AN EVALUATION OF THE EUROPEAN COMMISSION'S CONCEPT OF THE CONSUMER CONFIDENCE INDEX FOR SWITZERLAND

ABSTRACT: We evaluate the ability of consumer confidence indices (CCI) to provide early guidance on the course of the Swiss economy. This is motivated by the recent modification of the CCIs for EU countries by the European Commission. The new index has a better lead on private household consumption and GDP. Likewise, its contemporaneous correlations tend to be higher and it performs well for forecasting, particularly in the case of quarter-on-quarter growth rates. The new CCI has a similar record compared to the current CCI in tracking the direction of change of private household consumption and GDP. On the other hand, the signal of the new index is somewhat less precise than that of the current CCI. The indices are evaluated for the period Q2:2007-Q4:2018. We check the robustness of the results for samples starting in 1995 or 2010.

RÉSUMÉ: Nous évaluons la capacité des indices de climat de consommation (ICC) à prévoir l'évolution de l'économie en Suisse. Ceci est encouragé par la récente modification des ICC pour les pays de l'UE par la Commission européenne. Le nouvel anticipe de manière plus précoce la consommation privée et le PIB. De même, ses corrélations contemporaines tendent à être plus élevées et il produit de bonnes prévisions, en particulier concernant les taux de croissance trimestriels. Le nouvel ICC a un bilan similaire à celui de l'ICC actuel en ce qui concerne le suivi de la direction de l'évolution de la consommation privée et du PIB. Cependant, le signal transmis par le nouvel indice est un peu moins précis que celui de l'actuel ICC. Les indices sont évalués pour la période T2:2007-T4:2018. Nous vérifions la fiabilité des résultats pour les périodes à débutant en 1995 ou en 2010.

ZUSAMMENFASSUNG: Wir bewerten die Fähigkeit von Konsumentenstimmungindizes (KSI), die Entwicklung der schweizerischen Wirtschaft frühzeitig anzuzeigen. Dies ist motiviert durch die jüngste Änderung der KSIs für EU-Länder durch die Europäische Kommission. Der neue Index hat einen höheren Vorlauf zum privaten Konsum und zum BIP, weist tendenziell höhere kontemporäre Korrelationen und gute Prognoseeingenschaften, insbesondere für Wachstumsraten gegenüber dem Vorquartal, auf. In Bezug auf das korrekte Anzeigen der Richtungsveränderung des Konsums und des BIP ist die Bilanz für den neuen KSI ähnlich wie für den aktuellen. Das Signal des neuen Indizes ist jedoch etwas weniger präzise. Die Indizes werden für den Zeitraum Q2:2007-Q4:2018 evaluiert. Wir überprüfen die Robustheit der Ergebnisse für Stichproben ab 1995 bzw. 2010.

SINTESI: Valutiamo la capacità degli indici di fiducia dei consumatori (IFC) di fornire precocemente un'indicazione sull'andamento dell'economia svizzera. Ciò è motivato dalla recente modifica degli IFC per i Paesi dell'UE da parte della Commissione europea. Il nuovo indice ha un anticipo maggiore rispetto ai consumi privati e al PIL e le correlazioni contemporanee tendono ad essere più alte. Inoltre, il nuovo IFC è utile alle previsioni, in particolare per quanto riguarda i tassi di variazione rispetto al trimestre precedente. Il nuovo IFC ha risultati simili a quelli dell'attuale IFC nell'indicazione dei punti di svolta dei consumi privati e del PIL. Il segnale del nuovo indice però è un po' meno preciso di quello dell'attuale. Gli indici sono valutati per il periodo T2:2007-T4:2018. Verifichiamo la robustezza dei risultati usando i dati a partire dal 1995 e dal 2010.

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1. Motivation

The Swiss State Secretariat for Economic Affairs (SECO) conducts a quarterly survey of private households in the months of January, April, July and October. The survey collects the households' subjective assessments and expectations on a wide range of topics relevant to consumer behavior. A total of eleven questions relate to general economic conditions, personal finance, price trends, job security, etc. Responses from a subset of questions are used to construct a *Consumer Confidence Index (CCI)*. The first survey took place in October 1972.

Since the CCI is a prominent indicator of economic developments in Switzerland, it is important that it be regularly evaluated and, if necessary, updated. This evaluation is motivated by the fact that at the beginning of 2019 the European Commission (2018) adjusted the *Consumer Confidence Indicator* for the member states of the European Union (EU). This report examines the extent to which this change would lead to an improvement in the CCI in the case of Switzerland.

The CCI is usually built as a composite indicator by averaging the responses of a sample of consumers over a range of questions. These questions cover a temporal dimension (assessment of the past, current or future situation) and a cross-sectional dimension (financial situation, savings, unemployment risk, etc.), which can relate to the household or the economy as a whole. Changes in the composition of the questions comprising a CCI thus affect its ability to provide early guidance for changes in aggregate private household consumption and other macroeconomic variables.

The report starts with a description of the modification of the new consumer confidence index. It then assesses a) the ability of the indicators to provide early guidance for key macroeconomic variables by means of simple cross-correlation and directional change analysis and b) their informational content based on an in-sample analysis using information criteria and likelihood-ratio tests, and an out-of-sample forecasting performance based on forecast errors. Finally, the report evaluates the ability of the indicators to provide timely and reliable information on cyclical developments in the Swiss economy.

2. The old and new versions of the CCI in Switzerland

Consumer surveys are conceptualized as empirical research on consumers' attitudes and expectations on the relevant determinants of their economic environment. The responses from the questionnaires are usually summarized in the form of the CCI. The nature of the questions and the methodology of their aggregation into an index thus determine the CCI. The earliest version of the CCI from SECO, denoted *CCI_1972*, goes back to

1972 and was based on three questions that allowed for variation in both aforementioned dimensions (see Table 1 for the questions and the answer categories).

The current CCI, denoted *CCI_2009*, is based on four questions (see Table 1) of the *Consumer Survey*, which is conceptually equivalent to the *Harmonized EU-wide Consumer Survey*. It was designed in 2001 by the European Commission (EC) and adapted in Switzerland in 2009 to ensure comparability with the EU member states.[1] The focus of the adjustment at that time was on expectations.

The recent modification of the CCI by the EC motivates an assessment of an equivalent version of the CCI for Switzerland, denoted *CCI_2019*. The key difference between the current *CCI_2009* and the new *CCI_2019* indicator relates to questions Q3 and Q4 in Table 1. Question Q3 of *CCI_2009* captures the perceived risk associated with the labor market conditions. It thus embodies a forward-looking dimension, addressing a consumer's assessment of the aggregate economy. This question was changed to a backward-looking one, now focusing on the personal situation of the consumer rather than the consumer's assessment of the aggregate economy. The idea behind this change is that consumers generally find it easier to assess their own situation than to assess the overall economic conditions.[2] As regards question Q4, the EC essentially changed the purpose. The question used in *CCI_2009* focused on saving. However, an increase in saving can give rise to a positive or negative signal for consumption. On the one hand, consumers' intentions to save more can be a consequence of higher incomes. On the other hand, the nature of higher saving might be precautionary, reflecting increased economic uncertainty. In the first case, we should expect an increase in consumption, while in the second case consumption is likely to lose momentum. To avoid this ambiguity, question Q4 for *CCI_2019* focuses on spending rather than saving motives.[3]

The difference among the CCIs is due to different survey questions rather than different aggregation techniques. In each case, the CCIs are calculated as an arithmetic average of response balances for the survey questions. The temporal trajectory of the resulting CCIs is shown in Figure 1. The figure shows the three versions of the CCI (both seasonally adjusted and not seasonally adjusted) jointly with the quarterly year-on-year (y-o-y) and

[1]The Swiss Consumer Confidence Survey and the corresponding CCI are implemented on a quarterly basis, whereas in the case of the EU member states they are published on a monthly basis.

