized* growth rate in FTE jobs. The accuracy statistics indicate that the SECO forecasts made in the first quarter appear to be slightly more accurate than the KOF forecasts. The pattern is reversed in the third quarter of the year where forecast errors of the KOF forecast are slightly lower. Since this comparison is based on 11 observations only, the general result emerging from the table is that both forecasting institutions predict FTE jobs comparatively well or distorted. This conclusion is confirmed in the analysis of the loss differential in table 5, revealing that both annualized nowcasts are similarly accurate under quadratic loss.

TABLE 6 ABOUT HERE

Figure 4 visualizes the differences in the forecasts of the two institutions. One striking feature of that figure is that the KOF and SECO forecasts substantially overestimate the decline in FTE jobs during the recession in 2009. The picture thus visualizes the problem discussed in the introduction: opposed to what many economists thought, employment turned out to be surprisingly unaffected by the recession.

More generally, the figure illustrates that both KOF and SECO fail to make an accurate assessment regarding the trend growth of FTE jobs, while they capture the business cycle evolution of the reference series quite well. In particular, both forecasting institutions substantially underestimate the trend growth in FTE jobs since the middle of the last decade. This observation suggests the presence of a structural break in the evolution of employment that was not captured by the forecasting models of either in-

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stitution, as they both were building on historical patterns in the evolution of employment. Accordingly, these findings call for more flexibility in the forecasting process.

FIGURE 4 ABOUT HERE

Surprisingly, we do not find any significant difference between the KOF final forecasts and the KOF *Nullprognose*. Recall that the *Nullprognose* is the unadjusted forecasts of the KOF macroeconometric model, while the final forecasts incorporate ad hoc adjustments suggested by expert economists participating in the forecasting exercise. The comparison of the two forecasts indicates that, overall, the expert adjustments neither improved nor worsened the forecasts of the KOF macroeconometric model.[10]

As mentioned in Section 3.2, we also evaluate the forecasting performance of the KOF Employment Indicator (KOFEI) and the Federal Statistical Office Employment Indicator (FSOEI). Both indicators aim to map the quarterly year-on-year growth of FTE jobs. Hence, for the purpose of this comparison, we compute quarterly year-on-year growth rates of the KOF forecasts. We evaluate and compare the predictive ability of both indicators as nowcasts and one-quarter-ahead forecasts with the KOF nowcasts/one-quarter-ahead forecasts. Since both indicators use different units of measurement we standardize all data used in this comparison (KOF forecasts, KOFEI, FSOEI, and the reference series) in order to compute forecast accuracy statistics and to facilitate visual comparison.

Figures 5 and 6 display KOF, KOFEI, and FSOEI nowcasts and one-quarter-ahead forecasts, respectively, together with the FTE jobs series. Table 7 provides the corresponding forecast accuracy statistics. The KOFEI and the FSOEI fit the FTE jobs series remarkably well. Both indicators are actually preceding the FTE jobs series by one quarter. This can be seen well in figure 6, where both indicators in 2009q2 already signalize the increase in FTE jobs in 2009q2 one quarter before it took place. When using the two indicators as one-quarter-ahead forecasts they fit the reference

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[10]We presently have no hint whether this is a particular feature of the forecasting process at KOF or whether this finding can be generalized. Given the importance attached to expert opinion in the typical "eclectic" forecast procedure, this question would certainly call for similar investigations (and publications of the results) by other forecasting institutions.

series quite accurately; and the KOFEI predictions appear to fit the data more accurately than the FSOEI. Overall, the evaluation clearly confirms the predictive content of the KOFEI and the FSOEI, and shows that both indicators have potential to improve model-based FTE jobs forecasts. Moreover, the forecast accuracy statistics indicate that both indicators perform similarly well in terms of forecasting errors. This said, it appears that the KOFEI is preferable as it is available earlier and easier to interpret.

TABLE 7 ABOUT HERE

FIGURE 5 ABOUT HERE

FIGURE 6 ABOUT HERE

However, none of the indicators reach a similar forecast accuracy as the employment forecasts of the KOF macroeconometric model. How is this possible considering the relatively poor performance of the FTE forecasts of the model established above? The answer lies in the different growth rates of the analysis: while we considered quarter-on-quarter growth rates above, we now look at quarterly year-on-year growth. Quarterly year-on-year growth rates of the KOF nowcasts are significantly more accurate predictions than quarterly growth rates. The R^2 of quarter-on-quarter growth rates of nowcasts of KOF FTE jobs is only 0.42, whilst it is 0.92 for quarterly year-on-year nowcasts (figure 7).

