Nowcasting Regional GDP: The Case of the Free State of Saxony

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Abstract: We tackle the nowcasting problem at the regional level using a large set of indicators (regional, national and international) for the years 1998 to 2013. We explicitly use the ragged-edge data structure and consider the different information sets faced by a regional forecaster within each quarter. It appears that regional survey results in particular improve forecasting accuracy. Among the 10% best performing models for the short forecasting horizon, one fourth contain regional indicators. Hard indicators from the German manufacturing sector and the Composite Leading Indicator for Europe also deliver useful information for the prediction of regional GDP in Saxony. Unlike national GDP forecasts, the performance of regional GDP is similar across different information sets within a quarter.

Keywords: nowcasting, regional gross domestic product, bridge equations, regional economic forecasting, mixed frequency

JEL Code: C22, C52, C53, E37, R11

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1. Motivation

Macroeconomic forecasts are a widely used tool by policymakers. At the national level in particular, macroeconomic predictions with a forecast horizon of up to two years ahead are provided by a large number of different institutions such as research institutes, banks or national governments. Nowadays regional policymakers also depend heavily on predictions of economic activity for their regions. They are in need of unbiased forecasts for the allocation of public funds, fiscal policy and medium term financial planning. In the German case, in particular, regional economic forecasts are also important in the context of the debt brake (for a discussion of the German debt brake see RWI, 2010 and for a discussion of the role of forecasts for the business cycle correction of tax revenues see Boysen-Hogrefe, 2015). Moreover, regional forecasts are important in detecting divergent patterns from national developments at an early stage. Since a high degree of heterogeneity in existing economic structures means that regional entities react in different ways to national or international shocks, region-specific business cycles may lead to high forecast errors when regional economic developments are approximated by national patterns.

As a result, economic research institutes now tend to provide timely information on regional economic developments. In the case of Germany, quarterly gross domestic product (GDP) data are published for Baden-Württemberg, the Free State of Saxony, Saxony-Anhalt and Eastern Germany as a whole. There are also several suppliers of regional economic forecasts. For Germany, the RWI Essen calculates a forecast for North-Rhine Westphalia, the Ifo Institute provides a forecast for the Free State of Saxony and the Regional Statistical Office Hesse predicts the economic development for the German state of Hesse.

In the last decade growing efforts have also been undertaken to publish high-frequency data at the regional level. As a result, monthly data are now available for the industrial sector or from business surveys. The Ifo Institute has published regional survey indicators for Saxony since 1998. These data improvements introduce the nowcasting problem at the regional level. Nowcasts are important since they provide the starting point for longer-horizon predictions and have a predominant impact on forecast quality (Carstensen *et al.*, 2009). Whereas many studies intensively discuss the nowcasting problem at the national level (see, among others, Aastveit *et al.*, 2014; Marcellino and Schumacher, 2010; Giannone *et al.*, 2008; Schumacher and Breitung, 2008) or for aggregates (see, for example, Kuzin, Marcellino and Schumacher, 2011), no study exists to date which focuses on the regional level.[1] This paper asks whether monthly indicators collected at the regional level deliver useful information for nowcasting regional GDP. We focus on the Free State of Saxony because a large set of indicators from

[1]Regional studies that focus on forecasts of macroeconomic aggregates like GDP are rather scarce in the academic literature. The main reason for this scarcity is data unavailability or a low publication frequency at the regional level. From official statistics, often only annual aggregates are available. These, however, can only be used under different limitations within a time series framework due to an insufficient number of observations. For a recent survey of regional forecasting studies see Lehmann and Wohlrabe (2014b).

different categories is available for this German state.

This paper complements the two articles by Lehmann and Wohlrabe (2015, 2014a) in several ways. Firstly, it focuses on the short forecast horizon and calculates forecasts for the current quarter ('nowcast'), as well as for one quarter ahead. Secondly, it uses a very large set of monthly indicators measured either at the international, national or regional level and investigates which of these indicators is informative for a forecaster. The monthly indicators have different publication dates. To model this so called 'ragged-edge' structure of our data set, we consider the different information sets a forecaster has at hand when predicting quarterly GDP growth. Since most official time series have a substantial publication delay, forecasting accuracy should increase with more information. Thirdly, in addition to mean absolute forecast errors, we also rank the indicators using a rank-based criterion. Fourthly, supplementary to the evaluation of single indicators we take a look at various subcategories. Finally, we investigate the impact of the economic crisis in 2008/2009 on the performance of the various indicators.

Our results clearly suggest that regional survey indicators – and especially the Ifo business climate for Saxon industry and trade – contain valuable information on GDP growth in Saxony. Survey indicators are not, in general, worse than hard indicators like new orders or exports, even when different information sets are considered. This result leads us to conclude that whenever regional indicators are available, academics or practitioners should use them. Among the hard indicators, foreign new orders from the vehicle manufacturing sector have a high forecasting power. Moreover, the Composite Leading Indicator for Europe seems to be informative. These results may be explained by the industrial structure of Saxony.

The paper is organized as follows: section 2 introduces the data set and outlines the forecasting experiment and the different evaluation criteria. Section 3 presents our results in detail and section 4 offers some conclusions.

2. Data and Empirical Approach

2.1. Data

Our nowcasting exercise is based on a large set of monthly indicators. We come up with **257** indicators, which are grouped into seven categories: macroeconomic (69), finance (19), prices (11), surveys (55), international (25) and regional (78). All indicators are measured, with the exception of international and regional ones, at the national (here: Germany) level. In the macroeconomic category, all indicators like German industrial production or exports are included. Financial variables include government bond yields, interest rates or the German stock index DAX. In addition, we consider several price measures like the consumer price index or the HWWI index of world market prices. The category surveys covers a wide range of qualitative indicators from either business surveys (Ifo Institute or European Commis-

sion) or expert surveys (Centre for European Economic Research – ZEW). To capture the international transmission of growth shocks, we add several indicators from large economies such as the US, China or France. In addition, we also use Economic Sentiment Indicators from Eastern European countries like Poland and the Czech Republic. Firms in Eastern Germany traditionally have a high export share with these countries. Finally, our data set contains several regional indicators, which capture qualitative information (Ifo business survey), as well as regional quantitative indicators like new orders in the manufacturing sector. All survey results from the Ifo Institute (national and regional) are used in levels, as well as in first differences for the forecasting exercise. This is why we end up with a total of 353 indicators. For evaluation purposes, we also divide our data set into soft and hard indicators. The category "soft" comprises all survey results and the Composite Leading Indicators. Industrial production or prices fall into the category of hard indicators. We use only seasonally adjusted variables.[1] If a specific series is not stationary in levels, we apply, with the exception of the Ifo survey results, either first differences or growth rates. A complete description of our monthly data set can be found in the appendix A.

As in Lehmann and Wohlrabe (2015, 2014a), we use quarterly GDP data for the Free State of Saxony. These data are calculated using temporal disaggregation as in Chow and Lin (1971), which is also applied by Eurostat (for details see Nierhaus, 2007).[2] The method relies on a regression relationship between annual data and suitable indicators with a higher frequency (e.g. quarterly turnover in the manufacturing sector). Based on this relationship, a transformation from annual aggregates to quarterly data is possible. These quarterly data meet two requirements: sectoral and temporal aggregation. Sectoral aggregation means that the sum of sectoral gross value added (GVA) plus net taxes on products equals GDP for every point in time, while temporal aggregation denotes the identity between the average of quarterly data for one year and the specific annual value. To ensure a fair comparison, we exclude those indicators from our analysis that are used for the temporal disaggregation of sectoral GVA.[3] Our target variable, quarterly real GDP in Saxony, is available for the period from 1996Q1 to 2013Q4. We, however, base our analysis on data from 1998Q1 to 2013Q4 since most of the indicators are only available for that period. To capture the business cycle, we transform the data into quarter-on-quarter (qoq) growth rates. Saxon GDP is calculated on the basis of the latest Classification of Economic Activities (Edition 2008), which is the German pendant to the Classification of Economic Activities in the European Union (NACE Rev.2).[4] Figure 1 shows the movement of Saxon GDP for the period from 2008 to 2013. It illustrates the sharp decline during the economic crises of the years 2008/2009. The largest

[1] Whenever a series is not available in a seasonally adjusted form, we employ the Census X-12-ARIMA procedure for seasonal adjustment.

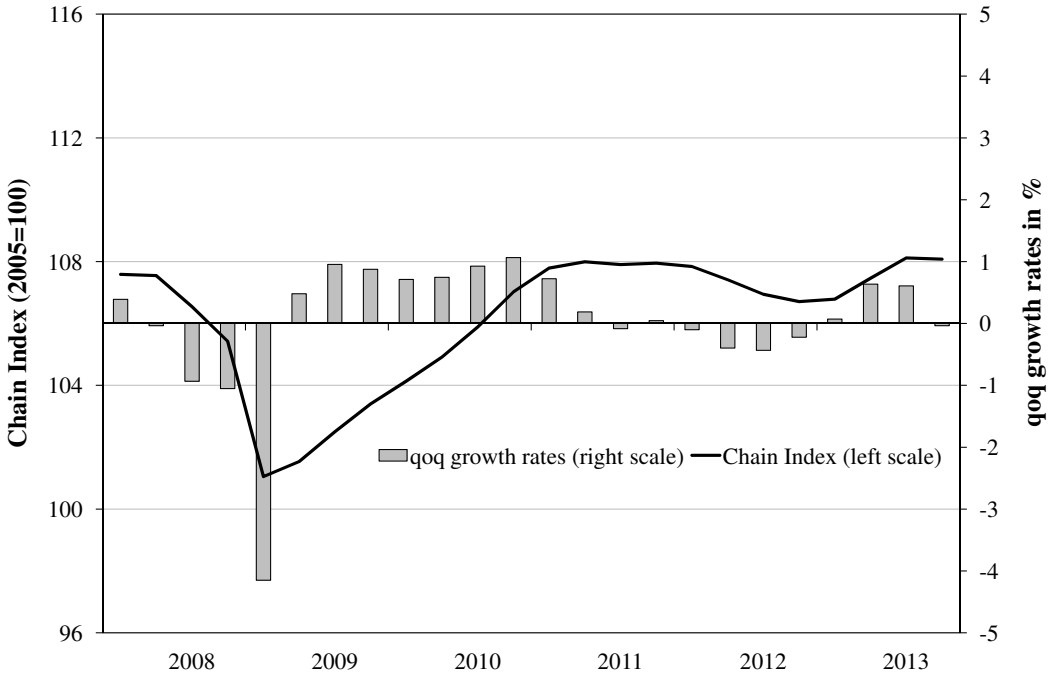
[2] The quarterly GDP data for Saxony are updated regularly and available from *dresden@ifo.de*.

[3] In particular, these indicators are: turnovers in the manufacturing and construction sector, turnovers for retail sale and wholesale trade.

[4] NACE is the French acronym for Nomenclature statistique des activités économiques dans la Communauté européenne.

slump can be seen in the first quarter of 2009. After this decline, the recovery of the Saxon economy sets in. The Saxon economy first reaches its pre-crises level at the beginning of 2011. From that point on, a more or less lateral movement can be observed.

Figure 1: Development of quarterly Saxon GDP from 2008 to 2013



Source: Based on Nierhaus (2007), own illustration.

