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Economic Sentiment: Disentangling Private Information from Public Knowledge*

Abstract

This paper addresses a general problem with the use of surveys as source of information about the state of an economy: Answers to surveys are highly dependent on information that is publicly available, while only additional information that is not already publicly known has the potential to improve a professional forecast. We propose a simple procedure to disentangle the private information of agents from knowledge that is already publicly known for surveys that ask for general as well as for private prospects. Our results reveal the potential of our proposed technique for the usage of European Commissions' consumer surveys for economic forecasting for Germany.

Keywords: consumer confidence, private information, public information, survey data

JEL classification: C83, D12, D82, E37

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1 Introduction

Surveys on private agents' economic sentiment (or assessments of economic conditions) are important tools for economic forecasting and in particular for nowcasting. Compared to other macroeconomic series they are promptly available and they aggregate a lot of private information that is otherwise so dispersed that it is not available to forecasters. A major problem with surveys, however, is that the economic assessment of agents is based both on private information (stemming from their own close economic environment) and on information that is, in principle, publicly available. In general professional forecasters have much better access to public information than ordinary agents such as private households, and therefore, these agents cannot add anything valuable concerning publicly available information to what is already known by professional forecasters. If this is true, surveys would be a more valuable source of information if the aggregate of private information that affects the survey results could be separated from information agents get from publicly available sources.

Although consumer surveys are widely used by forecasters, the literature is still inconclusive concerning the extent of valuable private knowledge about the general state of the economy scattered among the multitude of agents, and if this knowledge influences the answers to survey questions. Golinelli and Parigi (2004) have shown that the long-run relationship between consumer sentiment and output differs across countries and over time. An important contribution in support of the informative content of surveys is given by Barsky and Sims (2012). Their paper shows that consumer confidence in the US, based on results of the Michigan consumer survey, conveys incremental information about economic activity quite far into the future.[1]

The theoretical part of our paper is inspired by the literature, following the seminal papers of Morris and Shin (1998, 2004), on the interplay between private and public information in coordinating economic activity. Most of the contributions in this field (such as Lindner, 2006, 2009), however, deal with the question of how public information should be managed by an official agency such as a central bank, while this paper focuses on extracting private information from surveys. The contribution with a model setup most similar to ours is Driver, Trapani, and Urga (2013). They show that survey-based forecasts can be improved by taking into account cross-sectional measures for uncertainty (such as disagreement) among survey participants. A particular application of the interplay between public and private information is the analysis of strategic behaviour of professional forecasters, pioneered by Trueman (1994). Ottaviani and Sorensen (2006) show that, from a theoretical perspective, professional forecasts are imprecise in equilibrium if forecasters have the objective to maximize their own reputation for competence. According to their results precise forecasts will not be regarded as honest, since forecasters always have the incentive to give the impression that their best forecast equals their own private information – while actually it is a combination of their private and the publicly available information. According to Roth and Wohlfart (2020), agents update their expectations about

[1] Dovern (2015) shows that disagreement among professional forecasters is particularly high concerning the long run, either because of different private information or because forecasters differ in their priors on long run developments.

their personal economic circumstances in response to information about professional forecasts of the economy.

This paper focuses on how forecasters can get most from surveys when participants form their expectations on the basis of both public and private information. To our knowledge, we are the first to utilize the divergence between the agents' assessment of their own economic prospects and their assessments on the general prospects. It is shown that, assuming a simple information structure, the weight agents give to their private information is higher for their assessment of the own prospects than for their assessment of the general prospects of the economy, and that disentangling the two sources of information is therefore straightforward: the indicator representing private information is a linear function of the difference between the assessment of the agents' own economic prospects and the assessment of the general prospects. Using the European Commission (EC) survey on consumer sentiment we are able to assess the forecasting ability of private and public information for the case of Germany. It is shown for Germany that our proposed method provides better forecasts than the direct use of the standard survey answers. These results are interesting for a broader audience beyond macroeconomic forecasters: on the one hand side, the set of macroeconomic information is not complete without the aggregation of 'all the knowledge which ought to be used but which is initially dispersed among many different individuals' (Hayek, 1945). On the other hand, however, simply averaging individual assessments concerning the economy does not aggregate the information efficiently, because in this way private knowledge tends to be superseded by publicly available knowledge.

