Staff memo

Can inflation forecasts be improved by using alternative measures of labour market slack?

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Staff memo

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Summary

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Monetary policy affects inflation through several channels, including demand and resource utilisation in the economy. However, resource utilisation cannot be measured exactly and the Riksbank therefore makes an assessment based on data and indicators. Historically, the Riksbank has mainly used aggregate measures of total unemployment or various gaps to analyse the relationship between resource utilisation in the labour market and inflation. This staff memo analyses the co-variation between inflation and more than 50 other measures that can be assumed to capture labour market slack. Its aim is to investigate whether these measures are better at anticipating inflation than total unemployment according to the Labour Force Survey (LFS).

Many other measures of resource utilisation have a higher co-variation with inflation than total unemployment. In particular, inflation has a high co-variation with measures showing the labour market status of groups with relatively weak competitiveness in the labour market, such as those born abroad, those with a low level of education and the long-term unemployed. Co-variation is also high with measures showing the labour market status of the highly educated and those aged 25 to 34. A forecast evaluation also shows that several of the alternative measures of labour market slack had contributed to better model forecasts for the CPIF excluding energy than both a simple forecast model without indicator (autoregressive model) and a forecast model including total unemployment. However, the evaluation period is short and the results should therefore be interpreted with some caution.

We have not identified any individual indicators in the forecast evaluation that are clearly better than others at predicting the rate of inflation. Moreover, even if the evaluation period is short, the results indicate that the various indicators can generate quite different forecasts. All in all, the results suggest using a broader set of measures of resource utilisation in the labour market in the analysis of inflation.

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1 Introduction

The purpose of this staff memo is to examine whether there are alternative measures of resource utilisation in the labour market that are better than total unemployment at predicting the development of inflation in Sweden**.**

Economists have analysed theoretical and empirical links between resource utilisation and inflation since at least the end of the 1950s, when William Phillips observed a negative correlation between unemployment and inflation, thereby giving rise to the Phillips curve. It is relatively common to use aggregate measures such as total unemployment or various estimated gaps as a measure of resource utilisation.[2] However, if certain groups have a greater influence over price setting and wage formation, for example, it may be justifiable to monitor them on the labour market.

In recent years, several central banks, such as those in the United States and New Zealand, have drawn attention to a broader set of labour market indicators in addition to total unemployment. In general, these central banks monitor groups on the labour market that are more sensitive to fluctuations in economic activity and that have relatively weak competitiveness in the labour market.[3] An improvement in the labour market situation for these groups indicates that total resource utilisation in the labour market is beginning to be high and has also proved to be a good indicator of wage and price inflation. Actors outside the world of central banking have also noticed that more detailed measures of the labour market can be used to predict wage and inflation developments.[4]

One reason for the interest of the US and New Zealand central banks in weaker groups on the labour market is that they are mandated to act both to ensure maximum employment and to meet the inflation target. However, whether or not it is part of the central bank's mandate, economic policy in most countries is generally aimed at achieving durable high employment and low unemployment. Monitoring different measures of labour market slack and their interaction with inflation is one way of seeing how far the economy can be stimulated without inflation becoming too high.

[2] For example, at the end of 2016, the Riksbank published an article in its Monetary Policy Report that showed the relationship between different measures of resource utilisation and inflation. In addition to unemployment, the analysis included the Riksbank's resource utilisation indicator, the GDP gap, various measures of the labour market gap, and the development of unit labour costs. All the measures examined showed that high resource utilisation is normally followed by higher inflation, after a certain time lag; see Sveriges Riksbank (2016). The analysis in the article, as in this staff memo, is based on estimates in reduced form. Another approach would be to use structural models in which demand shocks affect both resource utilisation and prices.

[3] For example, on several occasions, the Federal Reserve has highlighted three measures: (i) unemployment among African Americans, (ii) wage increases in the lowest wage quartile, and (iii) labour participation among those without college education; see, for example, Powell (2021). Another example is the Reserve Bank of New Zealand, which uses unemployment among young people and Māori (the indigenous people of New Zealand) in its set of indicators for resource utilisation in the labour market; see Robinson, Culling and Price (2019).

[4] One example is Furman and Powell's analysis for the United States. They conclude that it is easier to predict wages than prices. The job quits rate is the best indicator for wage development, while the ratio of unemployed workers to job openings is the best indicator for core inflation; see Furman and Powell (2021).

2 Alternative measures illustrating labour market slack

In the following analysis, we have included time series that can be divided into three different groups.[5] The first contains the labour market status of groups that are **more sensitive to fluctuations in economic activity and that have relatively weak competitiveness**. Examples of series that capture groups with generally weak competitiveness are the proportion of employees in temporary employment, long-term unemployment, and unemployment among those born abroad, those with less education and young people. For example, the proportion of employees in temporary employment tends to increase early in an economic upturn and to decrease early in a downturn. The long-term unemployed and many people born abroad often find it difficult to get a job. Decreasing unemployment in these groups is thus a sign that resource utilisation is starting to become high.