2.2. Forecast Experiment

We validate the information content of our indicators using nowcasts from a common direct-step bridge equation:

$$y_{t+h} = c + \sum_{i=1}^{I} \alpha_i y_{t-i} \sum_{j=0}^{J} \beta_j x^q_{n,t-j} + \varepsilon_{t+h} \, . \tag{1}$$

The target variable y_{t+h} is available at quarterly frequency and is forecast using each of the indicators ($x^q_{n,t}$, $n = 1 \ldots N$) described in the previous section. These indicators are observed at a higher – usually monthly – frequency. We use a three month average transformation to obtain quarterly aggregates. The forecast horizon is denoted by h, where $h = 0$ indicates the forecast for the current quarter ('nowcast') and $h = 1$ denotes the forecast for the next quarter. It is worth noting that we re-estimate equation (1) for each forecast horizon separately. This direct-step procedure has the advantage that forecasts for $h \geq 1$ may be obtained without having to observe indicators for the upcoming quarters. The lag length is selected according to the Bayesian Information Criterion (BIC) for the range of $1 < I \leq 4$ and $0 < J \leq 2$. Equation (1) provides the basis for the relative comparison among different

indicators. Moreover, given the limited initial sample size, it meets the requirement of being parsimonious.

Out-of-sample forecasts are obtained as follows. We first estimate equation (1) using GDP data from 1998Q1 to 2001Q4 and obtain forecasts for 2002Q1 and 2002Q2 (the availability of monthly indicators depends on the respective information set). The estimation window balances two requirements. While the window should be large enough to allow for a meaningful estimation, it should not be too large since the sequence of forecasts would otherwise be too short for inference. We then move the estimation window forward by one quarter, re-estimate the models and calculate forecasts for 2002Q2 and 2002Q3. We iterate over time until the last forecasts for $h = 0$ and $h = 1$ are obtained for 2013Q3 and 2013Q4, respectively. We expand the length of the estimation period in every step by one quarter (i.e. expanding or recursive window). In contrast to a rolling window, which keeps the estimation window constant, an expanding window is better suited to deal with the limited sample. Given limited degrees of freedom, estimates based on a rolling window might suffer from instabilities.[5] We end up with a total of 46 forecasts for each indicator, for the two forecast horizons and each information set.

In a common forecast situation, within the current quarter not all monthly realizations of an indicator are available when a nowcast is produced. So called hard indicators usually have a larger publication lag than survey-based soft indicators. To deal with this ragged-edge data structure we have to fill in values for the missing months. We project the indicators for the missing months using a simple autoregressive model, where the lag length is selected by the BIC. Before estimating these models, we make the indicators stationary by taking growth rates or first differences where appropriate and necessary.

To simulate a realistic forecast situation, we consider four different information sets. In information set I, the forecast is issued shortly after the release of quarterly GDP for Saxony (e.g. the fourth quarter is usually published at the beginning of March next year). Information set II considers the information about one month later, e.g. at the beginning of April, while information set III uses information two months after the release date. In information set IV, the forecast is issued a few days before the current quarter realization is known, e.g. around the end of May. It is worth noting that analyzing this situation may provide valuable insights, since for all monthly indicators at least the third month of the current quarter is published, and we thus have full information available for the current quarter. Table A.1 in the appendix contains the number of available months for all indicators in the different information sets.

It should be noted that when we forecast the next quarter, the direct-step approach entails a possible disadvantage, since it discards information contained in monthly observations. For instance, using information on months 4 and 5 in information sets III and IV could

[5] We repeated our whole forecasting exercise using a rolling window. We found that in almost all cases the forecast evaluation criteria were worse compared to the recursive window.

increase forecast accuracy, but it does not enter the forecast when the direct-step method is applied. But even when the forecaster has no monthly information about the next quarter, the statistical overhang at the end of the current quarter may contain valuable information that can be used to improve forecast accuracy for the upcoming quarter. As an alternative to the direct-step method, a prediction for the next quarter ($h = 1$) may be obtained by projecting monthly indicators forward until the end of the upcoming quarter and using the estimated bridge equation for $h = 0$ to forecast both quarters (projection method). We analyze whether such a procedure increases forecast accuracy in the results section.

To check whether the indicators deliver useful forecasts in absolute terms, we introduce a purely autoregressive benchmark model of the form $y_{t+h} = c + \sum_{i=1}^{I} \alpha_i y_{t-i} + u_{t+h}$, where lag length is also selected according to the BIC.

2.3. Forecast Evaluation

The forecast performance of each indicator is evaluated according to the mean absolute forecast error ($MAFE$). It is given by

$$MAFE_{h,i} = 1/T \sum_{t=1}^{T} |y_{t+h} - y^f_{t+h,i}| \,, \tag{2}$$

where in our case $T = 46$ is the total number of out-of-sample forecasts, y_{t+h} is the realized quarterly growth rate, and $y^f_{t+h,i}$ denotes the forecast derived from indicator i for horizon h. As an alternative, the root mean squared forecast error may be used as a loss function. However, our evaluation period comprises the Global Financial Crisis with few extreme outcomes. Since $MAFE$ puts less weight on tail events, it is less prone to be dominated by the Global Financial Crisis, and hence results based on $MAFE$ should be more robust in our case.

To measure the forecast stability over time, we also calculate the rank of each indicator:

$$RANK_{h,i,t} = \text{rank}\left(|y_{t+h} - y^f_{t+h,i}|\right) \,. \tag{3}$$

The rank is limited to the range $1 \ldots N$, where the best forecast obtains rank 1 and the worst forecast obtains the value $N = 353$. To make the measure independent of the number of different models considered, we normalize by N. We calculate the average percentage of models that are outperformed by model i (see Kholodilin, Thomas and Ulbricht, 2014):

$$POUT_{i,t} = 1/T \sum_{t=1}^{T} (1 - RANK_{h,i,t}/N) \times 100 \,. \tag{4}$$

Since the values for $RANK$ are limited, the measure $POUT$ is rather robust to extreme outcomes and it provides some additional insights in comparison to $MAFE$.

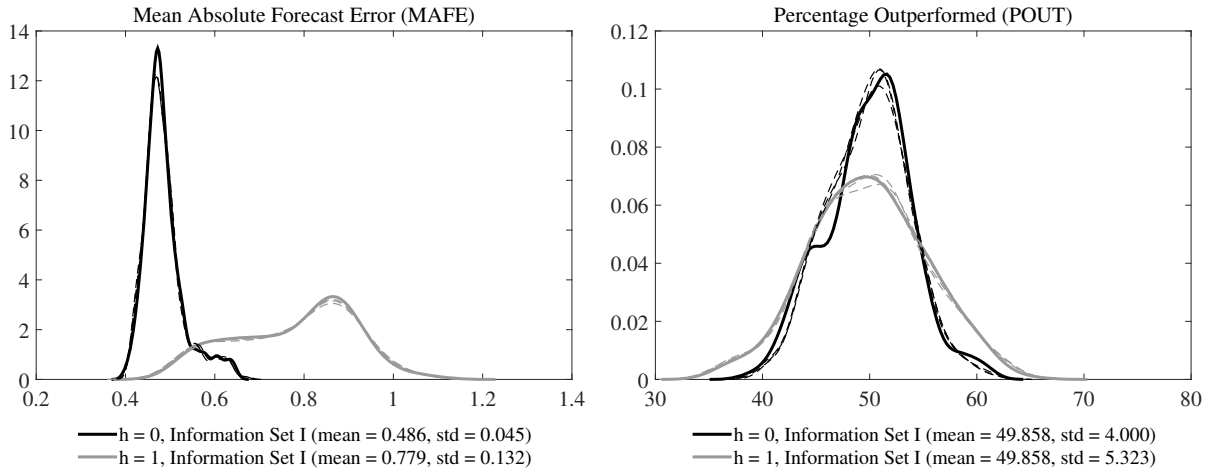
3. Results

Given the number of indicators ($N = 353$), two forecast horizons ($h = 0, 1$) and four information sets we obtain a huge number of results. These results are organized in various tables and figures. We first begin by presenting a general overview of the overall performance of the data set. Secondly, we take a closer look at which indicator performs best in which setting. Finally, we investigate whether and how the recent global financial and economic crisis in 2008/2009 affects our results.

3.1. General Results

As a starting point of presenting our results, Figure 2 plots the distribution of $MAFE$ and $POUT$ for all four information sets and the two forecast horizons. It shows a smoothed histogram using a normal kernel function.

Figure 2: $MAFE$ and $POUT$ distribution between information sets and forecast horizons



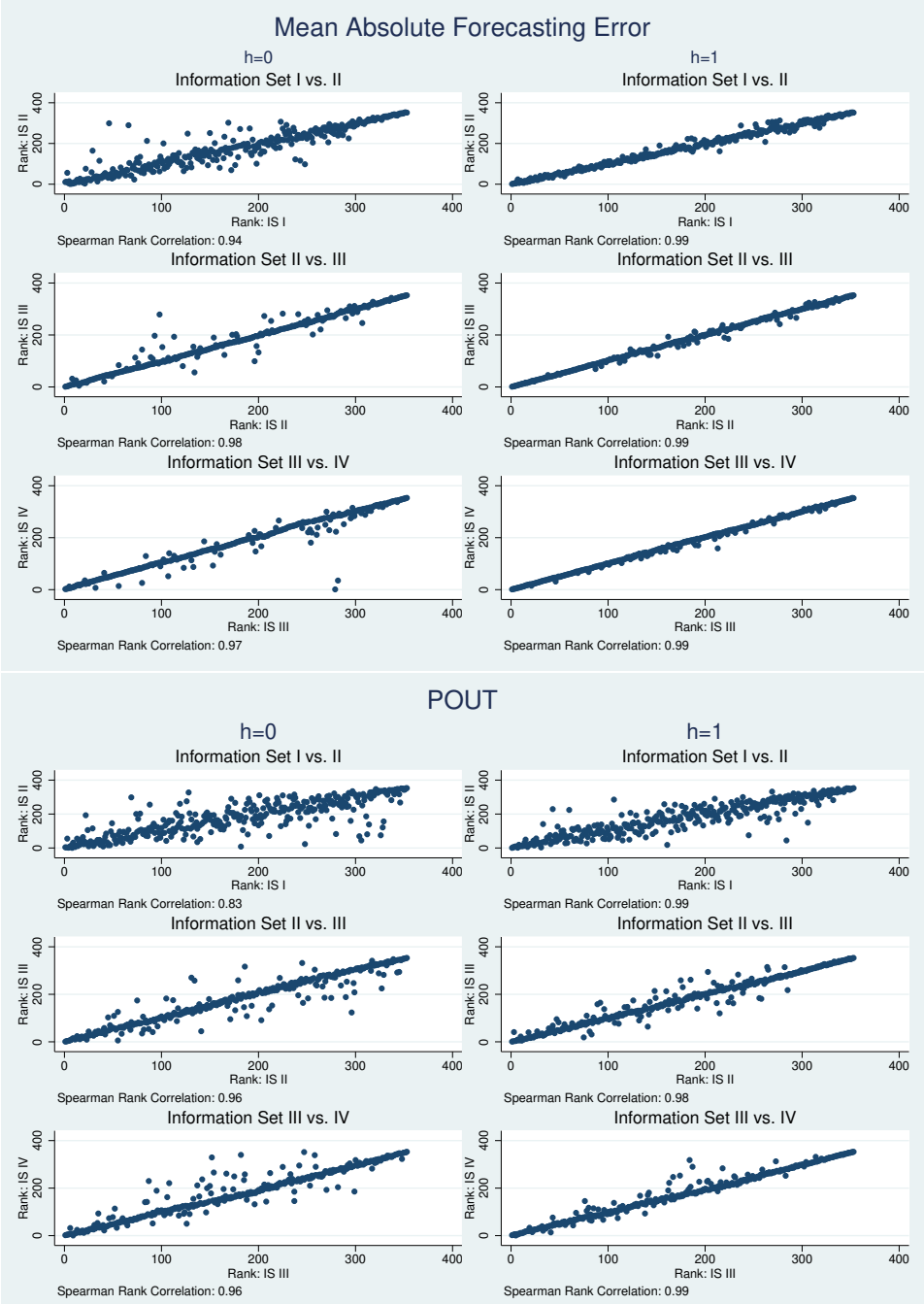
Note: This figure plots smoothed histograms using a normal kernel function for $MAFE$ and $POUT$ for $h = 0, 1$. The bold line represents information set I. The dashed lines stand for the remaining sets II to IV.