[2]The work of Jonsson and Lindén (2009) on consumer confidence has shown in theoretical terms that micro-oriented questions seem to be better suited as predictors of private consumption compared to macro-oriented questions. This is because consumers can be expected to have better knowledge of their own economic situation than of the general economic environment.

[3]Note that the EU survey asks about intentions to make major purchases over the next 12 months, whereas the question in the Swiss survey refers to the present.

TABLE 1. Survey questions for the consumer confidence indices

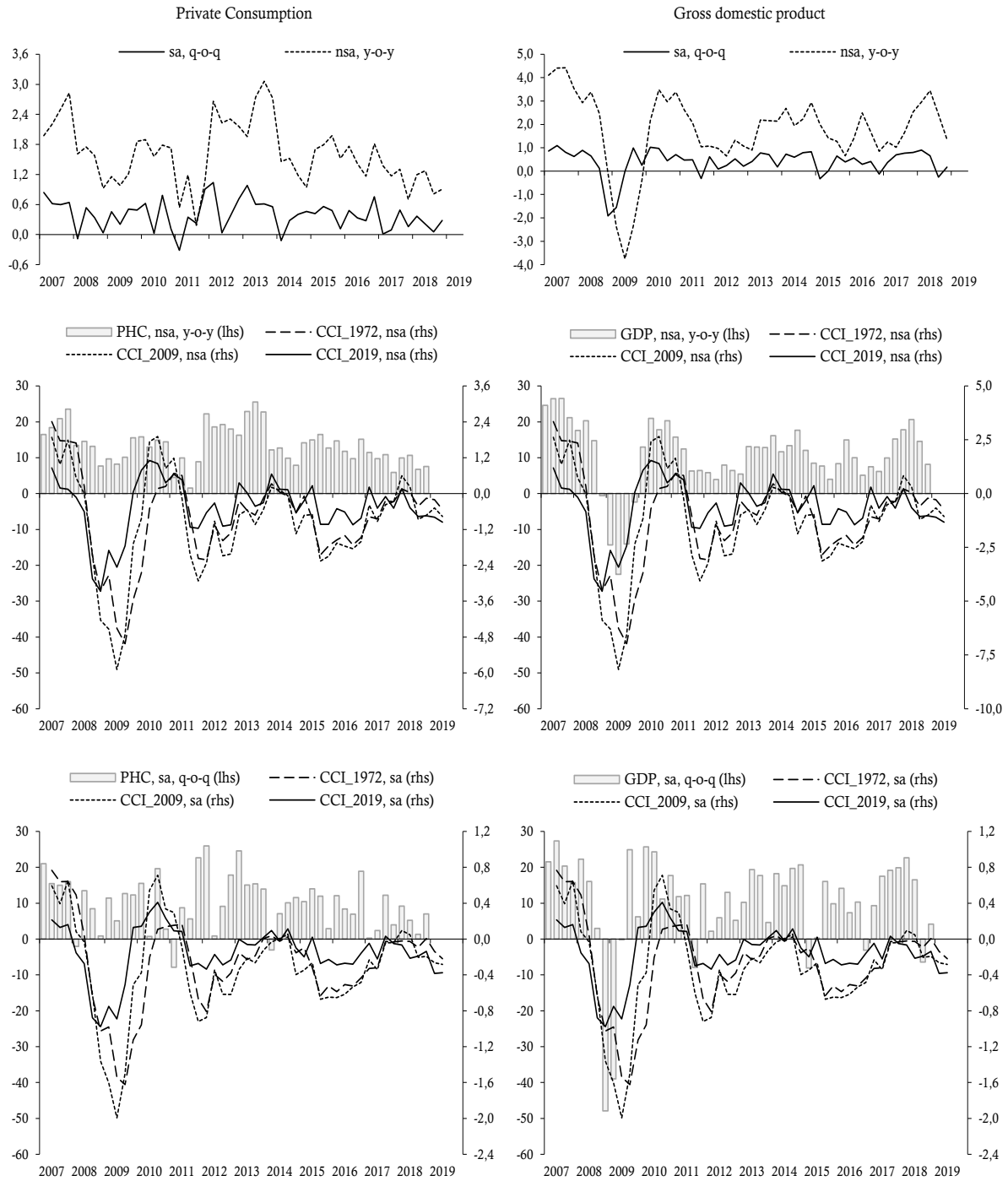
CCI_1972	*CCI_2009*	*CCI_2019*
Q1: [4.2] *How do you expect your household's financial situation to change over the next 12 months?* Will it: (a) significantly improve, (b) marginally improve, (c) remain virtually unchanged, (d) marginally deteriorate, (e) significantly deteriorate, (f) don't know?	Q1: [4.2] *How do you expect your household's financial situation to change over the next 12 months?* Will it: (a) significantly improve, (b) marginally improve, (c) remain virtually unchanged, (d) marginally deteriorate, (e) significantly deteriorate, (f) don't know?	Q1: [4.2] *How do you expect your household's financial situation to change over the next 12 months?* Will it: (a) significantly improve, (b) marginally improve, (c) remain virtually unchanged, (d) marginally deteriorate, (e) significantly deteriorate, (f) don't know?
Q2: [1.1] *How, in your view, has the general economic situation in Switzerland developed over the last 12 months?* Has it: (a) significantly improved, (b) marginally improved, (c) remained virtually unchanged, (d) marginally deteriorated, (e) significantly deteriorated, (f) don't know?	Q2: [1.2] *How do you think the general economic situation will develop over the next 12 months?* Will it: (a) significantly improve, (b) marginally improve, (c) remain virtually unchanged, (d) marginally deteriorate, (e) significantly deteriorate, (f) don't know?	Q2: [1.2] *How do you think the general economic situation will develop over the next 12 months?* Will it: (a) significantly improve, (b) marginally improve, (c) remain virtually unchanged, (d) marginally deteriorate, (e) significantly deteriorate, (f) don't know?
Q3: [4.1] *How, in your view, has your household's financial situation changed over the last 12 months?* Has it: (a) significantly improved, (b) marginally improved, (c) remained virtually unchanged, (d) marginally deteriorated, (e) significantly deteriorated, (f) don't know?	Q3: [3.2] *How do you expect the number of people unemployed in Switzerland to change over the next 12 months?* The number will: (a) increase sharply, (b) increase slightly, (c) remain virtually unchanged, (d) fall slightly, (e) fall sharply, (f) don't know?	Q3: [4.1] *How, in your view, has your household's financial situation changed over the last 12 months?* Has it: (a) significantly improved, (b) marginally improved, (c) remained virtually unchanged, (d) marginally deteriorated, (e) significantly deteriorated, (f) don't know?
Q4: ——	Q4: [5.3] *Over the next 12 months, how likely is it that you will save any money?* (a) very likely, (b) fairly likely, (c) not likely, (d) not at all likely, (e) don't know.	Q4: [5.2] *Do you think that now is a good time to make major purchases (major household appliances, furniture, car, consumer electronics, etc.)?* (a) Yes, now is a good time, (b) Yes and no: there is no such thing as a right or a wrong time, (c) No, now is not the right time to make major purchases; it is better to put it off until a later date, (d) don't know.

quarter-on-quarter (q-o-q) growth rates of real private household consumption (PHC) and real gross domestic product (GDP).[4]

The three CCIs are characterized by similar dynamics over time, with a few noteworthy differences. First, *CCI_2019* has a comparatively small amplitude. Its variance (59.3) is

[4]For both GDP and PHC, the q-o-q growth rates are based on seasonally adjusted series, whereas the y-o-y growth rates are based on unadjusted series.