Section 2 shows in a theoretical framework how the two types of information can be disentangled. Section 3 applies the basic model to the case of the EC's survey of professional forecasters. The forecasting performance is executed in Section 4. Section 5 concludes.

2 Optimal forecasting with survey data: a simple theoretical approach

The arguments presented in the introduction are rather general, and they are based on the assumption that the participants of surveys are capable to use the information they get with rationality. As a formal representation of these arguments, in this section it is shown that, for a highly stylized information structure, the weight rational agents give to their private information is higher for their assessment of their own economic prospects than for their assessment of the general economic prospects of the economy, and that the two sources of information can simply be disentangled by calculating the difference between the two assessments.

Consider an economy that consists of a large number of private agents receiving public as well as private signals about the state of the economy, measured by income per capita, y. The public signal $\tilde{y}$ about the state of the economy is noisy:[2]

$$\tilde{y} = y + \eta \tag{1}$$

with the variance of this signal equal to that of the noise term η, σ_η^2. This public information might be about, for example, policy measures or about developments abroad that will influence the state of the economy. We define the precision of this signal as the inverse of its variance $p_{\tilde{y}}(y) = 1/\sigma_\eta^2$.

Personal income of the representative agent i, y_i, equals economic output per capita y plus an idiosyncratic shock to her own income ρ_i that is a normally distributed random variable with zero mean and variance σ_ρ^2 (because for simplicity we assume that all the idiosyncratic income shocks have the same variance, $\sigma_{\rho_i}^2 = \sigma_\rho^2$): $y_i = y + \rho_i$. The agent does not observe ρ_i. Instead she gets a noisy private signal about her future personal income. The noise term ϵ (with variance σ_ϵ^2) is the same for all agents, blurring economic prospects for everyone in the same way.[3] Thus, the private signal $\tilde{y_i}$ the agent gets concerning her own economic state is:

$$\tilde{y_i} = y + \rho_i + \epsilon = y_i + \epsilon \tag{2}$$

The precision of this signal $p_{\tilde{y_i}}(y_i)$ is again defined as the inverse of its variance $p_{\tilde{y_i}}(y_i) = 1/\sigma_\epsilon^2$.

Moreover, agents can utilize this private signal on their own future income for an assessment of the overall economic state, as they can use the public signal on the latter for their assessment on their own economic prospects. Given only $\tilde{y}$, this would also be agent i's best estimate for y_i, with the precision of this signal being $p_{\tilde{y}}(y_i) = 1/(\sigma_\eta^2 + \sigma_\rho^2)$, and given only $\tilde{y_i}$, this would be her best estimate for y, with the precision of this signal being $p_{\tilde{y_i}}(y) = 1/(\sigma_\epsilon^2 + \sigma_\rho^2)$. Thus the precision of the private information $\tilde{y_i}$ for forecasting the average future income is lower than if used for forecasting the own future income of agent i.

The optimal forecasts of agent i for the general as well as for her individual income are the weighted sums of her private signal on her own income and of the public signal about the overall state of the economy; the weighting factors are, according to Bayes' rule, the fractions between the precision of the respective signal and the precision of the optimal forecast, with the latter

[2] In the following, variables with a ˜ are signals; random variables (in Greek letters) are assumed to be normally distributed with an expected value of 0. The covariances between these random variables are also assumed to be 0.