Based on Figure 2 and the upcoming figures, our results can be summarized as follows:

1. The global picture across information sets is very similar, although there are differences in the details. This similarity is illustrated by the kernel estimates presented in Figure 2, which are almost identical for all information sets in terms of $MAFE$ and $POUT$. Figure 3 confirms this suggestion. It compares the rankings of indicators between information sets. The $MAFE$ ranking across information sets is very stable. The Spearman rank correlation coefficient is at least 0.94. This also holds for the stability ranking ($POUT$) where the correlations start at 0.83. As a result, Figures 5 to 10 only feature the results for the first information set in order to save space. The graphs for the other three information sets are very similar across information sets and forecast

horizons.[6]

Figure 3: Rank comparisons for $MAFE$ and $POUT$ across information sets



2. In contrast to our expectations, the $MAFE$ of the best indicators do not improve with a richer information set. This fact is also depicted in Figure 2. An improvement in forecast accuracy with a larger information set implies that the distributions in Figure 2 either would move to the left or take another functional form. This finding is also illustrated in Tables 1 and 2, where rankings with its corresponding values for $MAFE$ and $POUT$ are very similar across information sets. Apart from the finding that the

[6] All Figures for other information sets are available upon request from the authors.

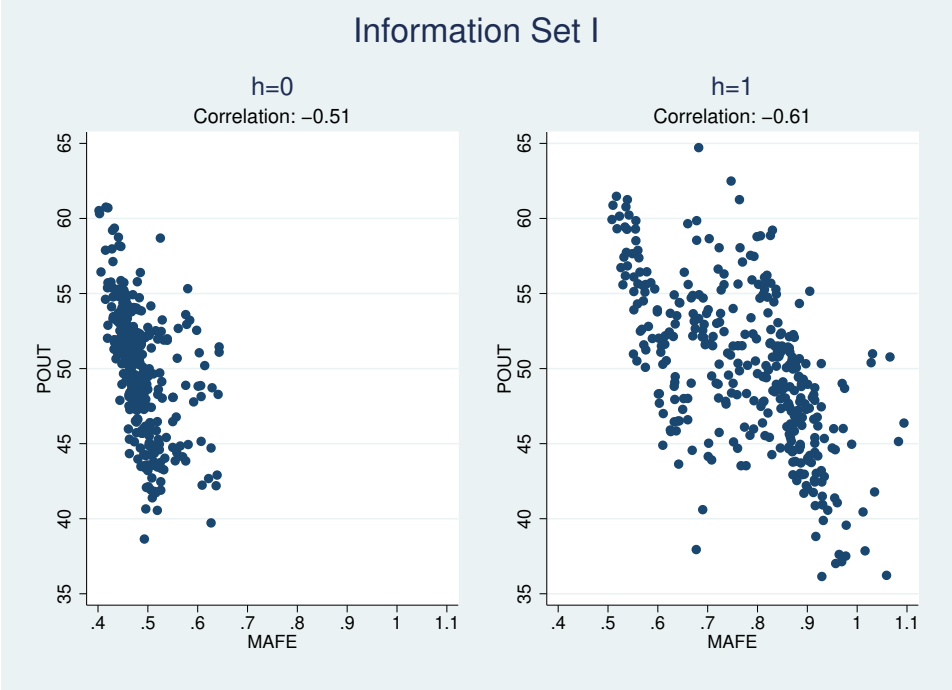
rankings remain largely unaffected by the information set, it might be the case that a single superior indicator dominates all others once it is observed.

3. Many indicator forecasts for Saxon GDP have an advantage over competitive benchmark models. The AR benchmark is outperformed across all information sets by about one fifth of all indicators in the nowcast setting and in about two thirds for forecasts one quarter ahead.

4. As expected, the average forecast performance across indicators is better for $h = 0$. The $MAFE$ are clustered closer around the mean in contrast to $h = 1$ (see Figure 2, left graph). In this case, not only the average forecast is worse, but there is also a higher risk of obtaining a bad forecast. Similarly, there is a higher standard deviation when forecasts are evaluated according to $POUT$ (see Figure 2, right graph).

5. Figure 4 reveals a negative relationship between $MAFE$ and $POUT$, i.e. on average, an indicator with a low $MAFE$ exhibits also a good forecasting performance over time. The correlation is -0.51 and -0.61, respectively.

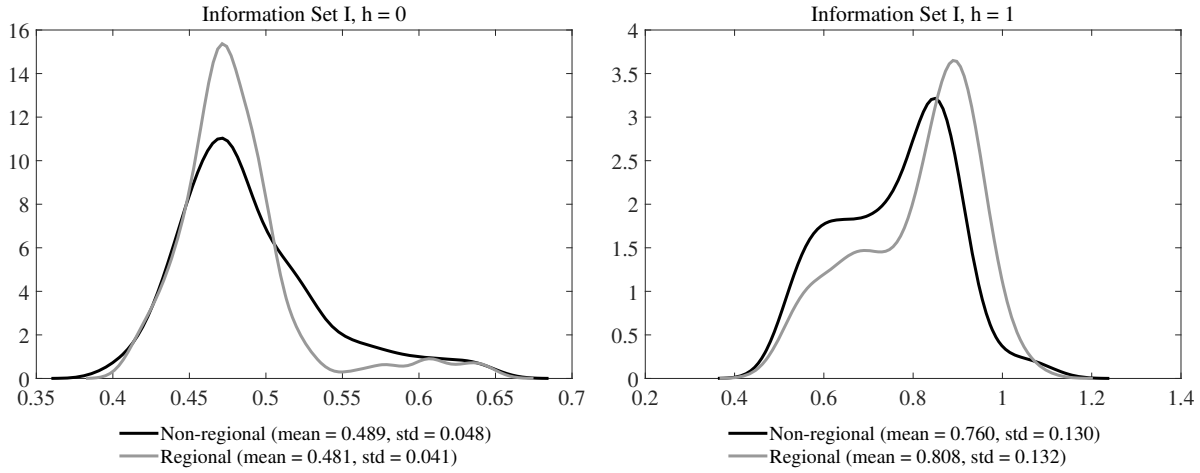
Figure 4: Relationship between $MAFE$ and $POUT$



6. The role of *regional* indicators for nowcasting Saxon GDP is heterogeneous. Both at the top and at the end of our rankings we find Saxon indicators. About 8% of all regional indicators are among the 10% best performing models for both forecast horizons. This figure rises to 20% for the best 20% of all indicators. On the other hand, one fourth of the worst 10% models contain regional indicators. Figure 5 reveals that regional indicators have a higher accuracy for nowcasts than their non-regional

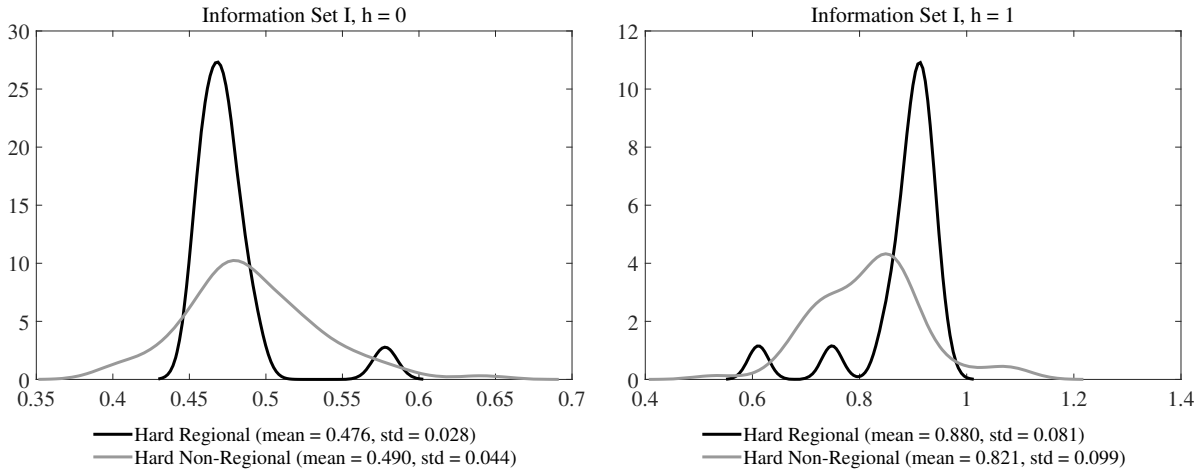
counterparts since the distributions have almost equal means with a lower standard deviation for regional indicators. For $h = 1$ the overall performance of non-regional indicators is better on average.

Figure 5: $MAFE$ distribution of regional and non-regional indicators



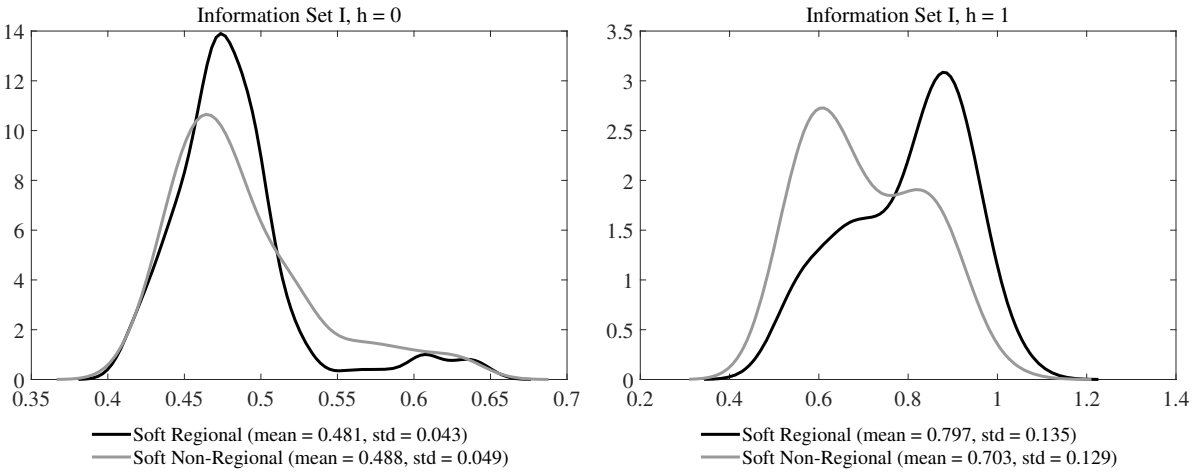
7. The various *regional hard* indicators deliver very similar forecasting results. As Figure 6 shows, the distributions of $MAFE$ and $POUT$ is clustered closely around the mean. In contrast, the performance of non-regional hard indicators is more dispersed for both h. On average, non-regional hard indicators are slightly better for $h = 1$.