FIGURE 1. Consumer confidence indices (CCIs)



CCI_1972 – Consumer Confidence Index according to SECO-definition 1972 to 2009 (see Table 1),
CCI_2009 – Consumer Confidence Index according to EU-definition 2001 to 2018 (see Table 1),
CCI_2019 – Consumer Confidence Index according to EU-definition as of 2019 (see Table 1),
PHC – Household and NPISH final consumption expenditure, volume, percent change from previous year or quarter,
GDP – Gross domestic product, volume, percent change from previous year or quarter,
nsa refers to *not seasonally adjusted data* and *sa* to *seasonally adjusted* data.

small compared to the other two indicators (155.3 for *CCI_1972* and 193.7 for *CCI_2009*). Second, there is a temporal shift between the three indicators. This is particularly pronounced in the period surrounding the global financial crisis. The *CCI_2019* indicator was the first to signal a downturn, followed by *CCI_2009* and then *CCI_1972*.

Common to all three indicators is a relatively high co-movement with the y-o-y growth rate of GDP. This is particularly evident in the period surrounding the global financial crisis, but less so thereafter. The same applies to PHC. The co-movement between the indices and the reference series appears to be more pronounced for larger changes in the indices. This suggests that the informational content of the CCIs varies substantially over the business cycle.

The *CCI_1972* and the *CCI_2019* are available since Q4:1972. The *CCI_2009* is not readily available prior to Q2:2007, because questions 3.2 und 5.3 were not included in the survey prior to this date. A longer sample of the *CCI_2009* can only be obtained using a retropolation (based on questions 1.2 and 4.2). We therefore choose the sample Q2:2007-Q4:2018 as the main estimation sample, and use a longer sample starting from Q1:1995 for robustness checks. To the same end, we also use a sub-sample of the main sample starting from Q1:2010, i.e. after the immediate effect of the global financial and economic crisis.

3. Correlation analysis

We use the cross-correlation coefficient to assess the extent of co-movement of the three CCIs with real PHC and real GDP. Unadjusted as well as seasonally and calendar-adjusted reference series are based on chain-linked volumes (reference year 2010). In each case, we relate the y-o-y quarterly growth rates and the q-o-q growth rates to the CCIs. There is no need for a frequency adjustment since both the CCIs and the two reference series are sampled at a quarterly frequency.

The cross-correlation is given by $\varrho(\tau) \in [-1, 1]$ where τ determines the temporal shift. A high value of the correlation coefficient at $\tau > 0$ implies that the CCI leads the reference series. Further technical details on the cross-correlation coefficient are provided in Section A of the Appendix. The sample used for the estimation covers Q2:2007-Q4:2018. The results are collected in Table 2.

Considering PHC first, *CCI_2019* has a noticeably higher correlation with the y-o-y growth rate for $\tau \geq 0$ than the other two indicators. This implies that *CCI_2019* has a higher contemporaneous correlation ($\tau = 0$) and higher lead correlations ($\tau > 0$), rendering this indicator more useful in tracking PHC than the other two indicators. This result holds irrespective of the seasonal adjustment. The correlation of the three CCIs with the q-o-q growth rate of PHC is negligibly small.

In the case of GDP, we find that all CCIs have a high correlation with the y-o-y growth rate, of which *CCI_2009* has the highest. Interestingly, the correlation of *CCI_1972* and

TABLE 2. Cross-correlation analysis

τ:	-4	-3	-2	-1	0	1	2	3	4
	lag					lead			
CCIs: not seasonally adjusted									
Correlation with PHC - y-o-y growth rates									
CCI_2019	-0.12	0.03	0.17	0.22	0.26	0.14	-0.03	-0.14	-0.19
CCI_2009	-0.01	0.17	0.27	0.30	0.23	0.03	-0.19	-0.32	-0.25
CCI_1972	0.10	0.27	0.34	0.29	0.17	0.02	-0.09	-0.17	-0.11
Correlation with PHC - q-o-q growth rates									
CCI_2019	-0.02	0.14	0.20	0.09	0.03	-0.12	-0.11	-0.07	-0.17
CCI_2009	0.07	0.18	0.18	0.05	-0.10	-0.21	-0.22	-0.16	-0.08
CCI_1972	0.12	0.20	0.12	-0.01	-0.11	-0.11	-0.09	-0.09	-0.02
Correlation with GDP - y-o-y growth rates									
CCI_2019	-0.60	-0.37	-0.04	0.27	0.61	0.78	0.70	0.48	0.20
CCI_2009	-0.45	-0.12	0.31	0.66	0.87	0.83	0.57	0.20	-0.11
CCI_1972	-0.12	0.25	0.59	0.78	0.83	0.69	0.41	0.07	-0.20
Correlation with GDP - q-o-q growth rates									
CCI_2019	-0.20	0.08	0.40	0.45	0.60	0.61	0.26	-0.11	-0.25
CCI_2009	0.03	0.32	0.63	0.65	0.54	0.32	-0.02	-0.28	-0.41
CCI_1972	0.28	0.50	0.62	0.50	0.38	0.23	-0.06	-0.35	-0.45
CCIs: seasonally adjusted									
Correlation with PHC - y-o-y growth rates									
CCI_2019	-0.13	0.02	0.17	0.23	0.27	0.15	-0.03	-0.14	-0.23
CCI_2009	-0.01	0.16	0.27	0.30	0.23	0.03	-0.19	-0.31	-0.26
CCI_1972	0.11	0.27	0.34	0.30	0.17	0.02	-0.08	-0.17	-0.11
Correlation with PHC - q-o-q growth rates									
CCI_2019	0.03	0.15	0.15	0.08	0.09	-0.10	-0.18	-0.09	-0.15
CCI_2009	0.09	0.19	0.16	0.04	-0.09	-0.19	-0.24	-0.17	-0.07
CCI_1972	0.14	0.20	0.09	-0.02	-0.09	-0.10	-0.11	-0.10	-0.01
Correlation with GDP - y-o-y growth rates									
CCI_2019	-0.63	-0.40	-0.03	0.31	0.64	0.81	0.75	0.53	0.20
CCI_2009	-0.45	-0.12	0.31	0.68	0.88	0.83	0.58	0.21	-0.12
CCI_1972	-0.12	0.25	0.60	0.80	0.84	0.69	0.41	0.08	-0.20
Correlation with GDP - q-o-q growth rates									
CCI_2019	-0.22	0.02	0.43	0.54	0.62	0.60	0.30	-0.06	-0.29
CCI_2009	0.04	0.30	0.63	0.68	0.54	0.31	-0.02	-0.26	-0.41
CCI_1972	0.28	0.48	0.63	0.53	0.38	0.21	-0.05	-0.33	-0.46

The sample: Q2:2007-Q4:2018.
Interpretation: a high correlation at lead ($\tau > 0$) implies that the CCI leads the reference series (PHC or GDP).