The second group contains series showing the labour market status of groups that are **less sensitive to fluctuations in economic activity and that have generally strong competitiveness.** These series include unemployment among those born in Sweden, the highly educated and the short-term unemployed, more established midlife age groups, and age groups that are moving up the career ladder and changing jobs relatively frequently.[6]

Finally, in the third group, we have also included series illustrating **resource utilisation in the labour market as a whole**, such as average recruitment time in the business sector, vacancy rates and the number of unemployed people per job vacancy in the economy.

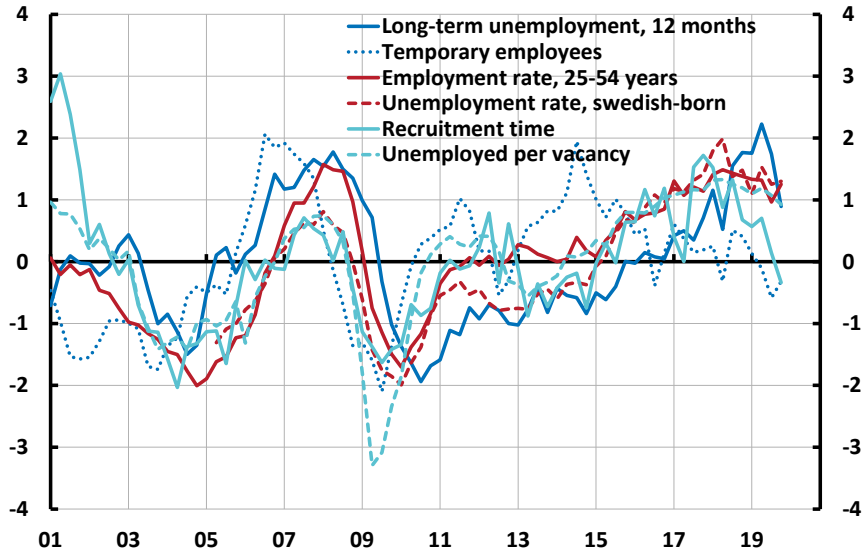
Figure 1 illustrates the spread between some of the included series in the three different groups. Dark blue lines refer to examples of more cyclically sensitive series, red lines refer to examples of less cyclically sensitive series, and turquoise series refer to examples of series that illustrate resource utilisation in the labour market as a whole.

[5] See Appendix 1 for a complete list of the time series included in the analysis.

[6] People who switch jobs generally have a stronger wage growth in that year than those who do not; see Flodberg, 2018.

Figure 1. Sample of alternative measures of resource utilisation

Standardised data, mean = 0, standard deviation = 1



Note: The series for long-term unemployment 12 months, unemployment among those born in Sweden, and number of unemployed people per vacancy are inverted.

Sources: Statistics Sweden and the Riksbank.

3 The co-variation with inflation is high for many of the measures

In a first step of the analysis, we have calculated the correlation between the different labour market series, including a summarising indicator[7], and three different measures of underlying inflation (CPIF excluding energy, UND24 and CPIFPC) expressed as annual percentage change.[8]

The correlations are estimated for the period for which data exists between 2000 and 2019. This means that the correlation for some series is estimated for a shorter period as these series do not extend so far back.[9] We choose this period partly because many

[7] A so-called principle component based on all series. Principal component analysis involves the calculation of what are known as latent variables (principal components), which explain as much as possible of the total variation of the original variables. The first principle component (used here) captures the largest share of the variation in the data set.

[8] In order to remove noise from energy prices, which is less affected by labour market slack, the CPI excluding energy is used as the most aggregated measure of inflation. Energy prices do not directly affect the CPIF excluding energy but they can affect the aggregate via so-called indirect effects such as higher costs. UND24 is an underlying measure of inflation that gives a higher weight to prices that vary slightly. The CPIFPC is a static factor estimated with the aid of principal component analysis. For an evaluation of different measures of underlying inflation, see Johansson, Löf, Sigrist and Tysklind (2018).

[9] See Appendix 1 for a review of how far back in time the different time series are available.

labour market series start in 2000 and partly because many of the labour market series are greatly affected by state support for short-time work compensation schemes during 2020–2021.[10]

In the further analysis below, we only retain series that have a higher co-variation with the CPIF excluding energy than with total unemployment according to the LFS.

3.1 Above all, measures for weaker groups have a high degree of co-variation with inflation

Nearly 30 of the series examined have a higher co-variation with the various measures of inflation than total unemployment.[11] There are relatively small differences between the measures that show a high correlation with the CPIF excluding energy, UND24 and the CPIFPC. In general, there are more series that capture groups with weak competitiveness in the labour market. In general, however, the correlations are higher for UND24 and the CPIFPC, which is probably because these inflation measures are less affected by temporary factors.