[3] The reason for this assumption is the following: if the noise terms of private signals were not correlated among agents, simply taking the average of all private signals would yield, by the law of large numbers, the true income per capita in the economy. There are strong arguments why such a situation is not realistic: private information comes mostly from sources that are close to economic agents. It is plausible that all this private information suffers from the same shortfall of missing national or global news. The most simple way to build this argument into the model is by assuming that all private signals have a common noise term.

precision being simply equal to the sum of the two single precisions[4]. Thus agent i's forecast for the overall state of the economy is:

$$\mathrm{E}_i[y] = \frac{p_{\tilde{y}}(y)\tilde{y} + p_{\tilde{y}_i}(y)\tilde{y}_i}{p_{\tilde{y}}(y) + p_{\tilde{y}_i}(y)} = \frac{\frac{1}{\sigma_\eta^2}\tilde{y} + \frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}\tilde{y}_i}{\frac{1}{\sigma_\eta^2} + \frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}} \tag{3}$$

Agent i's forecast for her own income is:

$$\mathrm{E}_i[y_i] = \frac{p_{\tilde{y}_i}(y_i)\tilde{y}_i + p_{\tilde{y}}(y_i)\tilde{y}}{p_{\tilde{y}_i}(y_i) + p_{\tilde{y}}(y_i)} = \frac{\frac{1}{\sigma_\epsilon^2}\tilde{y}_i + \frac{1}{\sigma_\eta^2+\sigma_\rho^2}\tilde{y}}{\frac{1}{\sigma_\epsilon^2} + \frac{1}{\sigma_\eta^2+\sigma_\rho^2}} \tag{4}$$

Using basic transformations it is easy to show that the difference between agent i's forecast of her own income and her forecast of the average income per capita in the economy is a simple linear function of her private and of the public signal, $\mathrm{E}_i[y_i] - \mathrm{E}_i[y] = A(\tilde{y}_i - \tilde{y})$, with $A = \sigma_\rho^2/(\sigma_\epsilon^2 + \sigma_\eta^2 + \sigma_\rho^2)$ and $0 < A < 1$. Intuitively, the larger the variance of the unobserved idiosyncratic shock ρ_i to the agent's economic state compared to the noise terms ϵ and η, the larger is the difference between the expected own income and the expected general income for any difference between the two signals the agent observes. Because ρ_i is unobserved, it makes private information less useful for assessing the general situation and public information less useful for assessing the private prospects.

Put differently, the private signal agent i receives is a linearly increasing function of the difference between her assessment of her own economic prospects and her assessment of the general economic prospects:

$$\tilde{y}_i = (\mathrm{E}_i[y_i] - \mathrm{E}_i[y])/A + \tilde{y} \tag{5}$$

Now we assume that a forecaster does a survey asking each agent for her expectations about her own and about the general average income, $\mathrm{E}_i[y_i]$ and $\mathrm{E}_i[y]$, and that each agent reveals her expectations correctly. The forecaster is able to calculate the private signal $\tilde{y}_i$ from eq. 13 if, as it is assumed here, the properties of the distribution functions of ρ, ϵ, and η are known. Furthermore, if the forecaster takes the average of all the single private signals $\tilde{y}_i$, $\bar{y}$, the idiosyncratic shocks ρ disappear: $\bar{y} = y + \epsilon$. The best forecast for the future average income $\mathrm{E}_f[y]$ is then a weighted average of the signal extracted from the survey and the public signal:[5]

[4] This result, shown by eq. 3 and 4, comes from the fact that the vectors $(y, \tilde{y}_i)$ and $(y_i, \tilde{y})$ have a multivariate normal distribution, see Lahiri and Sheng (2008) for an application in a model of forecaster behaviour. The vector of the corresponding means and the variance-covariance matrix of such a vector are given, for example, by Lütkepohl (2006, p. 677/678.)

[5] For simplicity, and unlike, for example, Clements (2018), we assume that the forecaster does not have private information.

$$\mathrm{E}_f[y] = \frac{\frac{1}{\sigma_\epsilon^2}\bar{y} + \frac{1}{\sigma_\eta^2}\tilde{y}}{\frac{1}{\sigma_\epsilon^2} + \frac{1}{\sigma_\eta^2}} \tag{6}$$

Broadly speaking, the central result of this section is that, in the theoretical setting presented here, the best way of utilizing a survey described above for forecasting the economy is to look at the differences between the agents' expectations concerning their private prospects and concerning the general economic prospects. If the forecast were based, for example, on some convex combination of the averages of $\mathrm{E}_i[y_i]$ and $\mathrm{E}_i[y]$ and of $\tilde{y}$, private information $\tilde{y}_i$ would not get enough weight since agents, in forming their expectations, take not only private, but public information as well into account, and thus the signal the forecaster gets from the survey is unnecessarily blurred.