This result emerges because forecasting errors that arise due to seasonality and its adjustment are irrelevant with year-on-year growth rates. Moreover, note also that the accuracy statistics in table 7 are computed using standardized growth rates. The normalization eliminates the failure of the KOF forecasts to capture the trend growth of FTE jobs. Put differently, the results in the table confirm that the forecasts of the KOF macroeconometric model are accurate in predicting the business cycle evolution of FTE jobs—even more accurate than short-run indicators of employment—but inaccurate in forecasting their trend.

FIGURE 7 ABOUT HERE

6 Concluding remarks

In this study, we evaluated forecasts of full time equivalent jobs in Switzerland over the period 1998q1–2011q4. We compared forecasts of the KOF Swiss Economic Institute macroeconometric model with predictions of the State Secretariat for Economic Affairs (SECO), with the KOF Employment Indicator (KOFEI) and the Federal Statical Office Employment Indicator (FSOEI), and with autoregressive models, serving as simple benchmark models. We evaluated the KOF nowcasts and one-quarter-ahead forecasts up to four-quarter-ahead forecasts.[11]

Our evaluation of the KOF forecasts regarding FTE jobs revealed that they are biased and not optimal. Even though MAEs are fairly small (0.28% and 0.33% for nowcasts and one-quarter-ahead forecasts, respectively), the KOF forecasts do not capture the trend of the reference series well. Similar results apply to the SECO forecasts of FTE jobs, which are also biased and not optimal. As a consequence of these inaccuracies, nowcasts and one-quarter-ahead forecasts with an autoregressive model of order two tend to be no less accurate than forecasts with the KOF macroeconometric model. In particular, AR(2) model forecasts encompass the KOF one-quarter-ahead forecasts, and AR(2) model nowcasts are more accurate under quadratic loss.

Moreover, there is no statistical difference between the KOF final forecasts and the KOF *Nullprognose* regarding FTE jobs, indicating that expert judgment neither improves nor impairs the forecasts.

In addition, we showed that both the KOF Employment Indicator as well as the Federal Statistical Office Indicator are useful to predict the evolution FTE jobs with a lead of about one quarter and hence provide useful information about the short-run behavior of job growth in Switzerland. In terms of forecast accuracy, the two indicators perform similarly.

Most importantly, the study confirmed that employment forecasts systematically underestimated the growth in the number of FTE jobs, while they accurately predict the business cycle fluctuations in job growth. Both, the SECO and KOF forecasts failed to capture the structural changes in the growth of employment that occurred in Switzerland during the past ten

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[11]For the comparison with the SECO forecasts, "forecasts" represent annualized predictions of the current year.

years. Annualized growth of forecasts of KOF and SECO were *on average* about 0.5 percentage points too low for nowcasts (cf. table 6). In particular, there is potential to improve forecasts regarding FTE jobs by more frequent updating of the trend growth component of the respective forecasting models.

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Appendix

Table 1: Example of a real-time data table

Reference quarter	Vintage				
	2008q1	2008q2	2008q3	2008q4	2009q1
2007q1	3196	3196	3196	3196	3196
2007q2	3218	3218	3219	3218	3218
2007q3	3239	3239	3239	3245	3244
2007q4	3266	3266	3265	3275	3275
2008q1	**3290**	3285	3285	3299	3300
2008q2	3298	**3293**	3304	3322	3322
2008q3	3306	3302	**3312**	3337	3336
2008q4	3311	3308	3315	**3337**	3342
2009q1	3316	3313	3307	3322	**3334**
2009q2		3315	3289	3301	3295
2009q3			3276	3270	3247
2009q4				3247	3193
2010q1					3152

Notes: Bold black values represent nowcasts; red values one-quarter-ahead forecasts; blue values two-quarter-ahead forecasts; orange values three-quarter-ahead forecasts; magenta values four-quarter-ahead forecasts. All values are measured in thousands of full time equivalent jobs.