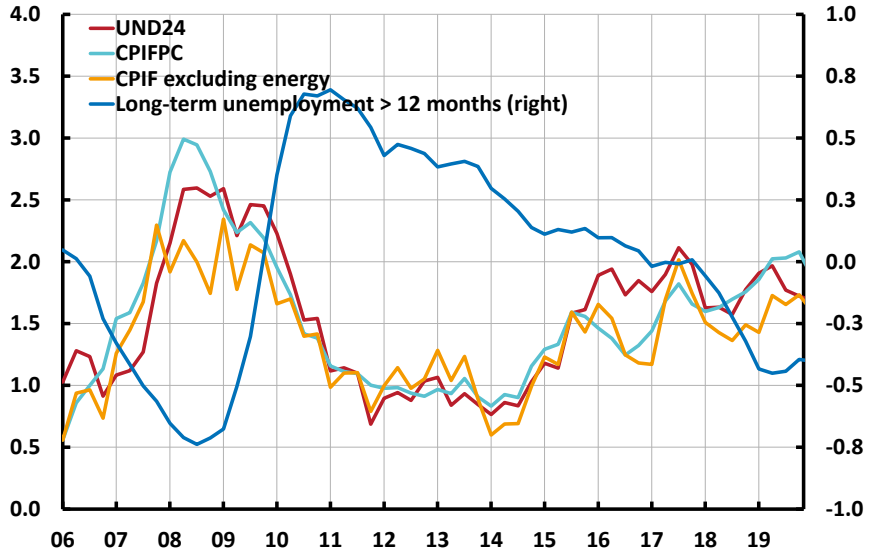
The maximum correlation has an average of four quarters of delay but there are large variations in the time lag between the different labour market measures. Long-term unemployment for more than 12 months according to the Swedish Public Employment Service is the series with the highest correlation with all inflation measures (see figure 2).[12]

[10] The support for short-time work compensation schemes allowed employers to adjust the number of hours worked without having to make employees redundant, which means that series such as unemployment and employment rate respectively increased and fell considerably less in conjunction with the crisis than the downturn in the number of hours worked. Crisis support during the pandemic differs from support in connection with earlier economic downturns, which means that the labour market may then develop differently to how it did in previous crises.

[11] See Appendix 2 for a full account.

[12] However, the fact that the correlation is high does not mean that there is causality.

Figure 2. Inflation and long-term unemployment for more than 12 months
Annual percentage change (left) and deviation from trend (right)

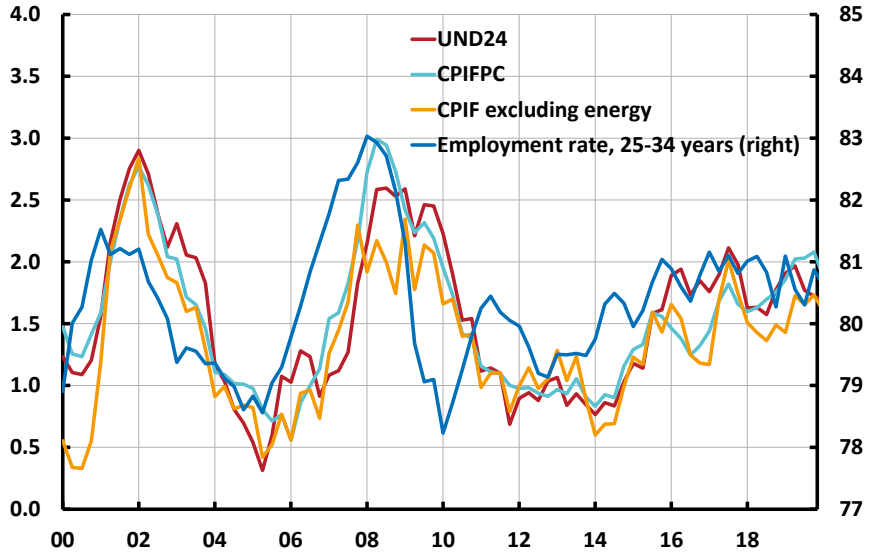


Note: The long-term unemployment series is non-stationary and is therefore trend-adjusted. The series consists of the residuals from a regression where a linear trend and an intercept have been estimated for the original series.

Sources: Swedish Public Employment Service, Statistics Sweden and the Riksbank.

However, the series for long-term unemployment of more than 12 months according to the Swedish Public Employment Service does not exist before 2006. The series that starts in 2000 and has the highest covariation with the inflation measures is the employment rate in the age group 25–34 years (see figure 3).

Figure 3. Inflation and employment rate, 25–34 years
Annual percentage change (left) and percentage of the labour force (right)



Sources: Statistics Sweden and the Riksbank.