The model presented above is static, but it is a concise representation of a dynamic model where y follows a random walk $y_t = y_{t-1} + \eta_t$ and between periods $t-1$ and t the following happens: the realization of y_{t-1} becomes public knowledge and can be used as a signal $\tilde{y}_t$ for y_t, each agent i gets a private signal $\tilde{y}_{it} = y_t + \rho_{it} + \epsilon_t$, and each agent i does a forecast on y_t and y_{it}; the professional forecaster can then utilize the average forecasts of the agents in addition to the commonly know y_{t-1} for her own prediction of y_t in exactly the same way as it was described for y in the static case.

To test whether empirical findings support our theoretical approach the paper examines assessments of private households according to the Economic Sentiment survey by the European Commission.

3 An Application to the EU Economic Sentiment Indicator

3.1 The Business and Consumer Surveys of the European Commission

The Directorate General for Economic and Financial Affairs of the European Commission has been conducting for many years harmonised business and consumer surveys in all member states of the European Union (EU) and in the applicant countries.[6] These surveys are frequently used as sources for nowcasting and short-term forecasting, since they provide information on very recent developments, as their frequency is monthly with the results being published as early as at the end of the month the surveys are conducted in. The surveys are conducted among representatives in the so-called "sectors" industry (this is manufacturing), services, financial services, retail trade, construction and consumers. Econometric analysis benefits from the relatively large number of participants.[7] The number of questions in each sector survey varies

[6] For more details on the Economic Sentiment Indicator see European Commission (2006) and European Commission (2017).

[7] For instance in Germany, the survey comprises about 3800 firms in industry, 3900 in services, 1000 in retail trade and construction, respectively. In the consumer survey about 2000 people are asked.

between 6 (for construction and for retail trade firms) and 12 (for consumers). Consumers, for example, are asked: "how do you expect the general economic situation in this country to develop over the next 12 months? It will.. a) get a lot better b) get a little better c) stay the same d) get a little worse e) get a lot worse f) don't know." Based on the different intensities, the following simple weighting scheme is applied by the EC for the overall balance of all panelists: $B = (\texttt{Number}(a) + \texttt{Number}(b)/2 - \texttt{Number}(d)/2 - \texttt{Number}(e))/\texttt{Total Number}$.

The resulting time series are seasonally adjusted and then aggregated to composite indicators of confidence in each of the single "sectors". The aggregation scheme is simply the arithmetic average of the balances of answers to specific questions chosen from the full set of questions in each individual survey. The selection of questions is guided by the aim to maximize the coincident correlation of the confidence indicator with a reference series. In the case of consumers this is the real expenditure of private households. The composite indicator of consumer confidence is constructed with the following four out of twelve questions of the EC consumer survey:

q2 How do you expect the financial position of your household to change over the next 12 months?

q4 How do you expect the general economic situation in this country to develop over the next 12 months?

q7 How do you expect the number of people unemployed in this country to change over the next 12 months?[8]

q11 Over the next 12 months, how likely is it that you save any money?

Based on the answers from the "sectors", the Commission calculates an overall Economic Sentiment Indicator (ESI) that consists of the 15 individual components of the single confidence indicators.[9]. The suitability of the Commission's Economic Sentiment Indicator for monitoring the economy has frequently been tested. A general result is that it is useful for nowcasting (Mourougane and Roma, 2003; Gayer, 2005; Drechsel and Scheufele, 2012), but less so for forecasting economic activity (or consumption spending) in future quarters (Gelper and Croux, 2010; for Germany see Hüfner and Schröder, 2002). Moreover, the performance in nowcasting can be improved by applying more sophisticated methods for the selection or weighting of indicators (Gelper and Croux, 2010; Dreger and Kholodinin, 2010).