Table 2: Forecast accuracy statistics of the KOF model forecasts of FTE jobs

Statistic	t+0	t+1	t+2	t+3	t+4
RMSE	0.36	0.43	0.52	0.56	0.52
ME	0.19	0.24	0.25	0.25	0.22
MAE	0.28	0.33	0.35	0.41	0.41
Theil U	0.43	0.52	0.59	0.67	0.69
Bias Prop.	0.28	0.31	0.22	0.21	0.19
Variance Prop.	0.01	0.01	0.050	0.01	0.00
Covariance Prop.	0.72	0.68	0.73	0.78	0.81
R^2	0.45	0.32	0.15	0.03	0.01

Notes: $t + h$ denotes forecasts for quarter h, i.e. $t + 0$ represent nowcasts and $t+1$ one-quarter-ahead forecasts. The forecast accuracy statistics was computed by using quarterly growth rates. The sample contains 37 observations for nowcasts.

Table 3: Mincer-Zarnowitz Regression Results of the forecast evaluation regarding FTE jobs

Dependent variable: Reference series of FTE jobs					
Variable	t+0	t+1	t+2	t+3	t+4
Constant	0.00 (0.00)	0.00 (.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
KOF forecast	0.61 (0.00)	0.49 (0.00)	0.29 (0.02)	0.15 (0.33)	0.07 (0.70)
No. Obs.	37	36	35	34	33
H_0: (Constant=0, KOF forecast=1)					
p-value	0.00	0.00	0.00	0.00	0.00

Comparison of KOF and SECO nowcasts				
	KOF		SECO	
	q1	q3	q1	q3
Constant	0.01 (0.04)	0.00 (0.00)	0.00 (0.10)	0.00 (0.00)
KOF forecast	0.92 (0.00)	0.99 (0.00)		
SECO forecast			1.15 (0.00)	0.99 (0.00)
No. Obs.	10	11	10	11
H_0: (Constant=0, KOF/SECO=1)				
p-value	0.10	0.010	0.13	0.01

Notes: p-values of the Mincer-Zarnowitz regression are displayed in parentheses. Results of the comparison with SECO forecasts have to be treated carefully due to the small sample size (11 observations).

Table 4: Forecast accuracy statistics of KOF and AR(q) forecasts

	KOF		AR(1)		AR(2)	
Statistic	t+0	t+1	t+0	t+1	t+0	t+1
RMSE	0.36	0.43	0.31	0.34	**0.27**	**0.30**
ME	0.19	0.24	0.06	0.06	**0.02**	**0.02**
MAE	0.28	0.33	0.24	0.27	**0.22**	**0.25**
Theil U	0.43	0.52	0.46	0.55	**0.37**	**0.42**
R^2	**0.45**	**0.32**	0.30	0.19	0.42	0.28

Notes: $t+h$ denotes forecast for quarter h, i.e. $t+0$ represents nowcasts and $t+1$ one-quarter-ahead forecasts. The forecast accuracy statistics was computed by using quarterly growth rates. Values in bold show which forecasts (KOF, AR(q)) are more accurate according to the corresponding statistics. The comparison with both AR(q) models was done for the period 1998q1–2011q4 which yields a sample size of 37 observations for nowcasts.

Table 5: Forecast accuracy results regarding FTE jobs

Dependent variable: Loss differential (LD)		
H_0: LD=0 H_1: Alternative forecast is more accurate		
	t+0	t+1
	p-value	
KOF vs. AR(1)	0.19	0.29
KOF vs. AR(2)	0.03	0.16
KOFq1 vs. SECOq1	0.22	
KOFq3 vs. SECOq3	0.88	

Notes: KOFq1 represent forecasts of the KOF made in the first quarter. The loss differential is defined in Section 4. For the comparison with SECO predictions $t + 0$ represents annualized nowcasts. Due to the small sample size (11 observations) results of the comparison with SECO predictions have to be treated carefully.

Table 6: Forecast accuracy statistics of KOF and SECO forecasts regarding FTE jobs

	KOF		SECO	
Statistic	q1	q3	q1	q3
RMSE	0.83	**0.56**	**0.71**	0.57
ME	0.55	0.48	**0.44**	**0.47**
MAE	0.65	**0.48**	**0.56**	0.50
Theil U	0.33	**0.21**	**0.30**	0.21
Bias Prop.	0.43	0.76	0.37	0.67
Variance Prop.	0.01	0.00	0.14	0.00
Covariance Prop.	0.56	0.24	0.49	0.33
R^2	0.71	**0.95**	**0.77**	0.92

Notes: q1 and q3 indicate forecasts for the current year made in the first and third quarter of the year, respectively. Values in bold show which forecasts are more accurate according to the corresponding statistics. The comparison between KOF and SECO nowcasts was done for the period 2001q3–2011q4 which yields a sample size of 11 observations.