Figure 6: $MAFE$ distribution of regional hard indicators



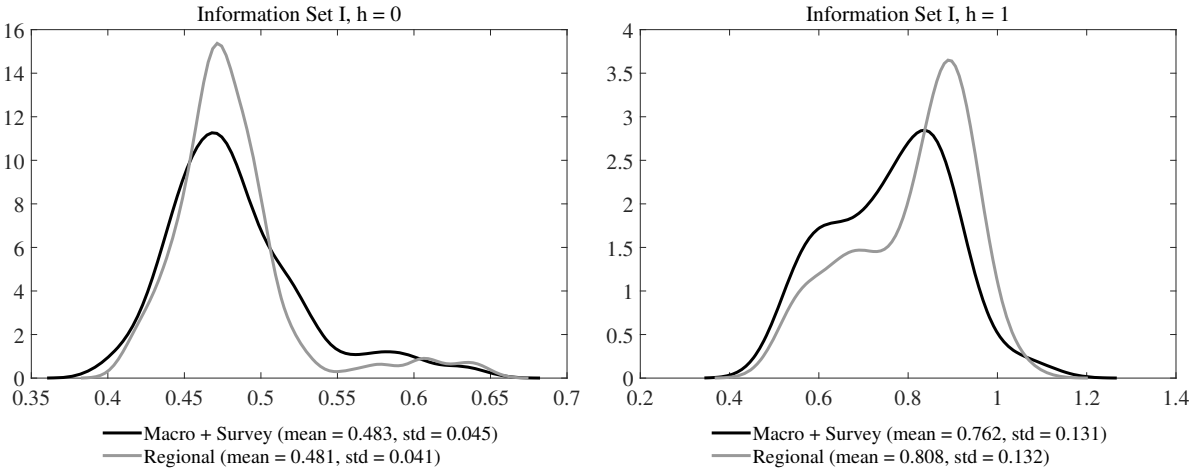
8. Figure 7 gives rise to a similar interpretation to the previous point. *Regional soft* indicators have on average no competitive advantage over national survey series. In case of $h = 1$, national soft indicators are clearly better on average.

Figure 7: $MAFE$ distribution of regional soft indicators



9. In Figure 8 we contrast the regional soft indicators with their national (macro + survey) counterparts. The conclusion remains the same as in Figure 5. For nowcasts, regional indicators have a lower risk of generating bad forecasts. But the forecast performance is somewhat worse for $h = 1$ when compared to national survey results and macro variables.

Figure 8: $MAFE$ distribution of macro indicators

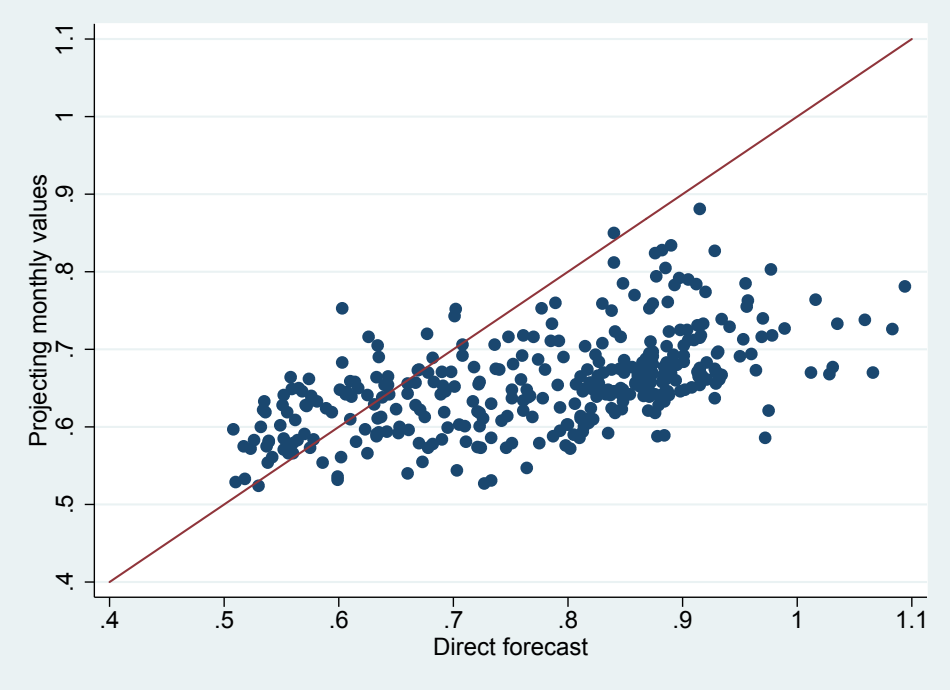


10. In Figure 9 we compare the direct-step forecasting approach for $h = 1$ with the projecting method. The latter fills the missing months of the monthly indicators by means of an autoregressive model. Figure 9 shows that the projection approach improves forecasting accuracy in about 80% of all cases. But the improvement is not sufficient to outperform the best indicators.[7] This implies that the forecast performance of already good indicators cannot be further improved by the projection method. It is

[7]For reasons of brevity we do not report these results here. The alternative ranking for the projection method can be obtained from the authors upon request.

worth noting that the projection method introduces additional estimation and forecast uncertainty since it necessitates monthly forecasts of the indicators up to six months ahead.

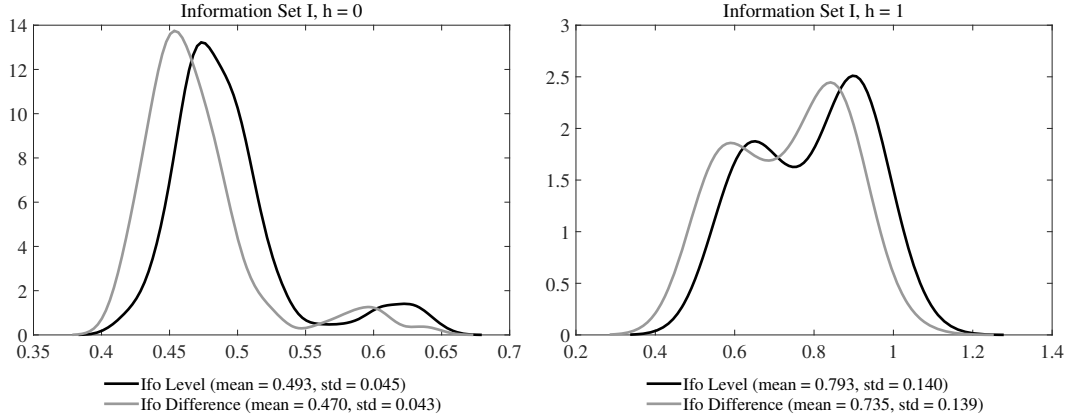
Figure 9: Direct-step forecasts vs. projecting method for $h = 1$



Note: This graph compares the $MAFE$ based on the direct forecast and the projection method for each indicator. The dot below the 45 degree line indicates a lower $MAFE$ of the projection method.

11. In our data set we not only include the Ifo indicators in levels, but also in first differences. Figure 10 shows that the transformation clearly makes a difference. Using first differences significantly improves forecasting accuracy. This is in line with the findings by Kholodilin and Siliverstovs (2006). One explanation is that the first difference variables are less persistent than their level counterparts.

Figure 10: The effect of first differences for the Ifo indicators



Putting these results into perspective, we can draw some general conclusions. On the national level it is often found that if hard indicators such as industrial production become available, forecasting accuracy improves substantially (see, e.g., Henzel and Rast, 2013). We cannot confirm this effect in our regional case study. On the regional level hard indicators do not play a predominant role. This might, however, be due to the fact that some hard indicators are not available on a monthly basis for German states. As a result, survey indicators play a crucial role in nowcasting regional GDP. When comparing regional with national or international indicators we find that national indicators play an important role, but do not substantially outperform international indicators.

3.2. Performance of Individual Indicators

We now turn to a discussion of which indicators are the most useful in our setting. In Tables 1 and 2 we show the 10 best indicators both in terms of $MAFE$ and $POUT$ for each information set and forecast horizon.[8] The tables show that the forecasting accuracy of the 10 best indicators are very similar. As we have seen before, the rankings across different information sets are also very similar. Nevertheless, there are differences in the details, which are worth discussing.

We start with the nowcasting setting ($h = 0$). We can classify the best indicators into four different groups. The first group comprises foreign turnover for German manufacturing, mining and quarrying or the capital goods industry. This result is straightforward because approximately 80% of all Saxon turnover in 2011 was generated by intermediate and capital goods producers (e.g. vehicle manufacturing, which is the dominant sector in the Saxon industry). While those indicators do not show up for the other information sets shown in the two tables, they are among the best 30 indicators in all cases. Similarly, the Ifo indicators for the same industries (in particular the business climate and expectations) also tend to have good forecasting power in their first differences. Moreover, both the Ifo indicators for Saxony and Germany play an important role. This would seem to indicate that both regional information, as well as the national German business cycle convey information. Furthermore, the number of foreign new orders in the German vehicle producing industry is important for nowcasting Saxon GDP. These results appear plausible, given the importance of this industrial sector in Saxony. It is worth noting that the three indicator groups all move together with industrial production, which is an important predictor for GDP at the national level. The last category is money supply. Money supply is often regarded as a leading indicator with a short publication lag. It turns out that the indicators mentioned above are also among the best in terms of $POUT$. Finally, the volume of German exports is the best indicator in information set IV, i.e. when all months of the current quarter are known. This is not surprising since the Saxon economy is highly interconnected to Europe.

[8] The results for all indicators are available upon request.

Table 1: Forecasting results I: Full sample

Information Set I

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Foreign turnover manufacturing	0.402	1	60.531	3	Composite Leading Indicator OECD (normalized)	0.508	1	59.927	10
Foreign turnover mining and quarrying	0.403	2	60.328	4	Ifo business climate Saxony (difference)	0.510	2	60.882	6
Foreign turnover capital goods	0.406	3	56.442	14	Ifo business climate intermediate goods (difference)	0.517	3	61.479	3
Ifo business climate intermediate goods Saxony (difference)	0.415	4	54.613	35	Ifo business climate manufacturing Saxony (difference)	0.518	4	59.318	15
Foreign new orders motor vehicles	0.415	5	57.889	12	Ifo business climate manufacturing (difference)	0.523	5	60.149	9
Ifo business expectations wholesale trade (difference)	0.416	6	60.753	1	Ifo business climate retail sales (difference)	0.526	6	56.725	36
Ifo business expectations Saxony (difference)	0.419	7	55.382	22	Domestic new orders intermediate goods	0.530	7	55.580	56
Ifo business climate manufacturing Saxony (difference)	0.419	8	52.020	107	Composite Leading Indicator OECD (amplitude adjusted)	0.532	8	57.427	32
Ifo business climate capital goods Saxony	0.420	9	55.715	20	Ifo business climate consumer goods (difference)	0.534	9	59.429	14
Ifo business climate manufacturing Saxony	0.420	10	52.882	71	Ifo business climate intermediate goods Saxony (difference)	0.535	10	56.177	43
Ifo business expectations wholesale trade (difference)	0.416	6	60.753	1	Ifo business climate food, beverage and tobacco Saxony	0.682	97	64.719	1
Ifo business situation wholesale trade (difference)	0.420	11	60.709	2	Ifo export expectations manufacturing Saxony (difference)	0.747	135	62.495	2
Foreign turnover manufacturing	0.402	1	60.531	3	Ifo business climate intermediate goods (difference)	0.517	3	61.479	3
Foreign turnover mining and quarrying	0.403	2	60.328	4	Ifo business expectations manufacturing Saxony (difference)	0.539	14	61.258	4
Money supply M2	0.433	24	59.355	5	Ifo business situation wholesale trade (difference)	0.764	146	61.251	5
Money supply M3	0.429	17	59.213	6	Ifo business climate Saxony (difference)	0.510	2	60.882	6
Ifo export expectations manufacturing Saxony (difference)	0.441	37	58.751	7	Ifo business climate consumer non-durables (difference)	0.536	11	60.777	7
Domestic new orders electronic products	0.525	304	58.696	8	Composite Leading Indicator EU (amplitude adjusted)	0.542	16	60.229	8
Foreign new orders manufacturing	0.442	39	58.191	9	Ifo business climate manufacturing (difference)	0.523	5	60.149	9
Composite Leading Indicator EU (normalized)	0.446	47	58.135	10	Composite Leading Indicator OECD (normalized)	0.508	1	59.927	10