The use of data driven procedures, however, risks losing sight of economic relations that a forecaster might be able to exploit. Such a relation can be found between the question concerning the expectations regarding the consumer's own financial situation (q2) and concerning the general economic situation (q4). If answers differ markedly, the reason might be found in differences between information stemming from private sources and publicly available information.

[8] The balance on this question enters the composite indicator with inverted sign.

[9] With 40% weight for industry components, 30% for services, 20% for consumers, 5% for construction and 5% for retail trade

Section 2 has shown that utilizing this difference might make the survey even more valuable for forecasting purposes.

3.2 Adapting the Model to the Consumer Survey

In the following we aim to show that a GDP forecast that includes private information inferred from the sentiment survey of the European Commission outperforms alternative specifications. The theoretical justification basically comes from the model of section 2. The answers households give to question 2 of the survey correspond to the agents' assessment of their own income according to equation 4, the answers to question 4 correspond to the agents' assessment of the overall state of the economy according to equation 3. The private information shall be captured by the difference between the indicator derived from question 2 and the indicator from question 4.

It might be asked whether the model dealing with quantitative assessments of agents also holds for a survey that consists of qualitative questions. It is, however, easy to show that the results derived in section 2 basically hold if agents are not asked to give cardinal numbers as indicators for their expectations, but are asked if their own and the general average income will exceed certain thresholds y_0 and y_{i0}. In such a case the forecaster can infer the agents' average cardinal expectations from the balance between positive and negative answers.[10] Because many agents are being asked, the share of agents that report that their expectation for y is lower than y_0 equals the probability that a single agent gets a private signal low enough that $\mathrm{E}_i[y] \leq y_0$ holds. From eq.3 we see that this is the case if the following holds:

$$\tilde{y_i} \leq \frac{\frac{1}{\sigma_\eta^2} + \frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}}{\frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}} y_0 - \frac{\sigma_\epsilon^2 + \sigma_\rho^2}{\sigma_\eta^2} \tilde{y} \tag{7}$$

The forecaster knows that $\tilde{y_i}$ is normally distributed with mean $\bar{y}$ and variance σ_ρ^2. Thus, the share of agents reporting that in their opinion the threshold will not be reached equals the probability:

$$P[E_i[y] \leq y_0] = N(\tilde{y_i} = \frac{\frac{1}{\sigma_\eta^2} + \frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}}{\frac{1}{\sigma_\epsilon^2+\sigma_\rho^2}} y_0 - \frac{\sigma_\epsilon^2 + \sigma_\rho^2}{\sigma_\eta^2} \tilde{y}; \mu = \bar{y}; \sigma^2 = \sigma_\rho^2) \tag{8}$$

With this equation the forecaster can infer the average private information $\bar{y}$ from the share of negative answers to the survey.

There is a more serious objection against the identification of $E_i[y]$ and $E_i[y_i]$ with the indicators derived from question 2 and 4: while it seems reasonable to identify the expectations

[10] Driver and Urga (2004) show empirically that taking the balance works quite well for transforming qualitative survey data into quantitative forecasts.

on the development of the general economic situation with expectations about GDP growth, expectations on the development of the own financial position might comprise more than expectations about personal income; in particular, expectations about the change in the net wealth of the household should be relevant as well. In order to take this into account, we reformulate the model of section 2 as follows:

While equations 1 and 3, relating to the general economic situation and its assessment by agent i still apply, the representative household i now understands her own financial position f_i as a weighted average of own income y_i and own net wealth w_i (with $0 < \alpha < 1$). Equation 2 is therefore replaced by:

$$f_i = \alpha y_i + (1 - \alpha) w_i \tag{9}$$

Net wealth is positively correlated with income, because assets are more valuable if the economy is in better shape, but it depends also on additional factors, subsumed by the random variable δ_i, which is normally distributed with an expected value of 0 and a variance of σ_δ^2:

$$w_i = y_i + \beta \delta_i \tag{10}$$

The household receives a signal $\tilde{y_i}$ on her income (see eq. 2) and and another signal on her net wealth w_i:[11]

$$\tilde{w_i} = y_i + \beta \delta_i + \mu_i \tag{11}$$

with the noise term μ_i as a normally distributed random variable with mean 0 and variance σ_{μ_i}. Agent i's forecast for her own financial position (replacing equation 4) is:

$$\mathrm{E}_i[f_i] = \frac{\frac{1}{\sigma_\epsilon^2}\tilde{y_i} + \frac{1}{\sigma_\eta^2 + \sigma_\rho^2}\tilde{y}}{\frac{1}{\sigma_\epsilon^2} + \frac{1}{\sigma_\eta^2 + \sigma_\rho^2}} + (1 - \alpha)(y_i + \beta \delta_i + \mu_i) \tag{12}$$