Table 7: Forecast accuracy statistics when comparing KOF, KOFEI, and FSOEI forecasts

	KOF	KOFEI	FSOEI	KOF	KOFEI	FSOEI
Statistic		t+0			t+1	
RMSE	**0.29**	0.62	0.48	**0.40**	0.42	0.49
MAE	**0.23**	0.51	0.41	**0.31**	0.33	0.40
Theil U	**0.15**	0.32	0.24	**0.20**	0.21	0.25
R^2	**0.92**	0.64	0.78	**0.84**	0.83	0.77

Notes: $t+h$ denotes forecast for quarter h, i.e. $t+0$ represents nowcasts and $t+1$ one-quarter-ahead forecast. Forecasts of the KOF, the KOFEI, and the FSOEI regarding FTE jobs were standardized due to the different units of measurement. Since both indicators aim to forecast the quarterly growth rate with respect to the previous year, KOF forecasts represent standardized quarterly year-on-year growth rates. Values in bold show which forecasts are more accurate according to the corresponding statistics. The comparison with the KOFEI and FSOEI was done for the period 2004q2-2011q4 which yields a sample size of 24 for nowcasts.
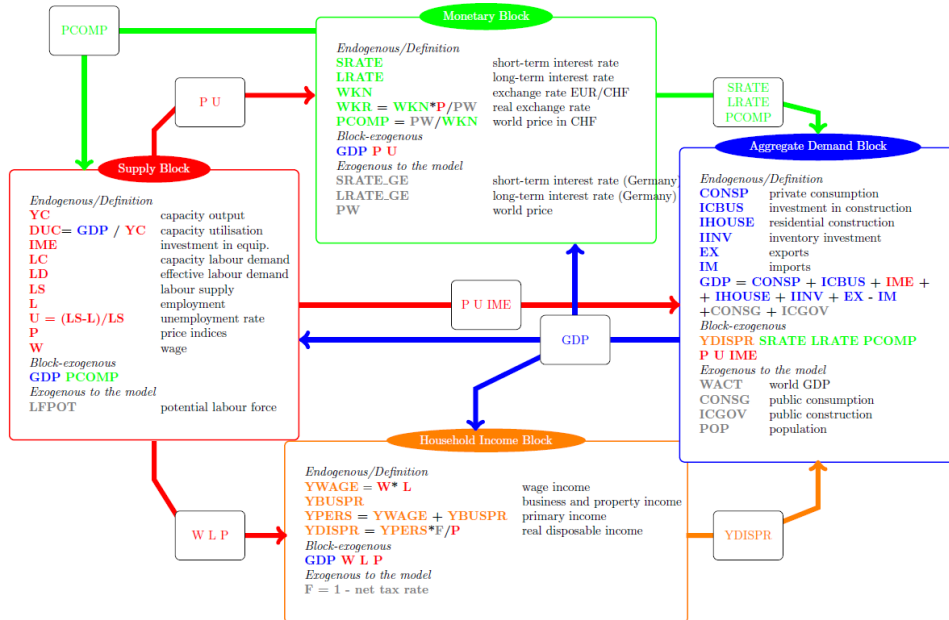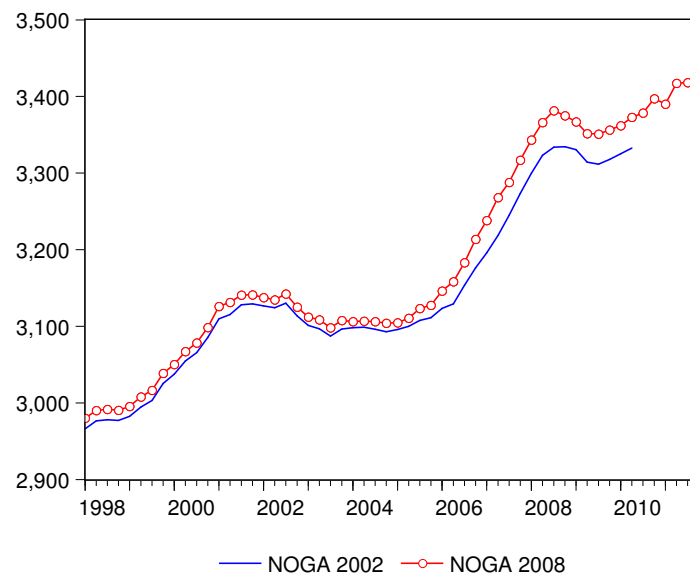
Figure 1: The KOF macroeconometric model