Information Set II

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo business expectations wholesale trade (difference)	0.411	1	61.442	1	Composite Leading Indicator OECD (normalized)	0.501	1	61.510	7
Ifo business climate manufacturing Saxony (difference)	0.414	2	52.630	80	Ifo business climate Saxony (difference)	0.506	2	62.378	3
Ifo business expectations consumer goods Saxony (difference)	0.415	3	55.580	19	Ifo business climate intermediate goods (difference)	0.509	3	62.040	5
Ifo business climate capital goods Saxony	0.416	4	55.499	21	Ifo business climate manufacturing (difference)	0.513	4	60.753	9
Ifo business climate intermediate goods Saxony (difference)	0.417	5	54.101	45	Ifo business climate manufacturing Saxony (difference)	0.520	5	58.412	23
Ifo business situation wholesale trade (difference)	0.418	6	59.509	2	Composite Leading Indicator OECD (amplitude adjusted)	0.526	6	59.256	16
Ifo business expectations Saxony (difference)	0.418	7	55.555	20	Composite Leading Indicator EU (normalized)	0.528	7	62.034	6
Foreign new orders intermediate goods	0.420	8	51.848	108	Ifo business climate consumer goods (difference)	0.528	8	58.930	20
Ifo business climate manufacturing Saxony	0.420	9	52.038	100	Ifo business climate consumer non-durables (difference)	0.529	9	61.436	8
Ifo business climate wholesale trade (difference)	0.422	10	57.766	6	Ifo business climate (difference)	0.530	10	57.661	31
Ifo business expectations wholesale trade (difference)	0.411	1	61.442	1	Ifo business climate food, beverage and tobacco Saxony	0.693	103	63.653	1
Ifo business situation wholesale trade (difference)	0.418	6	59.509	2	Composite Leading Indicator EU (amplitude adjusted)	0.533	11	62.748	2
Ifo export expectations manufacturing Saxony (difference)	0.436	32	59.373	3	Ifo business climate Saxony (difference)	0.506	2	62.378	3
Money supply M2	0.429	20	59.305	4	Ifo export expectations manufacturing Saxony (difference)	0.739	131	62.206	4
Money supply M3	0.427	18	58.807	5	Ifo business climate intermediate goods (difference)	0.509	3	62.040	5
Ifo business climate wholesale trade (difference)	0.422	10	57.766	6	Composite Leading Indicator EU (normalized)	0.528	7	62.034	6
Ifo export expectations manufacturing Saxony	0.472	160	57.692	7	Composite Leading Indicator OECD (normalized)	0.501	1	61.510	7
Composite Leading Indicator EU (normalized)	0.444	45	57.581	8	Ifo business climate consumer non-durables (difference)	0.529	9	61.436	8
Foreign turnover manufacturing	0.423	11	57.458	9	Ifo business climate manufacturing (difference)	0.513	4	60.753	9
Ifo business expectations mechanical engineering Saxony (difference)	0.426	17	57.421	10	Ifo business expectations manufacturing Saxony (difference)	0.537	16	60.463	10

Note: This table reports the forecasting results for information set I and II for $h = 0$ and $h = 1$ respectively. For each combination both the best ten models in terms of mean absolute forecasting error ($MAFE$) and the average percentage of models outperformed ($POUT$) are shown. The forecast period ranges from 2002Q1 to 2013Q4. The AR benchmark has an $MAFE$ of 0.455 and 0.863 respectively.

Table 2: Forecasting results II: Full sample

Information Set III

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo business expectations wholesale trade (difference)	0.411	1	61.356	1	Composite Leading Indicator OECD (normalized)	0.498	1	61.707	7
Ifo business climate manufacturing Saxony (difference)	0.414	2	52.771	71	Ifo business climate Saxony (difference)	0.506	2	62.169	4
Ifo business expectations consumer goods Saxony (difference)	0.415	3	55.641	21	Ifo business climate intermediate goods (difference)	0.509	3	61.867	5
Ifo business climate capital goods Saxony	0.416	4	55.838	15	Ifo business climate manufacturing (difference)	0.513	4	60.512	9
Foreign new orders motor vehicles	0.417	5	57.957	6	Ifo business climate manufacturing Saxony (difference)	0.520	5	58.086	23
Ifo business climate intermediate goods Saxony (difference)	0.417	6	54.126	43	Composite Leading Indicator OECD (amplitude adjusted)	0.523	6	59.860	14
Ifo business situation wholesale trade (difference)	0.418	7	59.527	2	Composite Leading Indicator EU (normalized)	0.526	7	62.268	3
Ifo business expectations Saxony (difference)	0.418	8	55.838	16	Ifo business climate consumer goods (difference)	0.528	8	58.843	21
Ifo business climate manufacturing Saxony	0.420	9	52.162	91	Ifo business climate consumer non-durables (difference)	0.529	9	61.356	8
Ifo business climate wholesale trade (difference)	0.422	10	57.686	7	Ifo business climate (difference)	0.530	10	57.784	27
Ifo business expectations wholesale trade (difference)	0.411	1	61.356	1	Ifo business climate food, beverage and tobacco Saxony	0.693	105	63.512	1
Ifo business situation wholesale trade (difference)	0.418	7	59.527	2	Composite Leading Indicator EU (amplitude adjusted)	0.531	11	62.822	2
Ifo export expectations manufacturing Saxony (difference)	0.436	33	59.484	3	Composite Leading Indicator EU (normalized)	0.526	7	62.268	3
Money supply M2	0.428	17	59.293	4	Ifo business climate Saxony (difference)	0.506	2	62.169	4
Money supply M3	0.427	15	58.449	5	Ifo business climate intermediate goods (difference)	0.509	3	61.867	5
Foreign new orders motor vehicles	0.417	5	57.957	6	Ifo export expectations manufacturing Saxony (difference)	0.739	133	61.836	6
Ifo business climate wholesale trade (difference)	0.422	10	57.686	7	Composite Leading Indicator OECD (normalized)	0.498	1	61.707	7
Composite Leading Indicator EU (normalized)	0.443	43	57.667	8	Ifo business climate consumer non-durables (difference)	0.529	9	61.356	8
Ifo business expectations mechanical engineering Saxony (difference)	0.426	14	57.643	9	Ifo business climate manufacturing (difference)	0.513	4	60.512	9
Ifo export expectations manufacturing Saxony	0.472	160	57.606	10	Ifo business expectations manufacturing Saxony (difference)	0.537	15	60.223	10

Information Set IV

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Exports volume index	0.398	1	60.543	2	Composite Leading Indicator OECD (normalized)	0.498	1	61.713	7
Ifo business expectations wholesale trade (difference)	0.411	2	61.288	1	Ifo business climate Saxony (difference)	0.506	2	62.021	4
Ifo business climate manufacturing Saxony (difference)	0.414	3	52.611	76	Ifo business climate intermediate goods (difference)	0.509	3	61.756	6
Ifo business expectations consumer goods Saxony (difference)	0.415	4	55.733	17	Ifo business climate manufacturing (difference)	0.513	4	60.352	9
Ifo business climate capital goods Saxony	0.416	5	55.616	21	Ifo business climate manufacturing Saxony (difference)	0.520	5	57.994	24
Ifo business climate intermediate goods Saxony (difference)	0.417	6	54.225	40	Composite Leading Indicator OECD (amplitude adjusted)	0.523	6	59.675	13
Foreign new orders intermediate goods	0.417	7	50.653	158	Composite Leading Indicator EU (normalized)	0.526	7	62.274	3
Ifo business situation wholesale trade (difference)	0.418	8	59.521	3	Ifo business climate consumer goods (difference)	0.528	8	58.616	21
Ifo business expectations Saxony (difference)	0.418	9	55.727	18	Ifo business climate consumer non-durables (difference)	0.529	9	61.184	8
Ifo business climate manufacturing Saxony	0.420	10	52.045	97	Ifo business climate (difference)	0.530	10	57.661	29
Ifo business expectations wholesale trade (difference)	0.411	2	61.288	1	Ifo business climate food, beverage and tobacco Saxony	0.693	106	63.456	1
Exports volume index	0.398	1	60.543	2	Composite Leading Indicator EU (amplitude adjusted)	0.530	11	62.655	2
Ifo business situation wholesale trade (difference)	0.418	8	59.521	3	Composite Leading Indicator EU (normalized)	0.526	7	62.274	3
Ifo export expectations manufacturing Saxony (difference)	0.436	37	59.281	4	Ifo business climate Saxony (difference)	0.506	2	62.021	4
Money supply M2	0.428	20	59.077	5	Ifo export expectations manufacturing Saxony (difference)	0.739	136	61.793	5
Money supply M3	0.427	19	58.400	6	Ifo business climate intermediate goods (difference)	0.509	3	61.756	6
Ifo business expectations mechanical engineering Saxony (difference)	0.426	18	57.636	7	Composite Leading Indicator OECD (normalized)	0.498	1	61.713	7
Composite Leading Indicator EU (normalized)	0.443	46	57.636	8	Ifo business climate consumer non-durables (difference)	0.529	9	61.184	8
Ifo export expectations manufacturing Saxony	0.472	161	57.569	9	Ifo business climate manufacturing (difference)	0.513	4	60.352	9
Ifo business climate wholesale trade (difference)	0.422	11	57.507	10	Ifo business expectations manufacturing Saxony (difference)	0.537	16	60.106	10

Note: This table reports the forecasting results for information set III and IV for $h = 0$ and $h = 1$ respectively. For each combination both the best ten models in terms of mean absolute forecasting error ($MAFE$) and the average percentage of models outperformed ($POUT$) are shown. The forecast period ranges from 2002Q1 to 2013Q4. The AR benchmark has an $MAFE$ of 0.455 and 0.863 respectively.

Turning to one quarter ahead forecasts ($h = 1$) we get qualitatively similar results as for $h = 0$. Soft indicators, in particular, play an important role. Most notably, there are no hard indicators among the 10 best performing models. Again, various Ifo indicators for manufacturing both for Saxony and Germany deliver high forecasting accuracy. In addition, the Composite Leading Indicators for the OECD or the EU add further forecast quality. This may be explained by the fact that European states have a high share in Saxon exports. With a total export quota of almost 40%, the most important trading regions or countries for Saxon firms can be found close to Saxony. Altogether, it appears valuable to consider business cycle developments in important trading partners and thus account for regional characteristics when choosing among indicator variables for forecasting.

3.3. Does the Crisis Affect the Results?

As our forecast evaluation sample includes the global financial and economic crisis of the years 2008 and 2009, it is natural to ask how our results and interpretations change if we exclude this period from our analysis. We drop the forecast errors from the years 2008 and 2009, i.e. eight observations. The remaining sample now comprises of only 'normal' (steady) periods of GDP growth in Saxony. In Figure 11 we plot the full sample rank vs. the rank without the crisis period both for $MAFE$ and $POUT$.

Although we find a positive correlation (about 0.53), there are large ranking shifts in the $MAFE$ measure. These shifts are less pronounced in the $POUT$ measure (see lower panel in Figure 11). This implies that there are indicators that perform well in normal times and show a poor forecasting performance in turbulent times. In Tables 3 and 4 we show the best indicators for the alternative evaluation period.

As expected, the average $MAFE$ decreases when the crisis is excluded. In comparison to the full sample, the $MAFE$ decreases slightly with a larger information set. The importance of regional indicators increases when we consider normal times only. Among the best 10% indicators for $h = 0$ the share of all regional indicators rises from 8% to 14%. The share remains constant for $h = 1$. Looking at the best 20% of all indicators, the share of all regional indicators rises up to 25%. Which variables climb up in the ranking? The Ifo industry export expectations and the assessment of the business situation in the motor vehicles sector in particular become more successful without the crisis. A significant drop in forecasting performance can be observed for the foreign turnover of the German manufacturing, mining and quarrying or the capital goods industry. Such a result is probably due to the fact that these sectors were the most heavily impacted by the Global Financial Crisis.