The difference between agent i's forecast of her own financial position (equation 12) and her forecast of the general state of the economy (equation 3) is no longer only a function of her private and of the public signal. The private signal agent i receives on her own income now becomes:

$$\tilde{y_i} = \frac{\mathrm{E}_i[y_i] - \mathrm{E}_i[y] - (1 - \alpha)(y_i + \beta \delta_i + \mu_i)}{A} + \tilde{y} \tag{13}$$

[11] For ease of exposition, we assume that there is no public information on net wealth in the economy.

In general the forecaster is not able to reconstruct the private information of agents from the difference between their assessments of the general state and their assessment of their own financial situation, even if the shocks on the net wealth of the single agents i, δ_i, and the private noise terms μ_i vanish through aggregation over all agents, because the private signals for income y_i are not publicly known. It is therefore to be expected that the difference measure is a potent forecasting tool if agents regard income as almost the only factor for their financial situation ($\alpha < 1$ but ≈ 1), but is less useful if they see net wealth as also or even more important (for α that is clearly smaller than 1). We will come back to this point when results of a forecasting exercise will be discussed.

4 Forecasting Analysis

This section investigates empirically whether a GDP forecast that includes private information inferred from the sentiment survey of the European Commission can outperform alternative specifications. This private information shall be captured by the difference between the results about the own financial position (q2) and about the general economic situation (q4). We do not try to estimate the complete model presented above in all details, including the variances of the noise terms η, ρ and ϵ and, based on these estimates, the non-linear relation between survey results and private information about the general economy deriving from eq.(8). Instead it is asked whether the general result of section 2 holds empirically: if agents form expectations about their private prospects, they weight their private information relative to public knowledge more heavily than if they form expectations on the general prospects. Therefore, a more positive result of the survey concerning prospects for the agents' own economic situation than those concerning the general situation means that private information points to more favourable general prospects than public information does. This theoretical claim has the following implications that will be tested empirically: first, forecast equations on the basis of public knowledge can be improved by adding, as a leading indicator, the difference between the indicator for the households' expectations about the private state and the indicator concerning the public state (called diff-measure in the following); second, the coefficient of the diff-measure in the forecasting equation should be positive; and third, the diff-measure improves the performance of the forecasting equation more than each of the single consumer indicators do.

Focusing on quarterly calender and seasonally adjusted German GDP data for which the Commission's survey has been well established for many years our sample covers the period 1995–2019.Using the EC's consumer survey, the two time series that are derived from questions q2 and q4 (cited above) are considered. Taking different volatilities of the time series stemming from different survey questions into account, we standardize them by mean and variance. Furthermore, monthly indicators have to be converted to the quarterly frequency of GDP. In this paper, we use the average monthly value to represent the quarterly value.[12] Based on the two

[12] As an alternative to this approach, monthly survey information can be directly employed to forecast GDP growth using a MIDAS approach (Ghysels, Sinko, and Valkanov, 2007).

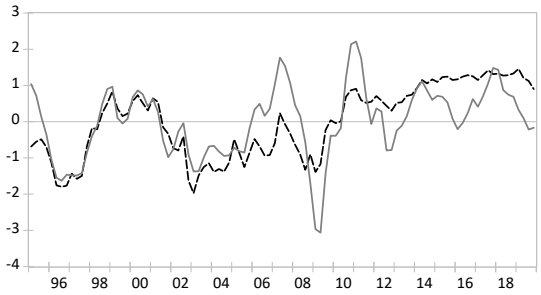
normalized time series q2 and q4 derived from the answers to the respective questions, we define their difference as a measure for private information of the households:

$$\text{diff} = q2 - q4 \tag{14}$$

4.1 Descriptive Statistics

In a first step, we look at the normalized answers of the EU consumer survey questions on expectations regarding the own economic status and on the general economy (Figure 1). Expectations on the own economic status are less cyclical than on the general economic development. The correlation between expectations regarding the own economic status and on the general economy is high for the time before the mid noughties.