Figure 2: Comparison of the number of FTE jobs according to NOGA 2002 and NOGA 2008

Notes: The left vertical scale shows the amount of FTE jobs measured in thousands.

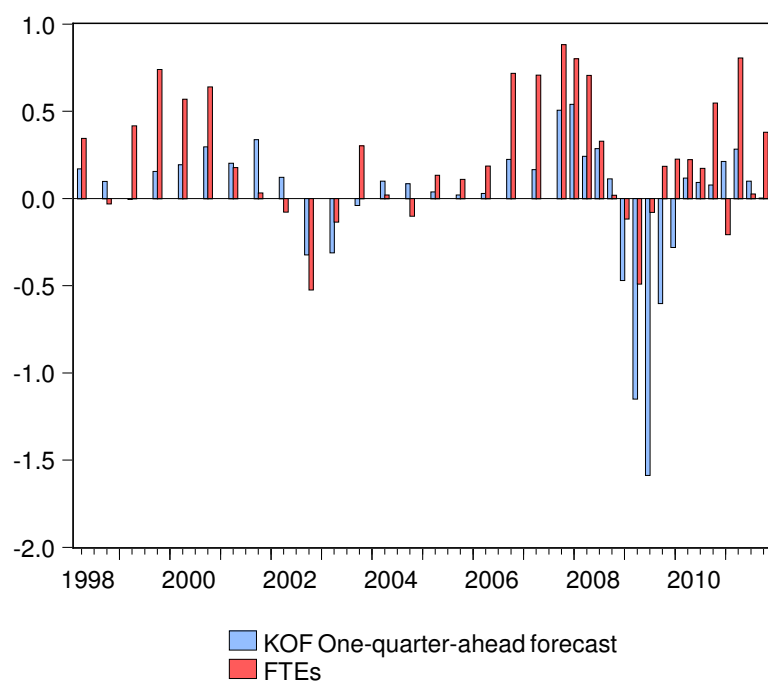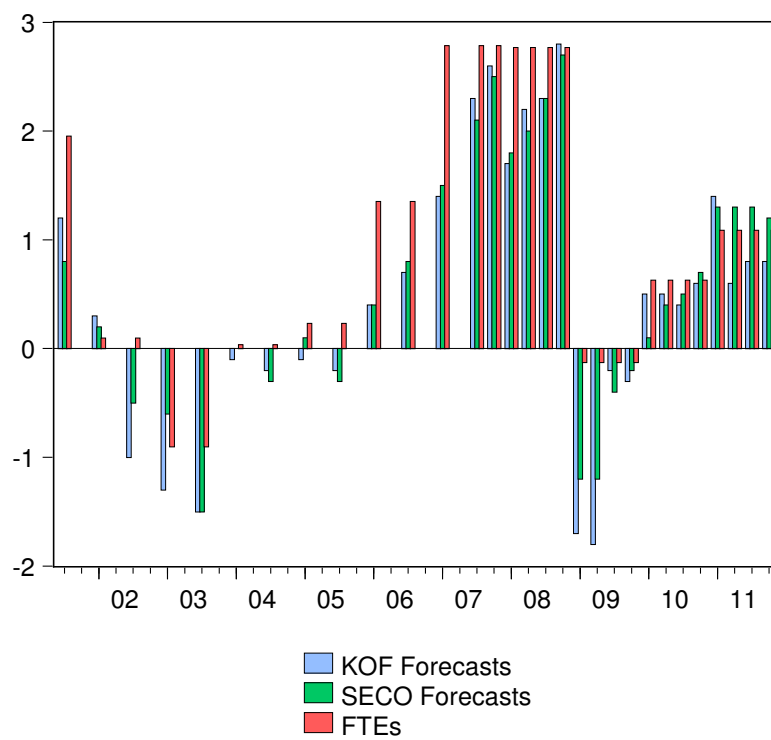Figure 3: Bar graph of KOF one-quarter-ahead forecasts and the reference series

Figure 4: Bar graph of KOF and SECO forecasts together with the FTE jobs series

Notes: Starting in 2007q4 the figure also contains forecasts made in the second and fourth quarter of a particular year. However, these forecasts are not considered in the evaluation due to the very small sample size available (four and five observations for forecasts made in the second and fourth quarter, respectively).