CCI_2009 with GDP declines when considering leads ($\tau > 0$), whereas it increases in case of the *CCI_2019*. Hence, the *CCI_2019* can be considered a truly leading indicator for GDP. The same applies when considering seasonal adjusted data for the CCIs. *CCI_2019* shows the highest correlations with the q-o-q growth rates of GDP for the first two leads.

The cross-correlation coefficients for the CCIs and their sub-indicators are collected in Appendix D.[5] Since the sub-indicators tend to have higher volatility than the composite indicators, their correlations with a reference series tend to be lower. The magnitudes of correlations of the sub-indicators are higher for the y-o-y growth rates of the reference series than for the q-o-q growth rates, which is similar to the pattern observed in the case of the CCIs.

To check for sub-sample stability of the cross-correlations, we start the sample in Q1:1995 or Q1:2010. For both seasonally adjusted and unadjusted CCIs, we find that

- For the y-o-y growth rates of GDP, correlations in the alternative samples are lower at all leads.
- Correlations for the y-o-y growth rates of PHC are lower in the sample starting in 2010 at all leads.
- Correlations in the sample since 1995 are higher for all three indices for both types of growth rates of PHC.
- For all other reference series, including the q-o-q growth rates of GDP, and all indices, contemporaneous correlations and correlations at first two leads tend to be lower in the alternative samples.

Although correlation patterns vary with the sample, the ranking among the CCIs in terms of contemporaneous and first two lead correlations remains stable over time.

4. Tracking the directional change

The cross-correlation is a measure for the average degree of co-movement of two series over time. A high correlation implies that if a CCI increases, then the reference series is also likely to increase. A similar tool in this context is the *directional change* measure, which shows how often a CCI correctly indicates the direction of change (decrease or increase) in the reference series.

We use the three CCIs and evaluate the precision of their signals for tracking the change in the reference series. To compute the measure for the frequency of directional change, we relate the change of a CCI to the growth rate of the reference series. The results are

[5]Contrary to all other questions, question 3.2 is defined such that a negative balance of the responses is associated with good economic conditions. To simplify the interpretation of the figures in Appendix D, we switch the sign of the balance to question 3.2.

TABLE 3. Tracking the directional change

	q-o-q growth rates		y-o-y growth rates	
	PHC	GDP	PHC	GDP
CCIs: not seasonally adjusted				
CCI_2019	59%	54%	57%	52%
CCI_2009	54%	50%	57%	52%
CCI_1972	48%	48%	46%	54%
CCIs: seasonally adjusted				
CCI_2019	59%	50%	48%	52%
CCI_2009	52%	52%	54%	54%
CCI_1972	57%	48%	46%	46%

The sample: Q2:2007-Q4:2018.
The values give the percentage of periods in which the sign of the change in a CCI coincided with the sign of changes of PHC and GDP.

presented in Table 3. The values in the table represent the percentage of periods in which the CCIs correctly indicated the direction of change of the two reference series. Here, we distinguish between seasonally adjusted and not seasonally adjusted CCIs, and between the q-o-q and y-o-y growth rates of the reference series.

For all CCIs the percentage of correct indications of change in Q2:2007-Q4:2018 is between 46 percent and 59 percent. The new indicator *CCI_2019* tends to be better in identifying the direction of change for the q-o-q growth rates of the reference series, while it performs similarly or slightly worse than *CCI_2009* for tracking the y-o-y growth rates. The old indicator *CCI_1972* has the lowest correct identification of the direction of change in most cases.

The ability of the CCIs to correctly identify the direction of change of the q-o-q growth rates of the references series seems to be independent of the seasonal adjustment in most cases. In contrast, the seasonal adjustment of the CCIs matters when considering the y-o-y growth rates, as seasonally adjusted indicators perform worse than their unadjusted counterparts. The percentage of correct indications has been relatively stable over the longer sample starting in 1995, but declined in the recent years (Q1:2010-Q4:2018) for all indicators. The new indicator does not outperform its predecessors according to this metric in the more recent sample.

TABLE 4. In-sample and out-of-sample forecasting analysis

	p-value		Δ BIC		$\text{RMSE}_{h=1}$		$\text{RMSE}_{h=2}$	
	PHC	GDP	PHC	GDP	PHC	GDP	PHC	GDP
y-o-y growth rates for PHC and GDP								
CCIs: not seasonally adjusted								
CCI_2019	0.50	0.00	9.2	-15.6	0.73	0.84	0.64	0.82
CCI_2009	0.24	0.00	7.4	-26.2	0.71	0.68	0.63	0.66
CCI_1972	0.87	0.00	10.9	-6.9	0.77	1.09	0.65	0.99
CCIs: seasonally adjusted								
CCI_2019	0.25	0.00	7.5	-21.2	0.76	0.76	0.65	0.77
CCI_2009	0.14	0.00	6.1	-28.3	0.73	0.67	0.64	0.65
CCI_1972	0.78	0.00	10.5	-10.3	0.77	1.16	0.65	0.97
q-o-q growth rates for PHC and GDP								
CCIs: not seasonally adjusted								
CCI_2019	0.75	0.00	10.3	-9.0	0.30	0.43	0.30	0.43
CCI_2009	0.92	0.00	11.1	-5.1	0.29	0.47	0.28	0.47
CCI_1972	0.88	0.07	10.9	4.5	0.30	0.50	0.30	0.50
CCIs: seasonally adjusted								
CCI_2019	0.58	0.00	9.6	-10.2	0.28	0.43	0.28	0.43
CCI_2009	0.90	0.00	11.0	-6.0	0.29	0.45	0.29	0.45
CCI_1972	0.93	0.09	11.1	4.9	0.30	0.50	0.30	0.50

The sample: Q2:2007-Q4:2018.
The p-value refers to the likelihood-ratio test. The likelihood ratio has an asymptotic χ^2-distribution under the null hypothesis of a zero coefficient on the CCI.
The Δ BIC refers to the improvement of the Bayesian information criterion (BIC) of the ARMAX model relative to the BIC of a standard ARMA model. A negative difference implies that the inclusion of a CCI improves the model fit.
The $\text{RMSE}_{h=1}$ and $\text{RMSE}_{h=2}$ test statistics refer to the root-mean-squared-error (RMSE) based on a one-step ($h = 1$) and two-step ($h = 2$) ahead (i.e. one and two quarter(s) ahead) forecast horizon. For the sake of better readability, we have multiplied the root-mean-squared-errors by 100.

5. In-sample fit and out-of-sample forecasting performance

We assess the ability of the CCIs to provide useful information on the reference series by estimating an ARIMAX(1,0,1) model involving the three CCIs as an exogenous variable, each one at a time.[6] The CCIs enter the model contemporaneously and with two lags to account for delayed effects.[7] We assess the CCIs' ability to explain the sample variation

[6]The econometric specification is: $\phi(L)(y_t - \mu) = \xi(L)x_{t-\zeta} + \vartheta(L)\varepsilon_t$ with $\varepsilon_t \sim N(0, \sigma^2)$, where $\phi(L)$, $\xi(L)$ and $\vartheta(L)$ are lag polynomials and μ is the unconditional mean of the reference series y_t. x_t is an exogenous variable for which we use the CCIs, ζ is a parameter capturing the temporal shift between y_t and x_t and we utilize the following specification: $\zeta = 0$ and $\xi(L) = \sum_{i=1}^{3} \xi_i L^{i-1}$.
[7]We determined lag lengths by computing the Bayesian information criterion (BIC) for each ARMAX specification, and choosing the specification that was selected most frequently by the criterion. We then estimate the same specification for all combinations of the CCIs and the reference series. This is done to rule out the effect of differences that are purely due to different specifications.

of PHC and GDP (likelihood-ratio test and the Bayesian information criterion (BIC)[8]), in addition to forecasting them out of sample.