3.2 The choice of time period has limited impact on results

We have also estimated the corresponding correlations for the period 2006–2019, partly because all series are available for this period and partly because we wish to examine whether differences in the length of the time series affect the results.

A comparison of these two estimation periods shows relatively small differences. On average, the correlation between labour market measures and inflation is somewhat higher for the short period. There are also slightly more series that have higher covariation with inflation than total unemployment according to the LFS over the short period than over the long period. However, the series that have a higher covariation over the short period overlap almost entirely with the series that also have it during the long period.

One difference between the short and long periods, however, is that the correlation, on average, is highest with a few quarters of additional delay over the short time period. The fact that the time lag in the correlation between the various labour market measures and inflation has been longer is in line with previous results where the Riksbank has analysed the relationship between labour market slack and inflation.[13]

4 Many of the measures have a higher coefficient of determination than total unemployment

In a second stage of the analysis, we have estimated equations for the CPIF excluding energy, UND24 and CPIFPC.[14] The analysis includes the measures of resource utilisation that have a higher correlation with inflation than total unemployment according to the LFS. The optimal time lag k from the same analysis is also used. The following specification is estimated for the periods 2000–2019 and 2006–2019:

$$\Delta^4\pi_t = \beta_1 + \beta_2\Delta^4\pi_{t-4} + \beta_3 AM_{t-k} + \varepsilon_t, \qquad (1)$$

where $\Delta^4\pi_t$ and $\Delta^4\pi_{t-4}$i (1) indicate annual percentage change for inflation for the current quarter and four quarters earlier, while AM_{t-k} indicates the respective labour market measures k quarters previously.

[13] See Sveriges Riksbank (2016).

[14] The specification follows a US study; see Furman and Powell (2021). The equations for UND24 and CPIFPC are given in Appendix 3.

Table 1. Equations for the CPIF excluding energy

		n	R^2	k	n	R^2	k
		2000–2019			2006–2019		
	Principal component	**71**	**0.63**	**0**	**53**	**0.70**	**0**
1	Long-term unemployment, more than 12 months, SPES				53	0.67	3
2	Employment rate, post-secondary education				53	0.61	5
3	Employment rate, 15– 74 years, born in Sweden				53	0.59	6
4	Unemployment, 25-34 years	76	0.58	3	53	0.57	6
5	Long-term unemployment, more than 24 months, SPES				53	0.57	1
6	Employment rate, 25–34 years	76	0.55	4	53	0.59	6
7	Long-term unemployment, more than 12 months, 15–74 years	71	0.51	5	53	0.62	5
8	Average length of unemployment, 15–74 years, born abroad				53	0.59	3
9	Long-term unemployment, more than 6 months, 16–64 years	76	0.37	4	53	0.59	6
10	Unemployment, 16–64 years, SPES	76	0.36	3	53	0.65	4
11	Long-term unemployment, more than 12 months, 16–64 years	76	0.28	3	53	0.60	5
	Total unemployment, LFS	**76**	**0.38**	**4**	**53**	**0.56**	**6**

Note: SPES refers to data from the Swedish Public Employment Service, while other series (apart from the principle component) are from the LFS. The results for 2000–2019 only include series available from 2000–2001. The principle component for 2000–2019 is based on the series 4, 6, 7, 9–11. The principle component for 2006–2019 is based on the series 1–11.

Source: The Riksbank.

The results for the CPIF excluding energy are summarised in table 1 above.[15] The second column in the table shows which labour market measures are included. *n*, in the third and sixth columns, shows how many observations are included in both time periods. R^2, in the fourth and seventh columns, shows the coefficient of determination for the various models. *k*, in the fifth and eighth columns, indicates the time lag used. The estimated coefficients for labour market measures are significantly different from zero in all cases.[16]

The analysis shows that the indicators obtained using so-called principle component analysis have the highest explanatory value for both the long and the short period. However, for the period 2006–2019, long-term unemployment according to the Swedish Public Employment Service has almost the same explanatory value as the principle component. Unemployment for persons aged 25–34 is the labour market series with the highest explanatory value for both periods. The ranking of the various indicators differs slightly between the short and long periods.

[15] Minor differences compared to the correlation analysis may arise, for example, because the lagged inflation term is included in (1).

[16] All indicators are significant at the one percent level for both the periods 2000–2019 and 2006–2019 but, in many cases, diagnostic tests indicate an autocorrelation in the first and fourth order residuals. As in the US study (see footnote 14), we have also tried using corrected standard errors (according to Newey-West). However, there is no change to the conclusion of significance.

5 Many of the measures provide better forecasts

In a final stage of the analysis, we make a forecast evaluation for the CPIF excluding energy to understand how well the different models work on average. We do this by comparing the models' forecasts for 2015 to 2019 against the actual outcomes for this period.