Figure 1: Expectations regarding own and general economic situation

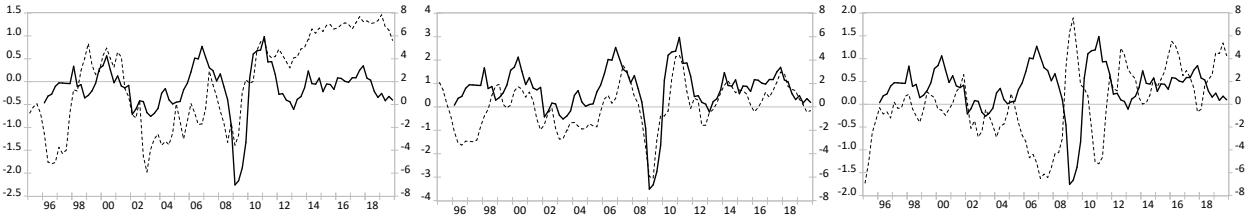


Note: The black dashed line refers to expectations regarding own economic status (q2), the grey line to expectations regarding general economy (q4) for Germany in the EC consumer survey.

Comparing both consumer survey answers with GDP growth (see Figure 2), we find a clear contemporaneous relationship, in particular for q4. While annual GDP growth is negatively correlated with the contemporaneous diff-measure, it is positively correlated with the diff-measure lagged by a few quarters. The maximum correlation is reached for the diff-measure lagged by 6 quarters.

Figure 2: Survey data and GDP growth

(a) Germany q2 (b) Germany q4 (c) Germany diff



Note: The dotted line refers to the standardised survey questions (q2, q4) or the difference between private and public information in period t, left axis; and the solid line to GDP growth (yoy), right axis.

Thus in accordance with the theory presented in section 2, the diff-measure appears to be an indicator for future GDP growth. Next, we will test in a more rigorous way whether our method works for forecasting the German economy.

4.2 An Out-of-Sample Forecasting Performance

The target of our forecast analysis is the annual growth rate of GDP four quarters ahead $y_t = (Y_t - Y_{t-4})/Y_{t-4}$ (with Y as the German GDP level in t), because the EC's survey refers to expectations about the economic situation 12 months ahead. The monthly survey indicators are averaged for each quarter. Figure 2 shows that the indicators q2 and q4 are coincident indicators, but that the diff-measure leads GDP growth by about 6 quarters.

The proxy for public information about the prospect for GDP growth comes from a forecast based on an quarter-on-quarter AR model with positive autocorrelation: good (bad) current conditions are to a certain extent good (bad) news for economic conditions in the near future.[13] The forecast based on this quarter-on-quarter AR process made in $t-4$ for the annual GDP growth rate in t, $y_{AR,t|t-4}$, is the benchmark for forecasts that use additional survey indicators available in $t-4$, x^j_{t-4}, i.e. the diff-measure (j =diff), the indicator from survey question q2 ($j = q_2$), or the indicator from survey question q4 ($j = q_4$):

$$y_t = \alpha + \beta\ y_{AR,t|t-4} + \gamma\ x^j_{t-4} + \varepsilon_t, \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon), \tag{15}$$