The likelihood-ratio test allows us to assess whether a CCI can improve the model fit. Table 4 lists the p-values for the test. None of the CCIs improves the forecast of both types of growth rates of PHC. In contrast, the CCIs are useful in forecasting real GDP. The implications of the change in BIC are similar. None of the CCIs improves the model fit for PHC, but all CCIs improve the model fit for the y-o-y GDP growth rates. For the q-o-q growth rates only the *CCI_1972* turns out to be less useful. These results are quite robust also in the samples starting in Q1:1995 and Q1:2010.

The results for the out-of-sample forecasting evaluation are based on the root-mean-squared error (RMSE). A smaller RMSE indicates a more precise forecast. The ARMAX model with *CCI_1972* produces the least precise GDP forecasts. This is also true for the alternative samples starting in Q1:1995 and Q1:2010. The model with *CCI_2009* tends to produce the most accurate forecasts for the y-o-y growth rates of the GDP. This result also holds for the alternative samples. The findings are more nuanced in the case of the q-o-q growth rates. Both the not seasonally adjusted version and the seasonally adjusted version of *CCI_2019* slightly outperform its *CCI_2009* counterpart in forecasting the q-o-q GDP growth rates. This conclusion, however, does not hold in the long-term perspective (Q1:1995-Q4:2018), where both indices perform equally good.

6. Precision of the CCIs' signals

A good economic indicator provides a timely and reliable indication of cyclical developments in an economy. Unfortunately, the economic signal contained in all economic indicators is accompanied by unsystematic noise (a spurious signal). The important question is: Does a turnaround in an indicator represent a genuine cyclical turning point, or is it simply noise? Filter techniques can be used to distinguish between cyclical and irregular movements of time series. The filtered series are, however, generally less reliable at the end of the sample. An alternative approach is to base the distinction between a genuine cyclical movement and data volatility on past experience with the series. The ratio $r(\tau)$ of the noise to the cyclical signal contained in a time series is therefore a quality criterion for economic indicators.

[8]The BIC is a popular model selection criterion that accounts for the error variance and the number of model parameters. This measure penalizes overfitting. When choosing between two models, the one with the lowest BIC is preferred. The negative difference in BIC of the ARMAX model relative to the ARMA model indicates an improvement of model fit due to the inclusion of the CCI.

TABLE 5. Quarters for cyclical dominance (QCD)

	Not seasonally adjusted				*Seasonally adjusted*			
τ (in Quarters)	1	2	3	4	1	2	3	4
CCI_2019	2.9	2.3	1.3	**0.9**	2.1	1.2	**0.8**	0.9
CCI_2009	1.6	1.2	**0.7**	0.6	1.3	**0.8**	0.6	0.6
CCI_1972	1.8	1.2	**0.8**	0.7	1.5	1.0	**0.7**	0.7

The sample: Q2:2007-Q4:2018.
The values indicate the noise-to-signal ratios for the CCIs for time spans of one to four quarters obtained using the Baxter-King band-pass filter.

This ratio can be used to determine the number of time periods for which a change in a series needs to be observed in order to assert a likely cyclical development rather than noise. The *quarters-for-cyclical-dominance (QCD)* is defined as the number of quarters it takes until the ratio $r(\tau)$ of the noise to the cyclical signal gets below one. A high QCD value indicates a higher degree of noise. The value of QCD is then the number of quarters τ, for which the ratio $r(\tau)$ of the noise to the cyclical signal is less than one for the first time. Therefore, an indicator with a low QCD value is preferable to one with a high QCD. Further technical details can be found in Section B of the Appendix, and in Shiskin (1957) and Abberger and Nierhaus (2009).

The results are shown in Table 5. The table highlights two important aspects: the QCD measures are generally lower for seasonally adjusted series, and there are noteworthy differences in the QCD measure – or the number of quarters needed for an observed change in the indicator to be confidently considered as cyclical. *CCI_2009* usually has the lowest QCD value, implying that its signal is already relatively precise after two quarters. For the other two CCIs it takes at least three quarters (in the case of seasonally adjusted data). Hence, the QCD analysis suggests *CCI_2009* as the best-performing indicator, but even in the case of this indicator a change must be observed over at least two quarters for a conclusion to be drawn. The robustness check for the two alternative samples starting in Q1:1995 or Q1:2010 corroborates the finding that a change must be observed roughly over three quarters. However, it also shows that *CCI_2009* appears to outperform *CCI_2019* in the long run, with precision of both indicators having declined since 2010.

Another way of assessing the precision of the CCIs' signals is to consider confidence intervals. Figure 2 shows the 95 percent confidence interval based on the cross-sectional dispersion of the sub-indicators. The technical details can be found in Appendix C. The intervals highlight the degree of uncertainty surrounding the three CCIs, which is rather low. Table 6 shows quantiles of the difference between the upper and the lower confidence

FIGURE 2. Confidence intervals

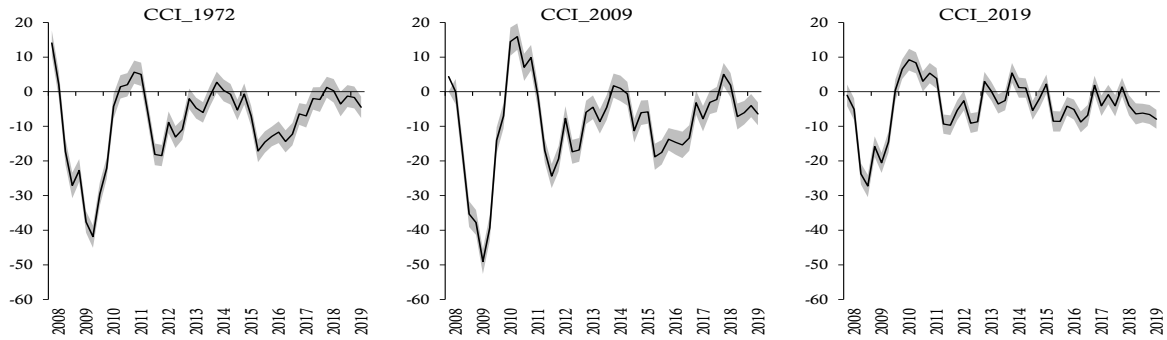


TABLE 6. The size of confidence intervals

	Sd.	Min.	25%	50%	75%	Max.
CCI_2019	7.7	5.3	5.5	5.8	5.9	6.4
CCI_2009	13.9	6.4	6.9	7.1	7.4	8.1
CCI_1972	12.5	5.7	6.1	6.3	6.7	7.7

The sample: Q2:2007-Q4:2018.
Sd. refers to the standard deviation of the index.
The remaining columns summarize the quantiles of the confidence intervals' width.

bounds, whereby *CCI_2009* has the broadest interval, implying a noisier signal in a cross-sectional perspective. Having a confidence interval allows us to evaluate the informational content of a newly observed realization of a CCI. For example, if the most recent value of a CCI is below the previous period's value but within the confidence interval of the previous period, then the informational content of this value is comparable to that of the previous value. This implies that a new value of the CCI contains a significant amount of new information only if it is far away from the previous period's value and outside this period's confidence interval. The plausibility of this reasoning has been confirmed by Bruno (2014) using non-parametric methods. He argues that the predictive content of a CCI is especially useful once the changes are unusually large.