Figure 11: Rank comparisons: full sample vs. sample excluding the global financial crisis

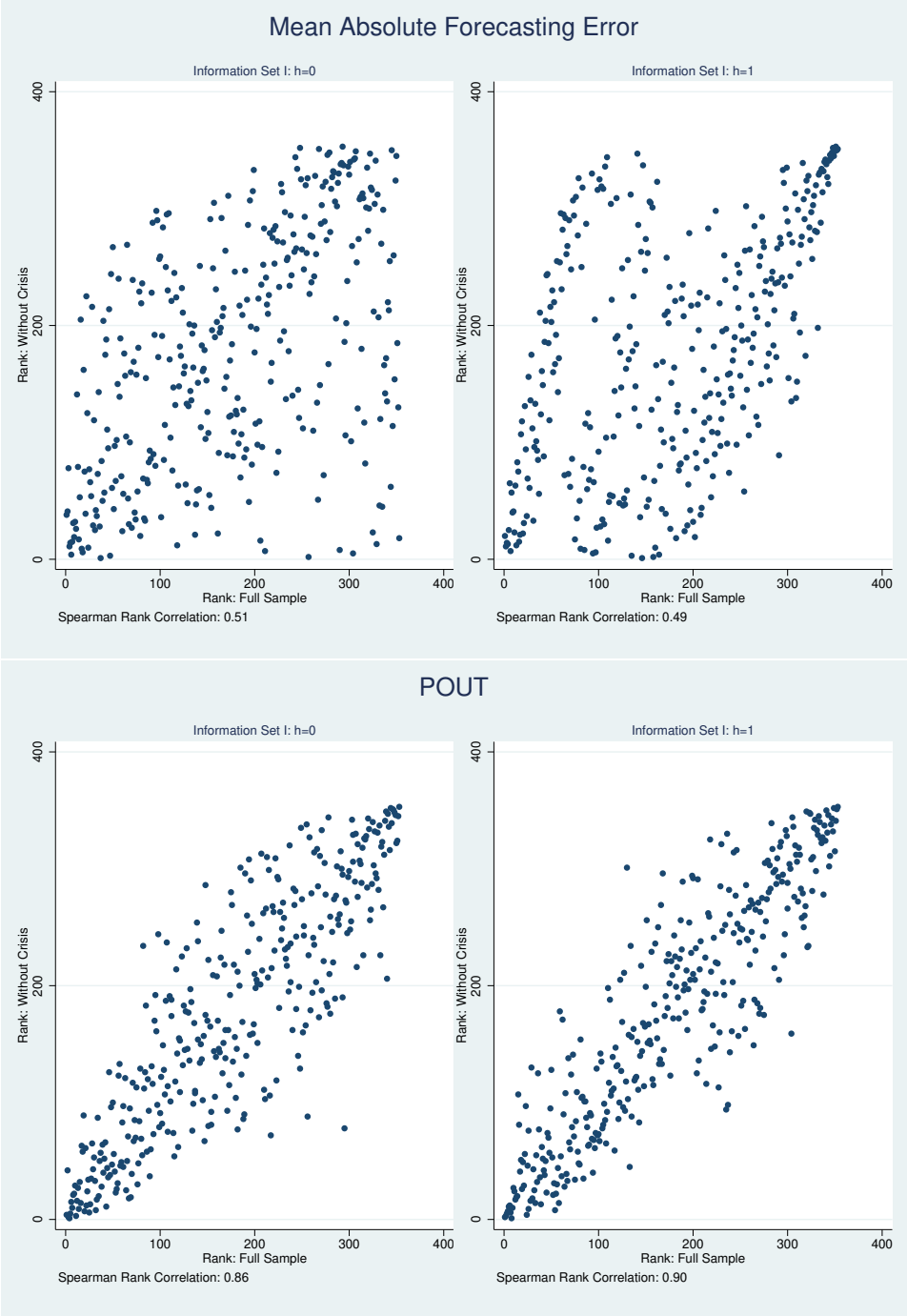


Table 3: Forecasting results III: Sample excluding the global financial crisis

Information Set I

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo export expectations manufacturing Saxony (difference)	0.215	1	61.138	4	Ifo business situation wholesale trade (difference)	0.368	1	64.075	2
Ifo business situation motor vehicles Saxony	0.217	2	58.827	10	Ifo business situation motor vehicles Saxony	0.368	2	59.691	7
Composite Leading Indicator EU (normalized)	0.219	3	61.645	2	Ifo export expectations manufacturing Saxony (difference)	0.371	3	63.911	3
Ifo business expectations wholesale trade (difference)	0.220	4	61.868	1	Consumer Confidence Indicator	0.380	4	59.840	6
Domestic new order electronic products	0.224	5	61.600	3	Ifo order expectations wholesale trade (difference)	0.385	5	59.639	8
Ifo business expectations mechanical engineering Saxony (difference)	0.225	6	59.945	7	Ifo business climate food, beverage and tobacco Saxony	0.385	6	64.261	1
Composite Leading Indicator EU (amplitude adjusted)	0.225	7	60.646	5	Domestic new orders intermediate goods	0.389	7	57.529	21
Ifo employment expectations motor vehicles Saxony (difference)	0.227	8	56.493	21	Economic Sentiment Indicator Czech Republic	0.392	8	57.925	15
Money supply M3	0.227	9	60.139	6	Ifo business climate wholesale trade (difference)	0.394	9	60.593	4
Money supply M2	0.232	10	59.773	8	Confidence Indicator Construction	0.395	10	56.642	34
Ifo business expectations wholesale trade (difference)	0.220	4	61.868	1	Ifo business climate food, beverage and tobacco Saxony	0.385	6	64.261	1
Composite Leading Indicator EU (normalized)	0.219	3	61.645	2	Ifo business situation wholesale trade (difference)	0.368	1	64.075	2
Domestic new order electronic products	0.224	5	61.600	3	Ifo export expectations manufacturing Saxony (difference)	0.371	3	63.911	3
Ifo export expectations manufacturing Saxony (difference)	0.215	1	61.138	4	Ifo business climate wholesale trade (difference)	0.394	9	60.593	4
Composite Leading Indicator EU (amplitude adjusted)	0.225	7	60.646	5	Ifo export expectations manufacturing Saxony	0.431	45	60.243	5
Money supply M3	0.227	9	60.139	6	Consumer Confidence Indicator	0.380	4	59.840	6
Ifo business expectations mechanical engineering Saxony (difference)	0.225	6	59.945	7	Ifo business situation motor vehicles Saxony	0.368	2	59.691	7
Money supply M2	0.232	10	59.773	8	Ifo order expectations wholesale trade (difference)	0.385	5	59.639	8
Ifo business situation wholesale trade (difference)	0.242	26	58.924	9	Ifo business expect. mechanical engineering Saxony (difference)	0.428	43	59.520	9
Ifo business situation motor vehicles Saxony	0.217	2	58.827	10	Ifo business climate food, beverage and tobacco Saxony	0.422	29	59.065	10

Information Set II

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.533	2	Ifo business situation motor vehicles Saxony	0.360	1	59.535	12
Ifo business expectations wholesale trade (difference)	0.215	2	62.815	1	Ifo business situation wholesale trade (difference)	0.370	2	63.024	3
Ifo business situation motor vehicles Saxony	0.217	3	61.115	3	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.314	2
Composite Leading Indicator EU (normalized)	0.219	4	60.899	4	Consumer Confidence Indicator	0.380	4	59.580	10
Ifo export expectations manufacturing Saxony	0.221	5	60.496	5	Economic Sentiment Indicator Czech Republic	0.383	5	58.968	14
Ifo employment expectations motor vehicles Saxony (difference)	0.225	6	57.321	19	Composite Leading Indicator EU (normalized)	0.384	6	60.154	6
Ifo business expectations mechanical engineering Saxony (difference)	0.226	7	59.423	7	Confidence Indicator Construction	0.385	7	57.470	24
Composite Leading Indicator EU (amplitude adjusted)	0.227	8	59.214	9	Ifo business climate wholesale trade (difference)	0.389	8	59.803	7
Ifo business expectations consumer goods Saxony (difference)	0.230	9	55.353	36	Composite Leading Indicator EU (amplitude adjusted)	0.392	9	60.795	4
Money supply M1	0.230	10	57.574	16	Ifo business climate food, beverage and tobacco Saxony	0.394	10	64.351	1
Ifo business expectations wholesale trade (difference)	0.215	2	62.815	1	Ifo business climate food, beverage and tobacco Saxony	0.394	10	64.351	1
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.533	2	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.314	2
Ifo business situation motor vehicles Saxony	0.217	3	61.115	3	Ifo business situation wholesale trade (difference)	0.370	2	63.024	3
Composite Leading Indicator EU (normalized)	0.219	4	60.899	4	Composite Leading Indicator EU (amplitude adjusted)	0.392	9	60.795	4
Ifo export expectations manufacturing Saxony	0.221	5	60.496	5	Ifo business expect. consumer non-durables Saxony (difference)	0.424	37	60.332	5
Money supply M2	0.230	11	59.773	6	Composite Leading Indicator EU (normalized)	0.384	6	60.154	6
Ifo business expectations mechanical engineering Saxony (difference)	0.226	7	59.423	7	Ifo business climate wholesale trade (difference)	0.389	8	59.803	7
Money supply M3	0.230	12	59.423	8	Ifo business expect. mechanical engineering Saxony (difference)	0.420	31	59.662	8
Composite Leading Indicator EU (amplitude adjusted)	0.227	8	59.214	9	Ifo business climate consumer non-durables (difference)	0.411	20	59.654	9
Ifo business situation retail sales Saxony (difference)	0.249	54	58.566	10	Consumer Confidence Indicator	0.380	4	59.580	10

Note: This table reports the forecasting results for information set I and II for $h = 0$ and $h = 1$ respectively. For each combination both the best ten models in terms of mean absolute forecasting error ($MAFE$) and the average percentage of models outperformed ($POUT$) are shown. The forecast period ranges from 2002Q1 to 2013Q4 excluding the crisis period (2008Q1 to 2009Q4). The AR benchmark has an $MAFE$ of 0.251 and 0.463 respectively.

Table 4: Forecasting results IV: Sample excluding the global financial crisis

Information Set III

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.749	2	Ifo business situation motor vehicles Saxony	0.360	1	59.416	12
Ifo business expectations wholesale trade (difference)	0.215	2	62.703	1	Ifo business situation wholesale trade (difference)	0.370	2	62.897	3
Ifo business situation motor vehicles Saxony	0.217	3	61.279	3	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.016	2
Composite Leading Indicator EU (normalized)	0.220	4	60.944	4	Consumer Confidence Indicator	0.380	4	59.699	8
Ifo export expectations manufacturing Saxony	0.221	5	60.332	5	Economic Sentiment Indicator Czech Republic	0.383	5	58.737	16
Ifo employment expectations motor vehicles Saxony (difference)	0.225	6	57.343	15	Composite Leading Indicator EU (normalized)	0.383	6	60.340	5
Ifo business expectations mechanical engineering Saxony (difference)	0.226	7	59.520	8	Confidence Indicator Construction	0.385	7	57.351	23
Composite Leading Indicator EU (amplitude adjusted)	0.227	8	59.609	7	Ifo business climate wholesale trade (difference)	0.389	8	59.647	9
Money supply M1	0.228	9	57.149	18	Composite Leading Indicator EU (amplitude adjusted)	0.390	9	60.825	4
Money supply M2	0.230	10	59.669	6	Ifo business climate food, beverage and tobacco Saxony	0.394	10	64.306	1
Ifo business expectations wholesale trade (difference)	0.215	2	62.703	1	Ifo business climate food, beverage and tobacco Saxony	0.394	10	64.306	1
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.749	2	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.016	2
Ifo business situation motor vehicles Saxony	0.217	3	61.279	3	Ifo business situation wholesale trade (difference)	0.370	2	62.897	3
Composite Leading Indicator EU (normalized)	0.220	4	60.944	4	Composite Leading Indicator EU (amplitude adjusted)	0.390	9	60.825	4
Ifo export expectations manufacturing Saxony	0.221	5	60.332	5	Composite Leading Indicator EU (normalized)	0.383	6	60.340	5
Money supply M2	0.230	10	59.669	6	Ifo business expectat. consumer non-durables Saxony (difference)	0.424	41	60.191	6
Composite Leading Indicator EU (amplitude adjusted)	0.227	8	59.609	7	Ifo business expect. mechanical engineering Saxony (difference)	0.420	34	59.736	7
Ifo business expectations mechanical engineering Saxony (difference)	0.226	7	59.520	8	Consumer Confidence Indicator	0.380	4	59.699	8
Money supply M3	0.230	12	58.909	9	Ifo business climate wholesale trade (difference)	0.389	8	59.647	9
M1 overnight deposits	0.245	38	58.707	10	Money supply M2	0.420	33	59.624	10