Figure 5: Graph of KOFEI, FSOEI, KOF forecast, and FTE jobs when both indicators are used as nowcasts. All time series are standardized, i.e. have mean and variance equal to one.
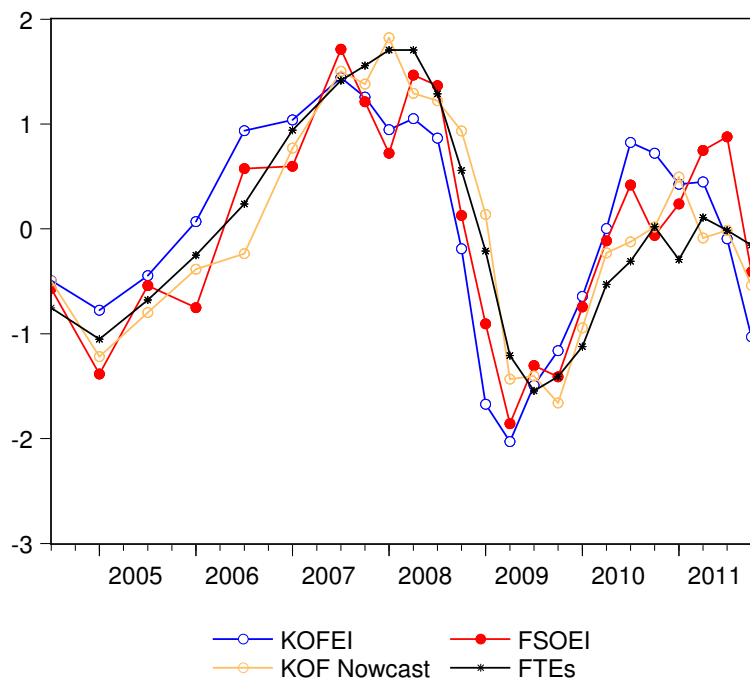
Figure 6: Graph of KOFEI, FSOEI, KOF forecast, and FTE jobs when both indicators are used as one-quarter-ahead forecasts. All time series are standardized, i.e. have mean and variance equal to 1.
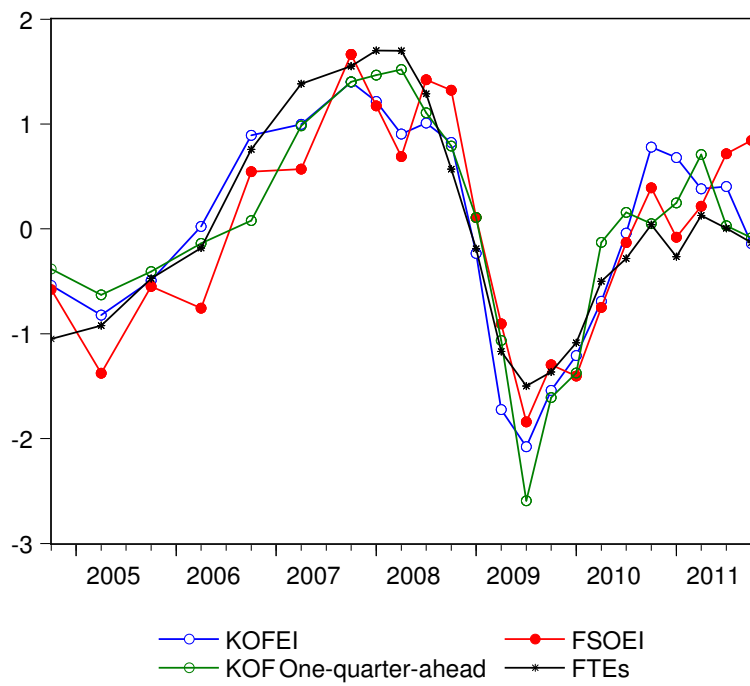
Figure 7: Bar graph of KOF nowcasts (quarterly growth rates with respect to the previous year) together with the FTE jobs series