The models are first estimated using data for the period Q4 2006 to Q4 2014 to ensure a common time period. Using each model, we then generate forecasts one to three quarters ahead, starting from Q1 2015. We then extend the estimation period by one observation and repeat the exercise with a new estimate and new forecasts, up to and including Q3 2019. This provides a set of forecasts that we can use to estimate average forecasting ability.[17] We then evaluate the forecasting ability of the models using the root of the mean squared error (RMSE) and compare it with the forecasting ability for total unemployment according to both the LFS and an autoregressive model (see 0).

Forecast evaluation for CPIF excluding energy, 2015–2019, root of mean squared error (RMSE)

		n	Quarter		
			1	2	3
	Principle component (based on 1-11)	**53**	**0.25**	**0.26**	**0.27**
1	Employment rate, 25–34 years	53	0.18	0.18	0.19
2	Unemployment, 25–34 years	53	0.20	0.21	0.22
3	Long-term unemployment, more than 12 months, SPES	53	0.21	0.22	0.23
4	Employment rate, post-secondary education	53	0.22	0.22	0.23
5	Long-term unemployment, more than 6 months, 16–64 years	53	0.23	0.24	0.25
6	Long-term unemployment, more than 24 months, SPES	53	0.23	0.24	0.25
7	Unemployment, 16–64 years, SPES	53	0.25	0.26	0.27
8	Employment rate, 15– 74 years, born in Sweden	53	0.25	0.26	0.27
9	Long-term unemployment, more than 12 months, 15–74 years	53	0.26	0.27	0.28
10	Long-term unemployment, more than 12 months, 16–64 years	53	0.28	0.29	0.30
11	Average length of unemployment, 15–74 years, born abroad	53	0.29	0.30	0.32
	Total unemployment, LFS	**53**	**0.27**	**0.28**	**0.29**
	Autoregressive model, (1) without indicator	**53**	**0.29**	**0.30**	**0.31**

Note: SPES refers to data from the Swedish Public Employment Service, while other series (apart from the principle component) are from the LFS.

Source: The Riksbank.

[17] The final result is 20 forecasts one quarter ahead by model, 19 forecasts two quarters ahead and 18 forecasts three quarters ahead.

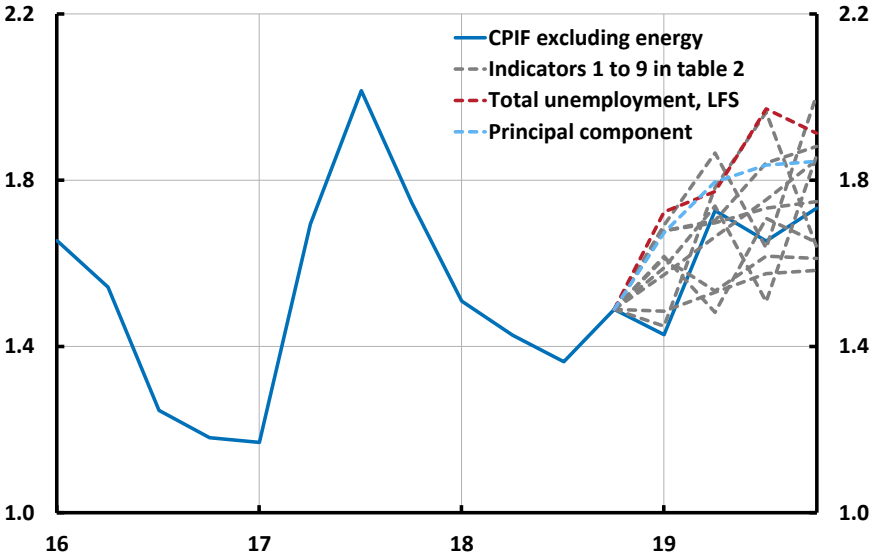
The forecasting ability of many of the indicators is relatively good with a low RMSE. However, the average time of unemployment for foreign-born persons, for example, works less well and does not seem to improve forecasting ability at all compared to a simple model without indicators (last line of the table).[18] Some examples of indicators that have a clearly better forecasting ability than total unemployment are the employment rate and unemployment in the age group 25–34 years. However, the evaluation period is short and the results should therefore be interpreted with some caution.

Figure 4 below shows forecasts for 2019 from models that include different measures of resource utilisation. The included measures are the same as those we presented in Table 2 above, except for indicators 10 and 11, which are long-term unemployment, more than 12 months, 16–64 years and average period of unemployment, 15–74 years, foreign-born. These both had a lower forecasting ability than total unemployment according to the LFS during the evaluation period 2015–2019.

The results indicate that the spread among the forecasts can be quite large. Using information for up to Q4 2018, the various models indicate that CPI inflation excluding energy would be between 1.6 and 2.0 per cent a year later in Q4 2019. Total unemployment according to the LFS gives one of the highest forecasts. Outcome amounted to 1.7 per cent.