The forecast performance of these equations for year-on-year GDP growth over the k evaluation periods is evaluated in an out-of-sample framework for the period 2010-2019. The AR- and survey-based forecasts $\widehat{y}_{j,t|t-4}$ are compared to the forecast that is based solely on the quarterly AR model $\widehat{y}_{AR,t|t-4}$ according to the relative Root Mean Square Forecast Error:

$$rRMSFE = \frac{\sqrt{\sum_{t=1}^{k}\left(y_t - \widehat{y}_{j,t|t-4}\right)^2}}{\sqrt{\sum_{t=1}^{k}\left(y_t - \widehat{y}_{AR,t|t-4}\right)^2}} = \frac{\sqrt{\sum_{t=1}^{k}\left(\widehat{e}_{j,t}\right)^2}}{\sqrt{\sum_{t=1}^{k}\left(\widehat{e}_{AR,t}\right)^2}}, \tag{16}$$

For a test whether the forecast differences are significant we follow the modification of the Diebold-Mariano test of equal predictive ability (Diebold and Mariano, 1995) proposed by Harvey, Leybourne, and Newbold (1997) based on small-sample bias corrected variance calculations. The results confirm the implications of the model: the forecast based on a quarterly AR equation improves significantly by adding, as a leading indicator, the difference between the indicator for the households' expectations about the private state and the indicator concerning the public state; the coefficient of the diff-measure in the forecasting equation is positive; and finally, the

[13] The first forecast for 2010Q1 is based on the quarter-on-quarter AR equation estimated for the window 1996Q1-2008Q4 and the last forecast for 2019Q4 is based on the estimation for the window 1996Q1-2018Q3.

diff-measure improves the performance of the forecasting equation by more than each of the single consumer indicators do (see Table 1).[14]

Table 1: Forecast Performance

estimation	with crisis dummies		without crisis dummies	
evaluation	in-sample	out-of-sample	in-sample	out-of-sample
RMSFE of benchmark	1.412	1.543	1.528	2.384
Diff + AR	0.640***	0.762**	0.624***	0.393*
Q2 + AR	0.651**	0.878	0.632**	0.781
Q4 + AR	0.658**	1.094	0.653**	0.789
Diff	0.979	0.991	0.930**	0.754
Q2	1.015	1.001	0.994	0.801
Q4	0.933**	0.963	0.907**	0.766

Note: Evaluation period 2010–2019 for change in quarterly GDP relative to same quarter of the previous year. Forecast performance is measured by RMSFEs relative to the RMSFE of the benchmark model given in the first row.

5 Conclusion

This paper argued that surveys would be a more valuable source of information if the aggregate of private information that affects the survey results could be separated from information agents get from publicly available sources. We proposed a procedure to disentangle private information from public knowledge for surveys that are structured such as that of the European Commission's (EC) on consumer sentiment. Utilizing the fact that this survey asks agents how they assess their own as well as the general economic prospects we showed that, under weak assumptions, the weight rational agents give to their private information is higher for their assessment of their own prospects than for their assessment of the general economic prospects of the economy. If this is the case, the indicator representing private information is simply a linear function of the difference between the assessment of the general prospects and the assessment of the private household's own economic prospects. Private information extracted from the consumer survey in this way can be used as input for forecasts.

It has been shown that extracting private information from the consumer survey of the European Commission in this way helps forecasting GDP growth in Germany. In principle, however, the informational content of our indicator could be diminished by quite a lot of reasons. For example, expectations on the development of the agents' own financial position might comprise, apart from expectations on personal income, changes in the net wealth of the household, which might not correlate with GDP as closely as personal income does. In addition,

[14] Table 1 also shows that the results hold for an in-sample evaluation framework (with an estimation sample of 1996q1 – 2019q4) and if dummies are applied to quarter 4/2008 and quarter 1/2009, when the world financial crisis hit the economy.

information agents get from their close environment might be of limited value for economies whose business cycle is largely driven by external shocks. Moreover, if consumers (contrary to our model) do not use public information efficiently, assessments of their own economic prospects might be more informative than those of the general prospects and also more so than the difference between the two assessments. Another potential problem with our approach is that the survey might not be the best representation of all the private information dispersed in the economy, since all consumers have equal weight in the survey, but income shares differ widely.[15] Probably even more important is that firms are missing in the survey.[16] Detecting the general usefulness of our approach by looking at other countries for which survey data of the European Commission exist will be the task for further research.

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[16] The reader might recall that the Commission's survey on firms does not contain the questions appropriate for our approach.

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