7. CONCLUSION

We evaluate three distinct consumer confidence indices' (CCI) ability to provide early guidance for the Swiss economy. This is motivated by two aspects: a) the CCI is an important indicator for assessing economic developments in Switzerland, which must be regularly evaluated, and b) the recent modification of the CCI by the EC motivates an assessment of an equivalent version of the CCI for Switzerland. The analysis involves the current CCI, the previous one and the new one, which is conceptually in line with the modified CCI of the EC. Our results can be summarized as follows:

- The new CCI performs best in forecasting the q-o-q growth rates of the GDP, but it is only second best in forecasting the y-o-y growth rates. In the long sample, however, the forecasting performance of both indices is comparable.
- The new CCI tends to have the highest lead property with respect to PHC and GDP, and its contemporaneous correlations tend to be higher as well.
- The new CCI's signal is less precise than that of the current index, but the new index performs similarly in tracking the direction of change of PHC and GDP.

Taking all the criteria together and comparing them over different samples leads to the overall conclusion that the quality of the new indicator is roughly comparable to that of its predecessor. The adequacy of the new index of consumer sentiment as a leading indicator and its comparability with similar indicators used in other European countries give purchase to considering the new CCI as the preferred index of consumer sentiment.

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Appendix A. Cross-correlation coefficient

We use the cross-correlation coefficient to rank the indicators according to the degree of correlation with the reference series and with respect to the size of lead. Let X_t, Y_t represent a pair of stochastic processes that are jointly wide-sense stationary. Then the cross-covariance and the cross-correlation are given by:

$$\sigma_{XY}(\tau) = \mathrm{E}\left(X_t - \mu_X\right)\left(Y_{t-\tau} - \mu_Y\right), \tag{1}$$

$$\varrho(\tau) = \frac{\sigma_{XY}(\tau)}{\sigma_X \cdot \sigma_Y}, \tag{2}$$

where μ_X (μ_Y) and σ_X (σ_Y) are the mean and standard deviation of X_t (Y_t), which are constant over time due to both processes being stationary, and $\mathrm{E}[\cdot]$ is the expectation operator. Let the CCI be represented by the variable Y; then τ captures the degree of lead or lag of Y relative to the reference series X. X leads Y if $\tau < 0$ and X lags Y if $\tau > 0$. In the latter case, the CCI (Y) is said to be a *leading indicator* for the series (X).

Appendix B. Quarters-for-cyclical-dominance

How strong and undistorted the cyclical signal of a series is depends on whether a movement of the current time series value is predominantly due to the influence of the irregular component ε_t, or due to a change in the smooth cyclical component c_t. In many time series, the irregular influence predominates in a comparison with the previous period. If, however, the time series values change over several periods, the share of the smooth cycle component in the total variability of the time series increases. In general, the magnitude of the change in the smooth cyclical component c_t increases with the time span, whereas the magnitude of the change in the irregular component ε_t does not depend on the time span. This implies that the noise-to-signal ratio declines when the time span increases. The ratio falls below unity once the size of the change in the cyclical component exceeds that of the irregular component. The length of the time span at that point is the number of time periods required, on average, for the smooth cyclical component c_t to become dominant over the irregular component ε_t. In general, the noisier a time series is, the longer that time span has to be.

The QCD-measure (Quarters required for a cyclical factor to dominate an irregular factor, Quarters for Cyclical Dominance) then indicates the smallest number of quarters for which the change in the smooth component on average outweighs the change in the irregular movements. The value of QCD is then the number of quarters τ, for which the

ratio $r(\tau)$ of the noise to cyclical signal is less than one for the first time.

$$r(\tau) = \frac{\sum_{t=\tau+1}^{T} |\varepsilon_t - \varepsilon_{t-\tau}|}{\sum_{t=\tau+1}^{T} |c_t - c_{t-\tau}|} < 1. \tag{3}$$

The QCD indicates the average waiting time (in quarters) before one can be relatively certain that movements in time series are not random, but are due to cyclical factors. The smaller the QCD measure for a time series is, the more appropriate is the comparison with the previous period of the time series.

To derive the Quarters for Cyclical Dominance for an economic indicator, the time series first has to be decomposed into estimates of its irregular and cyclical components, ε_t and c_t. This can be done using standard filter techniques. We use the Baxter-King band-pass filter in order to identify the smooth cycle component c_t; the remaining part of the series, i.e. the residuum, is the irregular component ε_t. Clearly, the actual value of the QCD for a time series crucially depends on the statistical decomposition procedure.

Appendix C. Variance of the CCIs

In what follows, we briefly outline some details for computing the variance of the CCIs, which is in turn used to establish the confidence intervals. Let $\bar{\zeta}_{t,k} = \frac{1}{n}\sum_{i=1}^{n} \zeta_{t,k,i}$ be the mean of sub-indicator k based on a specific question as depicted in Table 1. From this, the value for any of the three CCIs at time t is computed as the arithmetic average

$$CCI_t = \frac{1}{m}\sum_{k=1}^{m} \bar{\zeta}_{t,k}, \tag{4}$$

where $m = 3$ in the case of *CCI_1972* and $m = 4$ for *CCI_2009* and *CCI_2019*. The variance of $\bar{\zeta}_{t,k}$ is given by

$$\begin{aligned} \mathrm{Var}\left(\bar{\zeta}_{t,k}\right) &= \frac{1}{n^2}\mathrm{Var}\left(\sum_{j=1}^{n} \zeta_{t,k,j}\right), \\ &= \frac{1}{n}\sigma_{t,k}^2 \quad \text{with} \quad \sigma_{t,k}^2 = \frac{1}{n}\sum_{j=1}^{n}\left(\zeta_{t,k,j} - \bar{\zeta}_{t,k}\right)^2, \end{aligned} \tag{5}$$

where we assume that $\zeta_{t,k,j} \sim i.i.d.\ \forall\ j$. Using equation (5), the variance of the CCIs at a particular point in time t is then given by

$$\begin{aligned} \mathrm{Var}\left(CCI_t\right) &= \frac{1}{m^2}\left(\sum_{k=1}^{m}\mathrm{Var}(\bar{\zeta}_{t,k}) + 2\cdot\sum_{\substack{k,\kappa=1 \\ k\neq\kappa}}^{m}\mathrm{Cov}(\bar{\zeta}_{t,k},\bar{\zeta}_{t,\kappa})\right), \\ &= \frac{1}{n\cdot m^2}\left(\sum_{k=1}^{m}\sigma_{t,k}^2 + 2\cdot\sum_{\substack{k,\kappa=1 \\ k\neq\kappa}}^{m}\sigma_t(k,\kappa)\right), \end{aligned} \tag{6}$$

with $\sigma_t(k,\kappa) = \frac{1}{n}\sum_{j=1}^{n}\left(\zeta_{t,k,j} - \bar{\zeta}_{t,k}\right)\left(\zeta_{t,\kappa,j} - \bar{\zeta}_{t,\kappa}\right)$. As can be seen, we compute $\sigma^2_{t,k}$ and $\sigma_t(k,\kappa)$ based on the cross-sectional dimension i, i.e. the individual respondents' answers. The variance of the CCI takes the cross-correlation among the sub-indicators into account. Given the variance of the CCIs, the upper and lower bound for the confidence interval (CI) can then be computed by adding and subtracting the standard deviation from the current level of the CCIs

$$\left.\begin{array}{c} CI_t^u \\ CI_t^l \end{array}\right\} = CCI_t \pm 1.96 \cdot \sqrt{\mathrm{Var}\left(CCI_t\right)}. \tag{7}$$

In the case of a normal random variable, this would correspond to the 95 percent confidence interval. The interval conveys the informational content of the indicators' current value relative to its cross-sectional dispersion.