Figure 4. Forecasts for the CPIF excluding energy, 2019

Annual percentage change



Note: Grey broken lines indicate forecasts from models that include indicators 1 to 9 in table 2 above.

Sources: Statistics Sweden and the Riksbank.

[18] During the evaluated period, there have been major changes in the Swedish labour market. Among other things, the number of refugees born in Africa and Asia have increased as a proportion of the foreign-born population in Sweden. On average, these groups have a lower chance of finding work, which may have increased the correlation between inflation and the average period of unemployment for those born abroad over the whole period, at the same time as the forecasting ability of the series has been relatively poor.

6 Alternative measures of labour market slack should be included in the analysis of inflation

All in all, the results in this staff memo suggest that the analysis of inflation should be supplemented with other measures of resource utilisation in the labour market. We have not identified any indicators that are clearly better than others are. The results also indicate that the spread among the forecasts can be quite large depending on the indicator and that the ranking is somewhat sensitive to the estimation period selected. It is therefore important to use a broader set of measures of resource utilisation in the analysis of inflation.

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APPENDIX 1 – List of series tested

1	Unemployment, 15–74 years, LFS, 2000q1–2019q4.
2	Unemployment, 15–74 years, born in Sweden, LFS, 2005q2–2019q4.
3	Unemployment, 15–74 years, born abroad, LFS, trend-adjusted, 2005q2–2019q4.
4	Unemployment, 15–74 years, pre-secondary education, LFS (non-spliced data), trend-adjusted, 2005q2–2019q4.
5	Unemployment, 15–74 years, upper secondary education (non-spliced data), 2005q2–2019q4.
6	Unemployment, 15–74 years, post-secondary education, LFS (non-spliced data), 2005q2–2019q4.
7	Unemployment, 20–24 years, LFS, 2000q1–2019q4.
8	Unemployment, 25–34 years, LFS, 2000q1–2019q4.
9	Unemployment, 25–54 years, LFS, 2000q1–2019q4.
10	Unemployment, 35–44 years, LFS, 2000q1–2019q4.
11	Unemployment, 45–54 years, LFS, trend-adjusted, 2000q1–2019q4.
12	Unemployment, 55–64 years, LFS, 2000q1–2019q4.
13	Unemployment, 16–64 years, SPES, 2000q1–2019q4.
14	Open unemployment, 16–64 years, SPES, 2000q1–2019q4.
15	Unemployment among unemployment insurance fund members (excluding ALFA), SPES and Swedish Unemployment Insurance Board, 2004q1–2019q4.
16	Long-term unemployment, over six months, per cent of the labour force, 15–74 years, LFS (non-spliced data), 2001q1–2019q4.
17	Long-term unemployment, over six months, per cent of the labour force, 16–64 years, LFS (non-spliced data), 2000q1–2019q4.
18	Long-term unemployment, over one year, per cent of the labour force, 15–74 years, LFS (non-spliced data), trend-adjusted, 2001q1–2019q4.
19	Long-term unemployment, over one year, per cent of the labour force, 16–64 years, LFS (non-spliced data), 2000q1–2019q4.
20	Long-term unemployment, over six months, per cent of register-based labour force, 16–64 years, SPES, 2006q1–2019q4.
21	Long-term unemployment, over one year, per cent of register-based labour force, 16–64 years, SPES, trend-adjusted, 2006q1–2019q4.
22	Long-term unemployment, over two years, per cent of register-based labour force, 16–64 years, SPES, trend-adjusted, 2006q1–2019q4.
23	Short-term unemployment, less than six months, per cent of register-based labour force, 16–64 years, SPES, 2006q1–2019q4
24	Average period in unemployment (weeks), 15–74 years, LFS, trend-adjusted, 2001q1–2019q4.
25	Average period in unemployment (weeks), 16–64 years, LFS, trend-adjusted, 2000q1–2019q4.
26	Average period in unemployment (weeks), born in Sweden, 15–74 years, LFS, 2005q2–2019q4.
27	Average period in unemployment (weeks), born abroad, 15–74 years, LFS, trend-adjusted, 2005q2–2019q4.
28	Fixed-term employees, proportion of employees, LFS, trend-adjusted, 2001q1–2019q4.
29	Total new recruitment, proportion of employees, STES, 2001q1–2019q4.
30	New permanent recruitment, proportion of employees, STES, 2001q1–2019q4.
31	New fixed-term recruitment, proportion of employees, STES, trend-adjusted, 2001q1–2019q4.
32	Average recruitment time in business sector (months), STVS, trend adjusted, 2001q1-2019q4.