Information Set IV

$h = 0$					$h = 1$				
	$MAFE$		$POUT$			$MAFE$		$POUT$	
Indicator	Value	Rank	Value	Rank	Indicator	Value	Rank	Value	Rank
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.607	2	Ifo business situation motor vehicles Saxony	0.360	1	59.505	9
Ifo business expectations wholesale trade (difference)	0.215	2	62.614	1	Ifo business situation wholesale trade (difference)	0.370	2	62.599	3
Ifo business situation motor vehicles Saxony	0.217	3	61.317	3	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.024	2
Composite Leading Indicator EU (normalized)	0.220	4	60.884	4	Consumer Confidence Indicator	0.380	4	59.498	10
Ifo export expectations manufacturing Saxony	0.221	5	60.221	5	Economic Sentiment Indicator Czech Republic	0.383	5	58.528	19
Imports value Saxony	0.224	6	58.513	11	Composite Leading Indicator EU (normalized)	0.383	6	60.392	5
Ifo employment expectations motor vehicles Saxony (difference)	0.225	7	57.231	17	Confidence Indicator Construction	0.385	7	57.216	25
Ifo business expectations mechanical engineering Saxony (difference)	0.226	8	59.505	7	Exports volume index	0.385	8	59.006	14
Composite Leading Indicator EU (amplitude adjusted)	0.227	9	59.490	8	Ifo business climate wholesale trade (difference)	0.389	9	59.527	8
Money supply M1	0.228	10	57.172	18	Composite Leading Indicator EU (amplitude adjusted)	0.390	10	60.646	4
Ifo business expectations wholesale trade (difference)	0.215	2	62.614	1	Ifo business climate food, beverage and tobacco Saxony	0.394	11	64.373	1
Ifo export expectations manufacturing Saxony (difference)	0.207	1	61.607	2	Ifo export expectations manufacturing Saxony (difference)	0.373	3	63.024	2
Ifo business situation motor vehicles Saxony	0.217	3	61.317	3	Ifo business situation wholesale trade (difference)	0.370	2	62.599	3
Composite Leading Indicator EU (normalized)	0.220	4	60.884	4	Composite Leading Indicator EU (amplitude adjusted)	0.390	10	60.646	4
Ifo export expectations manufacturing Saxony	0.221	5	60.221	5	Composite Leading Indicator EU (normalized)	0.383	6	60.392	5
Money supply M2	0.230	11	59.542	6	Ifo business expect. consumer non-durables Saxony (difference)	0.424	43	60.228	6
Ifo business expectations mechanical engineering Saxony (difference)	0.226	8	59.505	7	Ifo business expect. mechanical engineering Saxony (difference)	0.420	36	59.617	7
Composite Leading Indicator EU (amplitude adjusted)	0.227	9	59.490	8	Ifo business climate wholesale trade (difference)	0.389	9	59.527	8
Money supply M3	0.230	13	58.916	9	Ifo business situation motor vehicles Saxony	0.360	1	59.505	9
M1 overnight deposits	0.245	39	58.528	10	Consumer Confidence Indicator	0.380	4	59.498	10

Note: This table reports the forecasting results for information set III and IV for $h = 0$ and $h = 1$ respectively. For each combination both the best ten models in terms of mean absolute forecasting error ($MAFE$) and the average percentage of models outperformed ($POUT$) are shown. The forecasting period ranges from 2002Q1 to 2013Q4 excluding the crisis period (2008Q1 to 2009Q4). The AR benchmark has an $MAFE$ of 0.251 and 0.463 respectively.

4. Conclusions

This paper extends the existing literature on regional economic forecasting by providing an extensive treatment of the nowcasting problem. More specifically, the paper answers the question of which monthly indicators (regional, national, international) provide valuable information about regional GDP growth during the current and the upcoming quarter. We consider a large data set consisting of 257 variables and running from 1998 to 2013. We focus on nowcasts for the Free State of Saxony since both quarterly GDP and many monthly indicators are available for this region. We find that regional survey indicators in particular are valuable for regional GDP nowcasts. Moreover, the information content of regional survey indicators is not outweighed when more and more information on hard indicators becomes available.

Since regional policymakers are increasingly interested in regional forecasts, the question arises as to which indicators play a crucial role in other German states. We presume that, as in the Saxon case, the regional economic structure in particular delivers hints for the selection of preferable indicators. While hard data are important sources for nowcasting regional GDP, business surveys in particular are valuable for the forecast and for detecting regional business cycle developments at an early stage. It thus appears useful to nowcast GDP in German states using indicator sets that do not only reproduce national patterns, but which are tailored to the regional characteristics. Moreover, the forecast may profit when regional survey indicators are available. The Ifo Institute provides those types of survey indicators not only for Saxony, but also for the Free State of Bavaria, North-Rhine Westphalia and Baden-Württemberg. Other sources of survey indicators are the surveys conducted by the Chambers of Industry and Commerce (IHK) or the Halle Institute for Economic Research (IWH).

Our study thus highlights the need for regional indicators, and it appears fruitful to further increase the availability of regional indicators. A major requirement for future research activities in this field are quarterly national accounts at the regional level. Besides the provision of regional accounts, indicators such as industrial production would also be highly useful.

Finally, this paper gives hints for future research activities for the national level. To the extent that nowcasting tools are able to improve forecasts for other regional entities, one might ask whether the aggregation of state-specific forecasts can improve the predictions for Germany as a whole. The answer to this intriguing question is, however, beyond the scope of this paper.

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A. Set of Indicators

Table A.1: Information on indicators

Indicator	Info I	Info II	Info III	Info IV	Transformation
Dependent Variable					
gross domestic product (GDP): total, Saxony	–	–	–	–	1
Macroeconomic Variables					
industrial production (IP): total (incl. construction)	0	1	2	3	1
IP construction: total	0	1	2	3	1
IP energy supply: total	0	1	2	3	1
IP manufacturing: mining and quarrying	0	1	2	3	1
IP manufacturing: total	0	1	2	3	1
IP manufacturing: capital goods	0	1	2	3	1
IP manufacturing: consumer durables	0	1	2	3	1
IP manufacturing: consumer non-durables	0	1	2	3	1
IP manufacturing: intermediate goods	0	1	2	3	1
IP manufacturing: consumer goods	0	1	2	3	1
IP manufacturing: chemicals	0	1	2	3	1
IP manufacturing: basic metals	0	1	2	3	1
IP manufacturing: mechanical engineering	0	1	2	3	1
IP manufacturing: motor vehicles, trailers	0	1	2	3	1
turnover (TO): mining and quarrying, domestic	0	1	2	3	1
TO: mining and quarrying, foreign	0	1	2	3	1
TO: manufacturing total, domestic	0	1	2	3	1
TO: manufacturing total, foreign	0	1	2	3	1
TO: capital goods, domestic	0	1	2	3	1
TO: capital goods, foreign	0	1	2	3	1
TO: consumer durables, domestic	0	1	2	3	1
TO: consumer durables, foreign	0	1	2	3	1
TO: consumer non-durables, domestic	0	1	2	3	1
TO: consumer non-durables, foreign	0	1	2	3	1
TO: intermediate goods, domestic	0	1	2	3	1
TO: intermediate goods, foreign	0	1	2	3	1
TO: consumer goods, domestic	0	1	2	3	1
TO: consumer goods, foreign	0	1	2	3	1
TO: comp., electr. and opt. prod., domestic	0	1	2	3	1
TO: comp., electr. and opt. prod., foreign	0	1	2	3	1
TO: chemicals, domestic	0	1	2	3	1
TO: chemicals, foreign	0	1	2	3	1
TO: mechanical engineering, domestic	0	1	2	3	1
TO: mechanical engineering, foreign	0	1	2	3	1
TO: motor vehicles, trailers etc., domestic	0	1	2	3	1
TO: motor vehicles, trailers etc., foreign	0	1	2	3	1
TO: energy, gas etc. supply, domestic	0	1	2	3	1
TO: energy, gas etc. supply, foreign	0	1	2	3	1
new orders (NO): manufacturing total	0	1	2	3	1
NO: manufacturing total, domestic	0	1	2	3	1
NO: manufacturing total, foreign	0	1	2	3	1
NO: capital goods	0	1	2	3	1
NO: capital goods, domestic	0	1	2	3	1
NO: capital goods, foreign	0	1	2	3	1
NO: consumer goods	0	1	2	3	1
NO: consumer goods, domestic	0	1	2	3	1
NO: consumer goods, foreign	0	1	2	3	1
NO: intermediate goods	0	1	2	3	1
NO: intermediate goods, domestic	0	1	2	3	1
NO: intermediate goods, foreign	0	1	2	3	1
NO: chemicals, domestic	0	1	2	3	1
NO: chemicals, foreign	0	1	2	3	1
NO: mechanical engineering, domestic	0	1	2	3	1
NO: mechanical engineering, foreign	0	1	2	3	1
NO: motor vehicles, trailers etc., domestic	0	1	2	3	1
NO: motor vehicles, trailers etc., foreign	0	1	2	3	1
NO: comp., electr. and opt. prod., domestic	0	1	2	3	1
NO: comp., electr. and opt. prod., foreign	0	1	2	3	1
wholesale trade (WT): total employment	0	1	2	3	1
retail sales (RS): total (excl. cars)	1	2	3	4	1
new registrations (NR): all vehicles	1	2	3	4	1
NR: cars	1	2	3	4	1
NR: heavy trucks	2	3	4	5	1
exports: volume index, basis 2005	0	1	2	3	1
imports: volume index, basis 2005	0	1	2	3	1
unemployed persons (UNP): total, % of civilian labor	2	3	4	5	2
employed persons (EMPL): residence concept, total	1	2	3	4	1

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Table A.1: Information on indicators – continued