Appendix D. Cross-correlation analysis for the sub-components

Figure 3. Cross-correlation: GDP y-o-y with CCI nsa

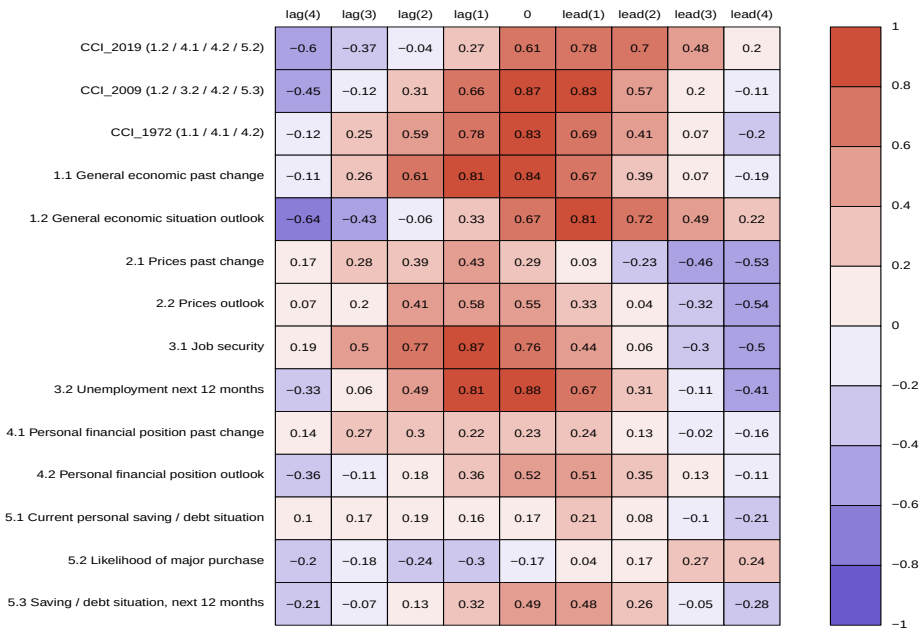

Figure 4. Cross-correlation: GDP q-o-q with CCI nsa

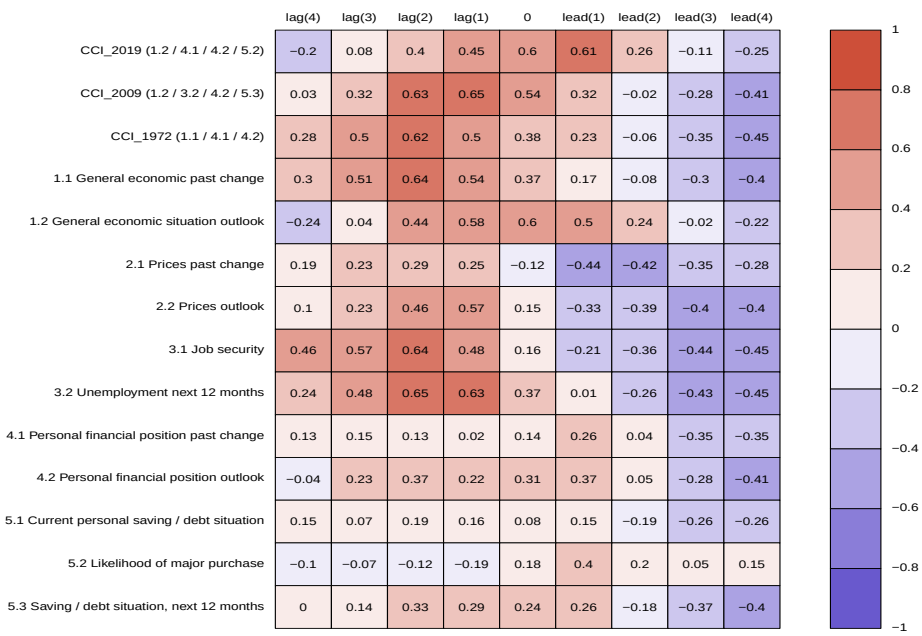

FIGURE 5. Cross-correlation: PHC y-o-y with CCI nsa

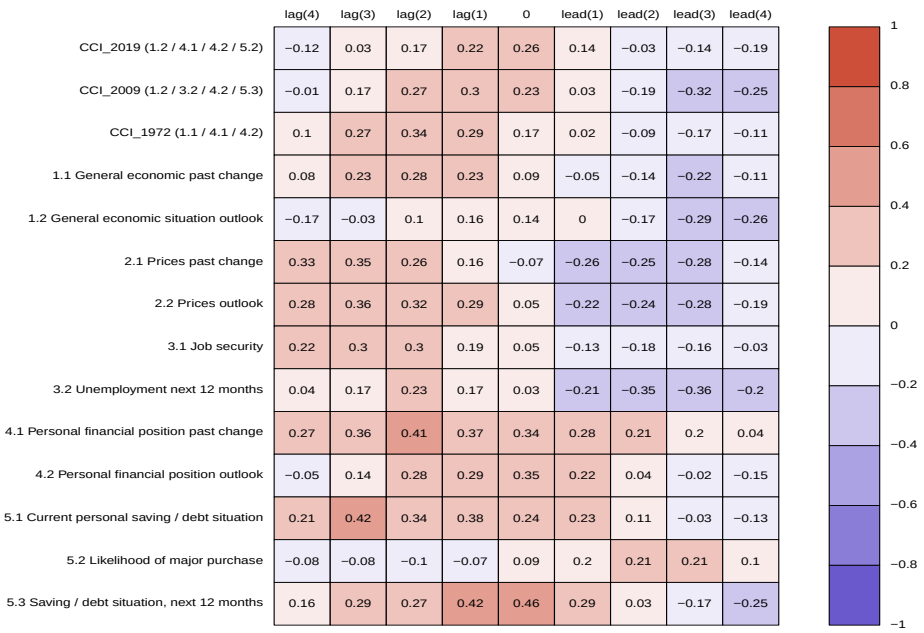

FIGURE 6. Cross-correlation: PHC q-o-q with CCI nsa