33	Separations among permanent employees, proportion of employees, STES, trend-adjusted, 2000q1–2019q4
34	Vacancies needing to be filled immediately, percentage of job openings, short-term vacancy statistics, 2002q1–2019q4.
35	Employment in manufacturing, NA, trend-adjusted, 2000q1–2019q4.
36	Employment in temporary employment sector, NA, trend-adjusted, 2000q1–2019q4.
37	Employment in manufacturing sector, annual percentage change, NA, 2000q1-2019q4.
38	Employment in temporary employment sector, annual percentage change, NA, 2000q1–2019q4.
39	Number of unemployed people per available job, LFS and STVS, trend-adjusted, 2001q1–2019q4.
40	Number of unemployed people per new vacancy, LFS and SPES, 2000q1–2019q4.
41	Number of unemployed people per job vacancy, LFS and STVS, 2001q1–2019q4.
42	Employment rate, 15–74 years, LFS, trend-adjusted, 2001q1–2019q4.
43	Employment rate, 15–74 years, born in Sweden, LFS, trend-adjusted, 2005q2–2019q4.
44	Employment rate, 15–74 years, born abroad, LFS, trend-adjusted, 2005q2–2019q4.
45	Employment rate, 15–74 years, pre-secondary education, LFS (non-spliced data), trend-adjusted, 2005q2–2019q4.
46	Employment rate, 15–74 years, upper secondary education (non-spliced data), 2005q2–2019q4.
47	Employment rate, 15–74 years, post-secondary education, LFS (non-spliced data), 2005q2–2019q4.
48	Employment rate, 20–24 years, LFS, 2000q1–2019q4.
49	Employment rate, 25–34 years, LFS, 2000q1–2019q4.
50	Employment rate, 25–54 years, LFS, 2000q1–2019q4.
51	Employment rate, 35–44 years, LFS, trend-adjusted, 2000q1–2019q4.
52	Employment rate, 45–54 years, LFS, trend-adjusted, 2000q1–2019q4.
53	Employment rate, 55–64 years, LFS, trend-adjusted, 2000q1–2019q4.
54	Job-finding rate, SPES, trend-adjusted, 2000q1-2019q4.
55	Principal components (a separate component for each inflation series), 2006q1–2019q4 (common time period for series 1–54 above).

Note: SPES = Swedish Public Employment Service, STES = short-term employment statistics, STVS = short-term vacancy statistics, NA = National accounts, LFS = Labour Force Survey. Trend-adjusted series refers to residuals from a regression where a linear trend and an intercept have been estimated for the original series. Non-spliced data refers to LFS series that Statistics Sweden has not yet spliced following the changeover in statistics in January 2021.

APPENDIX 2 – Correlation tables

Table A1. Maximal correlation between various labour market measures and inflation over the period 2000–2019

Coefficient and time lag in number of quarters in brackets

	CPIFxE	UND24	CPIFPC
Long-term unemployment >12 months, SPES	-0.85 (3)	-0.91 (3)	-0.92 (2)
Average length of unemployment, born abroad	-0.83 (3)	-0.79 (3)	-0.86 (2)
Long-term unemployment >24 months, SPES	-0.81 (1)	-0.89 (2)	-0.91 (1)
Employment rate, born in Sweden	0.81 (6)	0.83 (6)	0.88 (5)
Principal component	-0.78 (6)	-0.82 (6)	-0.83 (5)
Employment rate, secondary education	0.78 (6)	0.79 (7)	0.88 (6)
Employment rate, 25–34 years	0.78 (4)	0.82 (5)	0.85 (4)
Employment rate, post-secondary education	0.77 (5)	0.88 (4)	0.90 (3)
Unemployment, born abroad	-0.75 (5)	-0.83 (6)	-0.83 (5)
Unemployment, 25–34 years	-0.75 (3)	-0.77 (4)	-0.81 (3)
Long-term unemployment >6 months, SPES	-0.74 (3)	-0.77 (3)	-0.87 (2)
Long-term unemployment >6 months	-0.74 (5)	-0.76 (5)	-0.81 (5)
Long-term unemployment >12 months	-0.74 (5)	-0.75 (5)	-0.84 (5)
Average length of unemployment, born in Sweden	-0.73 (5)	-0.71 (6)	-0.80 (3)
Unemployment, upper secondary education	-0.72 (6)	-0.78 (6)	-0.77 (5)
Long-term unemployment 0–6 months, SPES	-0.70 (5)	-0.75 (5)	-0.73 (5)
Unemployment, 25–54 years	-0.70 (4)	-0.74 (4)	-0.79 (3)
Unemployment, post-secondary education	-0.70 (5)	-0.78 (5)	-0.75 (4)
Separations, percent of employees, STES	0.70 (2)	0.75 (2)	
Long-term unemployment >6 months, 16–64 years	-0.69 (4)	-0.73 (4)	-0.78 (4)
Employment rate, upper secondary education	0.69 (6)	0.67 (6)	0.79 (5)
Employment rate, born abroad	0.69 (5)	0.78 (6)	0.75 (5)
Unemployment, 35–44 years	-0.68 (4)	-0.68 (4)	-0.75 (3)
Employment rate, 20–24 years	0.63 (4)	0.73 (4)	0.70 (4)
Long-term unemployment >12 months, 16–64 years	-0.63 (3)	-0.67 (3)	-0.75 (3)
Unemployment, 16–64 years, SPES	-0.63 (3)	-0.69 (4)	-0.79 (3)
Employment growth, temporary employment agencies, NA	0.62 (8)		
Job-finding rate, SPES			0.71 (5)
Total unemployment, LFS	**-0.60 (4)**	**-0.66 (4)**	**-0.69 (4)**