Indicator	Info I	Info II	Info III	Info IV	Transformation
EMPL: work-place concept, total	1	2	3	4	1
vacancies: total	2	3	4	5	1
Finance					
discount rate - short term euro repo rate	2	3	4	5	2
long term government bond yield, 9-10 years	2	3	4	5	2
yields on fully taxed bonds outst. (YFTBO): public	2	3	4	5	2
YFTBO: corporate bonds	2	3	4	5	2
yields listed fed. bonds outst. mat. (YLFBOM): 3-5 y.	2	3	4	5	2
yields listed fed. bonds outst. mat. (YLFBOM): 5-8 y.	2	3	4	5	2
corporate - treasury bond	2	3	4	5	0
german price compet.: 23 industr. Countr., basis: cpi	1	2	3	4	1
DAX share price index	2	3	4	5	1
nominal effective exchange rate	2	3	4	5	1
M1, overnight deposits	1	2	3	4	1
M2, money supply	1	2	3	4	1
M3, money supply	1	2	3	4	1
EM money supply: M1, ep	1	2	3	4	1
EM money supply: M1, flows	1	2	3	4	0
bank lending to domestic non-banks, short term	0	1	2	3	1
bank lending to enterprises and individuals, short term	0	1	2	3	1
time deposits of domestic enterprises	0	1	2	3	1
saving deposits of domestic enterprises	0	1	2	3	1
Prices					
consumer price index	2	3	4	5	1
consumer price index (excl. energy)	1	2	3	4	1
HWWI index world market prices: eurozone, energy	1	2	3	4	1
HWWI index world market prices: eurozone, excl. energy	1	2	3	4	1
oil prices, euro per barrel	2	3	4	5	1
brent oil price, UK average	2	3	4	5	1
London gold price, per US $	2	3	4	5	1
import price index	1	2	3	4	1
export price index	1	2	3	4	1
wholesale trade price index, 1975=100	1	2	3	4	1
producer price index	1	2	3	4	1
Surveys					
ZEW: present economic situation	2	3	4	5	0
ZEW: economic sentiment indicator	2	3	4	5	0
ifo: business climate industry and trade	2	3	4	5	0
ifo: business expectations industry and trade	2	3	4	5	0
ifo: assessm. of business situation industry and trade	2	3	4	5	0
ifo: business climate manufacturing	2	3	4	5	0
ifo: business expectations manufacturing	2	3	4	5	0
ifo: assessm. of business sit. manufacturing	2	3	4	5	0
ifo: export expectations next 3 months manufacturing	2	3	4	5	0
ifo: orders on hand manufacturing	2	3	4	5	0
ifo: foreign orders on hand manufacturing	2	3	4	5	0
ifo: inventory of finished goods manufacturing	2	3	4	5	0
ifo: business climate capital goods	2	3	4	5	0
ifo: production expectations capital goods	2	3	4	5	0
ifo: assessment of business situation capital goods	2	3	4	5	0
ifo: business climate consumer durables	2	3	4	5	0
ifo: production expectations consumer durables	2	3	4	5	0
ifo: assessment of business situation consumer durables	2	3	4	5	0
ifo: business climate consumer non-durables	2	3	4	5	0
ifo: production expectations consumer non-durables	2	3	4	5	0
ifo: assessm. of business sit. consumer non-durables	2	3	4	5	0
ifo: business climate intermediate goods	2	3	4	5	0
ifo: production expectations intermediate goods	2	3	4	5	0
ifo: assessm. of business sit. intermediate goods	2	3	4	5	0
ifo: business climate consumer goods	2	3	4	5	0
ifo: business expectations consumer goods	2	3	4	5	0
ifo: assessment of business situation consumer goods	2	3	4	5	0
ifo: business climate construction	2	3	4	5	0
ifo: business expectations construction	2	3	4	5	0
ifo: assessment of business situation construction	2	3	4	5	0
ifo: orders on hand construction	2	3	4	5	0
ifo business climate wholesale trade	2	3	4	5	0
ifo: business expectations wholesale trade	2	3	4	5	0
ifo: assessm. of business sit. wholesale trade	2	3	4	5	0
ifo: assessment of inventories wholesale trade	2	3	4	5	0
ifo: expect. with regard to order activ. next 3 months WT	2	3	4	5	0
ifo business climate retail sales	2	3	4	5	0
ifo: business expectations retail sales	2	3	4	5	0
ifo: assessment of inventories retail sales	2	3	4	5	0

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Table A.1: Information on indicators – continued

Indicator	Info I	Info II	Info III	Info IV	Transformation
ifo: expect. with regard to order activ. next 3 months RS	2	3	4	5	0
EU cons. surv. (EUCS): unempl. expect. next 12 m.	2	3	4	5	0
EUCS: statement on financial situation	2	3	4	5	0
EUCS: consumer confidence indicator	2	3	4	5	0
EUCS: economic sentiment indicator	2	3	4	5	0
EU busin. surv. (EUBS): product. trends month, ind.	2	3	4	5	0
EUBS: assessment of order-book levels, industry	2	3	4	5	0
EUBS: assessment of export order-books level, industry	2	3	4	5	0
EUBS: assessment of stocks of finished products, industry	2	3	4	5	0
EUBS: production expect. for the month ahead, industry	2	3	4	5	0
EUBS: selling price expect. for the month ahead, industry	2	3	4	5	0
EUBS: employment expect. for the month ahead, industry	2	3	4	5	2
EUBS: industrial confidence indicator	2	3	4	5	0
EUBS: service sector confidence indicator	2	3	4	5	2
EUBS: retail trade confidence indicator	2	3	4	5	2
EUBS: construction confidence indicator	2	3	4	5	2
International					
Belgium business indicator survey, whole economy	2	3	4	5	0
Belgium business indicator survey, manufacturing	2	3	4	5	0
EUCS: economic sentiment indicator, France	2	3	4	5	0
EUCS: economic sentiment indicator, Spain	2	3	4	5	2
EUCS: economic sentiment indicator, Poland	2	3	4	5	2
EUCS: economic sentiment indicator, Czech Republic	2	3	4	5	0
EUCS: economic sentiment indicator, Italy	2	3	4	5	0
EUCS: economic sentiment indicator, United Kingdom	2	3	4	5	0
IP: United States, total	1	2	3	4	1
OECD Comp. Lead. Ind. (CLI): OECD, ampl. adj.	0	1	2	3	0
CLI: OECD, trend restored	0	1	2	3	1
CLI: OECD, normalised	0	1	2	3	1
CLI: Asia, amplitude adjusted	0	1	2	3	0
CLI: Asia, trend restored	0	1	2	3	0
CLI: Asia, normalised	0	1	2	3	1
CLI: China, amplitude adjusted	0	1	2	3	0
CLI: China, trend restored	0	1	2	3	1
CLI: China, normalised	0	1	2	3	0
CLI: Euro Area, amplitude adjusted	0	1	2	3	0
CLI: Euro Area, trend restored	0	1	2	3	1
CLI: Euro Area, normalised	0	1	2	3	0
CLI: United States, amplitude adjusted	0	1	2	3	0
CLI: United States, trend restored	0	1	2	3	1
CLI: United States, normalised	0	1	2	3	0
Euro-Coin real time estimates	2	3	4	5	0
Regional – Free State of Saxony					
ifo business climate industry and trade Saxony	2	3	4	5	0
ifo: business expectations industry and trade Saxony	2	3	4	5	0
ifo: assessm. of busin. sit. industry and trade Saxony	2	3	4	5	0
ifo: business climate manufacturing Saxony	2	3	4	5	0
ifo: business expectations manufacturing Saxony	2	3	4	5	0
ifo: assessment of business situation manufacturing Saxony	2	3	4	5	0
ifo: employment expectations manufacturing Saxony	2	3	4	5	0
ifo: export expectations manufacturing Saxony	2	3	4	5	0
ifo: business climate intermediate goods Saxony	2	3	4	5	0
ifo: business expectations intermediate goods Saxony	2	3	4	5	0
ifo: assess. of busin. sit. intermediate goods Saxony	2	3	4	5	0
ifo: employment expectations intermediate goods Saxony	2	3	4	5	0
ifo: business climate capital goods Saxony	2	3	4	5	0
ifo: business expectations capital goods Saxony	2	3	4	5	0
ifo: assessment of busin. sit. capital goods Saxony	2	3	4	5	0
ifo: employment expectations capital goods Saxony	2	3	4	5	0
ifo: business climate consumer non-durables Saxony	2	3	4	5	0
ifo: business expect. cons. non-durables Saxony	2	3	4	5	0
ifo: assessm. of business sit. cons. non-durables Saxony	2	3	4	5	0
ifo: employment expect. cons. non-durables Saxony	2	3	4	5	0
ifo: business climate consumer goods Saxony	2	3	4	5	0
ifo: business expectations consumer goods Saxony	2	3	4	5	0
ifo: assessment of business situation consumer goods Saxony	2	3	4	5	0
ifo: employment expectations consumer goods Saxony	2	3	4	5	0
ifo: business climate food, beverage and tobacco Saxony	2	3	4	5	0
ifo: business expectations food, beverage and tobacco Saxony	2	3	4	5	0
ifo: assessment of business situation FBT Saxony	2	3	4	5	0
ifo: employm. Expect. food, beverage and tobacco Saxony	2	3	4	5	0
ifo: business climate chemicals Saxony	2	3	4	5	0
ifo: business expectations chemicals Saxony	2	3	4	5	0
ifo: assessment of business situation chemicals Saxony	2	3	4	5	0
ifo: employment expectations chemicals Saxony	2	3	4	5	0

Continued on next page...

Table A.1: Information on indicators – continued

Indicator	Info I	Info II	Info III	Info IV	Transformation
ifo: business climate mechanical engineering Saxony	2	3	4	5	0
ifo: business expectations mechanical engineering Saxony	2	3	4	5	0
ifo: assessment of busin. sit. mechanical engineering Saxony	2	3	4	5	0
ifo: employment expectations mechanical engineering Saxony	2	3	4	5	0
ifo: business climate motor vehicles Saxony	2	3	4	5	0
ifo: business expectations motor vehicles Saxony	2	3	4	5	0
ifo: assessment of business sit. motor vehicles Saxony	2	3	4	5	0
ifo: employment expectations motor vehicles Saxony	2	3	4	5	0
ifo: business climate construction Saxony	2	3	4	5	0
ifo: business expectations construction Saxony	2	3	4	5	0
ifo: assessment of business situation construction Saxony	2	3	4	5	0
ifo: employm. Expect. over next 3 months construct. Saxony	2	3	4	5	0
ifo: business climate building engineering Saxony	2	3	4	5	0
ifo: business expectations building engineering Saxony	2	3	4	5	0
ifo: assessment of busin. sit. building engineering Saxony	2	3	4	5	0
ifo: business climate civil engineering Saxony	2	3	4	5	0
ifo: business expectations civil engineering Saxony	2	3	4	5	0
ifo: assessment of busin. sit. civil engineering Saxony	2	3	4	5	0
ifo business climate wholesale trade Saxony	2	3	4	5	0
ifo: business expectations wholesale trade Saxony	2	3	4	5	0
ifo: assessment of business situation wholesale trade Saxony	2	3	4	5	0
ifo: employm. expect. over next 3 months WT Saxony	2	3	4	5	0
ifo business climate retail sales Saxony	2	3	4	5	0
ifo: business expectations retail sales Saxony	2	3	4	5	0
ifo: assessment of business situation retail sales Saxony	2	3	4	5	0
ifo: employm. expectat. over next 3 months RS Saxony	2	3	4	5	0
NO: manufacturing Saxony, total	0	1	2	3	1
housing construction (HC): new orders Saxony	0	1	2	3	1
HC: working hours Saxony	0	1	2	3	1
HC: turn over Saxony	0	1	2	3	1
industry construction (IC): new orders Saxony	0	1	2	3	1
IC: working hours Saxony	0	1	2	3	1
IC: turn over Saxony	0	1	2	3	1
public construction (PC): new orders Saxony	0	1	2	3	1
PC: working hours Saxony	0	1	2	3	1
PC: turn over Saxony	0	1	2	3	1
construction: new orders Saxony	0	1	2	3	1
construction: working hours Saxony	0	1	2	3	1
construction: firms Saxony	0	1	2	3	1
construction: employed people Saxony	0	1	2	3	1
construction: fees Saxony	0	1	2	3	1
ifo: capacity utilization construction, Saxony	2	3	4	5	2
ifo: orders on hand construction, Saxony	2	3	4	5	0
consumer price index, Saxony	1	2	3	4	1
exports: value, Saxony	0	1	2	3	1
imports: value, Saxony	0	1	2	3	1

For each information set, this table shows the number of months observed during the current and the following quarter. *Note on the transformation:* 0 = levels; 1 = mom growth rate; 2 = first difference. For GDPSAX, quarter-on-quarter growth rates are applied. *Source:* Own investigations and calculations.