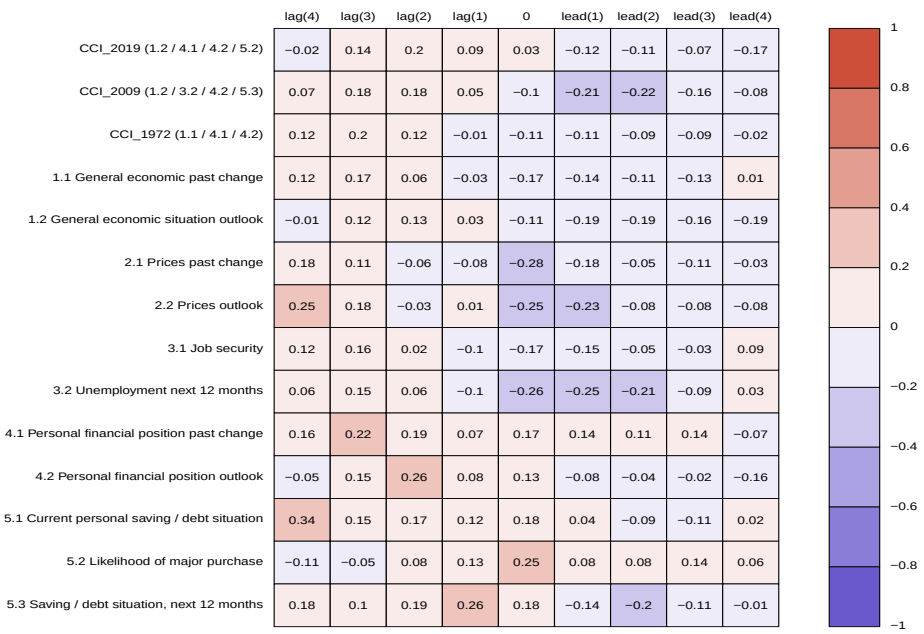

FIGURE 7. Cross-correlation: GDP y-o-y with CCI sa

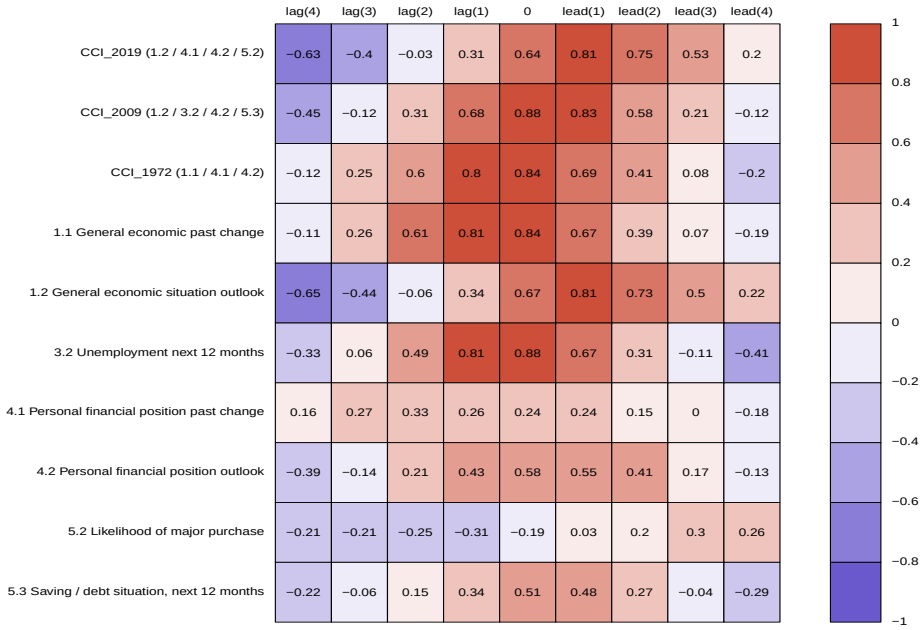

FIGURE 8. Cross-correlation: GDP q-o-q with CCI sa

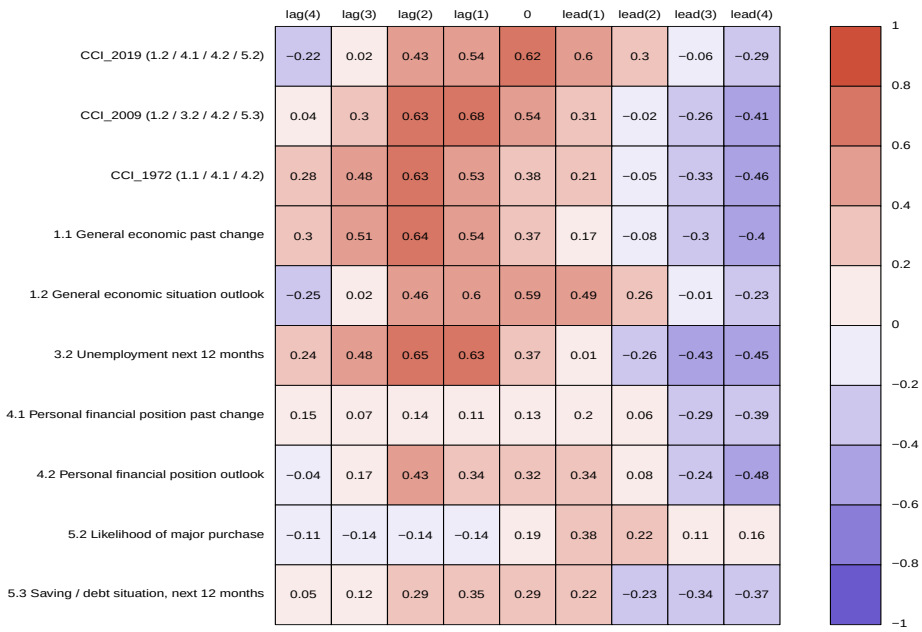

FIGURE 9. Cross-correlation: PHC y-o-y with CCI sa

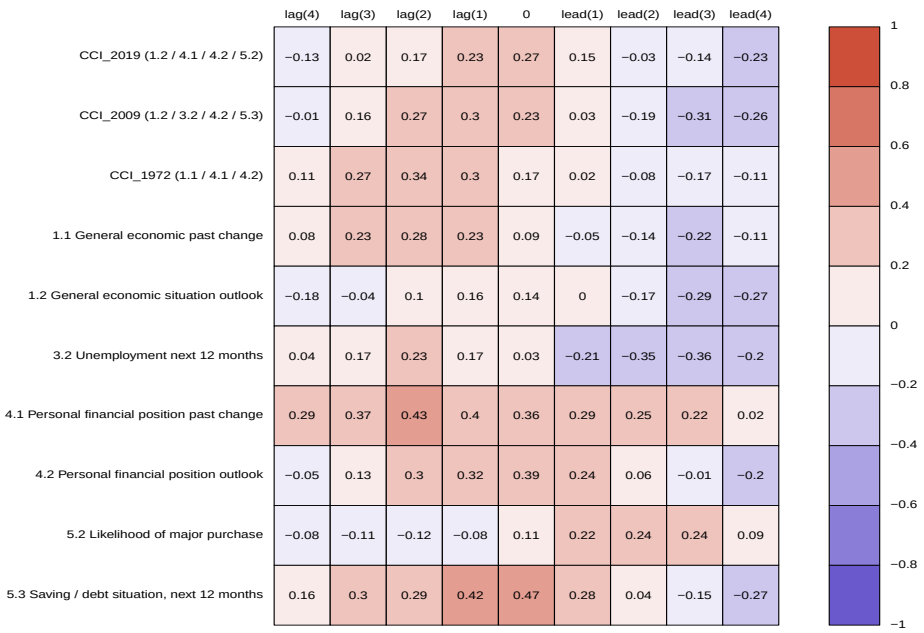

FIGURE 10. Cross-correlation: PHC q-o-q with CCI sa