Note: CPIF excluding energy (CPIFxE). Labour market series where age group is not specified refers to 15–74 years. SPES = Swedish Public Employment Service, STES = short-term employment statistics, NA = National accounts. Unless otherwise stated, data refers to the Labour Force Survey. An empty column means that the labour market series does not have a higher correlation than total unemployment for that measure of inflation. Length of the lag in brackets.

Source: The Riksbank.

APPENDIX 3 – Equations for UND24 and CPIFPC

Table A2. Equations for UND24

		n	R^2	k	n	R^2	k
		2000–2019			2006–2019		
	Principal component	**71**	**0.68**	**0**	**52**	**0.78**	**0**
1	Employment rate, post-secondary education				52	0.79	4
2	Long-term unemployment, more than 12 months, SPES				52	0.78	3
3	Employment rate, 15– 74 years, born in Sweden				52	0.72	6
4	Employment rate, 15– 74 years, born abroad				52	0.69	6
5	Long-term unemployment, more than 24 months, SPES				52	0.69	2
6	Employment rate, secondary education				52	0.64	7
7	Long-term unemployment, more than 6 months, 15–74 years	71	0.61	5	52	0.71	6
8	Employment rate, 25–34 years	75	0.57	5	52	0.73	5
9	Average length of unemployment, 15–74 years, born abroad				52	0.61	3
10	Long-term unemployment, more than 12 months, 15–74 years	71	0.55	5	52	0.71	5
11	Long-term unemployment, more than 6 months, 16–64 years	76	0.49	4	52	0.71	6
12	Unemployment, 16–64 years, SPES	76	0.46	4	52	0.75	5
13	Long-term unemployment, more than 12 months, 16–64 years	76	0.43	3	52	0.68	5
	Total unemployment, LFS	**76**	**0.50**	**4**	**52**	**0.68**	**6**

Note: SPES refers to data from the Swedish Public Employment Service, while other series (apart from the principle component) are from the LFS. The results for 2000–2019 only include series available from 2000–2001. The principle component for 2000–2019 is based on the series 7, 8, 10–13. The principle component for 2006–2019 is based on the series 1–13.

Source: The Riksbank.

Table A3. Equations for CPIFPC

		n	R^2	k	n	R^2	k
		2000–2019			2006–2019		
	Principal component	**71**	**0.76**	**0**	**53**	**0.86**	**0**
1	Long-term unemployment, more than 12 months, SPES			2	53	0.84	2
2	Employment rate, post-secondary education			3	53	0.79	4
3	Employment rate, 15– 74 years, born in Sweden			5	53	0.79	5
4	Employment rate, secondary education			6	53	0.77	6
5	Long-term unemployment, more than 24 months, SPES			1	53	0.78	1
6	Long-term unemployment, more than 6 months, SPES			2	53	0.72	2
7	Unemployment, 15– 74 years, born abroad			5	53	0.69	5
8	Unemployment, 25–54 years	76	0.67	3	53	0.70	5
9	Long-term unemployment, more than 6 months, 15–74 years	71	0.66	5	53	0.73	5
10	Long-term unemployment, more than 12 months, 15–74 years	71	0.63	5	53	0.76	5
11	Unemployment, 16–64 years, SPES	76	0.61	3	53	0.86	3
12	Average length of unemployment, 15–74 years, born abroad				53	0.72	3
13	Long-term unemployment, more than 6 months, 16–64 years	76	0.56	4	53	0.74	5
14	Long-term unemployment, more than 12 months, 16–64 years	76	0.52	3	53	0.79	4
15	Job-finding rate, SPES	75	0.51	5	53	0.74	5
	Total unemployment, LFS	**76**	**0.54**	**4**	**53**	**0.71**	**5**

Note: SPES refers to data from the Swedish Public Employment Service, while other series (apart from the principle component) are from the LFS. The results for 2000–2019 only include series available from 2000–2001. The principle component for 2000–2019 is based on the series 8–11, 13–15. The principle component for 2006–2019 is based on the series 1–15.

Source: The Riksbank.

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