

Resource utilisation, costs and inflation

The aim of this box is to illustrate the relationship between resource utilisation, cost levels and inflation.

An important message is that there are no simple correlations between these variables. For instance, resource utilisation is not a quantity that can be directly observed and no clear definition is provided in economic theory. Resource utilisation can accordingly be measured in different ways and different measures do not produce an entirely clear-cut picture. The correlation between resource utilisation and inflation is moreover affected by the disturbances the economy is exposed to. For instance, the Swedish economy has been exposed to a number of "positive supply shocks" which have led to falling inflation and cost levels without resulting in a corresponding fall in resource utilisation.

Changes in the inflation rate are correlated with resource utilisation and/or cost levels in the economy. This view often characterises analyses that serve as the basis for forecasts and assessments of the best formulation of monetary policy. In economic studies, the correlations between inflation, resource utilisation and the cost levels are often described in terms of some variant of the Phillips curve.

According to modern "Neo-Keynesian" theory, inflation depends on inflation expectations and firms' marginal costs. In principle, the Phillips curve then has the following appearance:

$$\pi = a \cdot \pi^e + b \cdot mc,$$

where π denotes inflation, π^e households' and firms' expectations of inflation, mc a measure of firms' costs to increase production (their real marginal cost), and a and b are parameters with a positive value which depend on a number of different factors that affect the functioning of

the economy, e.g. the degree of price rigidity. Neo-Keynesian theory thus stresses the cost situation (more specifically, the firms' real marginal cost) as a key determinant of the rate of inflation. A key assumption underlying this theory is that firms, for various reasons, choose not to change their prices for long periods of time. However, when they eventually do change a price, they take into consideration what they expect inflation and their production cost to be in the future, i.e. during the period that the price is to be unchanged.

The Neo-Keynesian Phillips curve is reminiscent of the traditional Phillips curve. The difference is that the Neo-Keynesian theory emphasises the firm's costs while the traditional theory emphasises resource utilisation as the central determinant. The traditional Phillips curve is usually described as follows:

$$\pi = \pi^e + c \cdot \gamma,$$

where γ is a measure of resource utilisation and c a parameter larger than zero. According to the traditional Phillips curve, inflation is determined by resource utilisation and inflation expectations.²⁰

The difference between the Neo-Keynesian and the traditional Phillips curves is not necessarily so great, since there is some correlation between the firms' real marginal cost and the degree of resource utilisation.²¹ In practice, it is difficult to measure both resource utilisation and cost levels. There are a number of different measures with more or less strong theoretical and empirical support.

One commonly used way of describing resource utilisation is to measure the difference between the actual level of output, GDP, and some conceivable trend level. The trend level can, in turn, be calculated in various ways and is occasionally labelled "potential" GDP or "the long-term sustainable" GDP level. The difference

²⁰ A description of the traditional Phillips curve can be found in any basic textbook such as Mankiw G., *Macroeconomics*, Worth Publishers, 2002.

²¹ According to Neo-Keynesian theory, a direct and simple relationship only exists in certain conditions. This is the case, for instance, if no capital accumulation takes place in the economy and if wages are completely flexible. See also Galí, J. Clarida, & M. Gertler, "The Science of Monetary Policy: A New Keynesian Perspective", *Journal of Economic Literature* 37, 1999 for a description of the Neo-Keynesian theory and the correlation between real marginal cost and resource utilisation.

Figure B2. Proportion of firms with full capacity utilisation in three service industries
Per cent

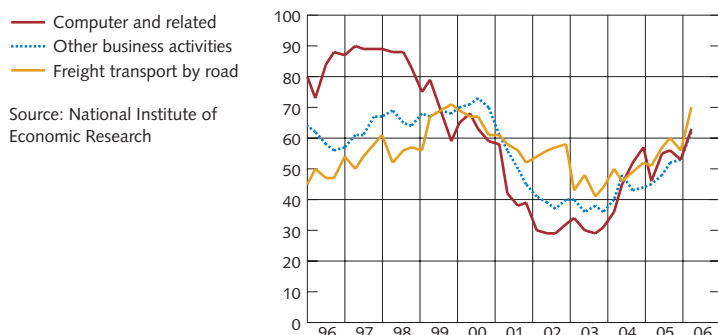
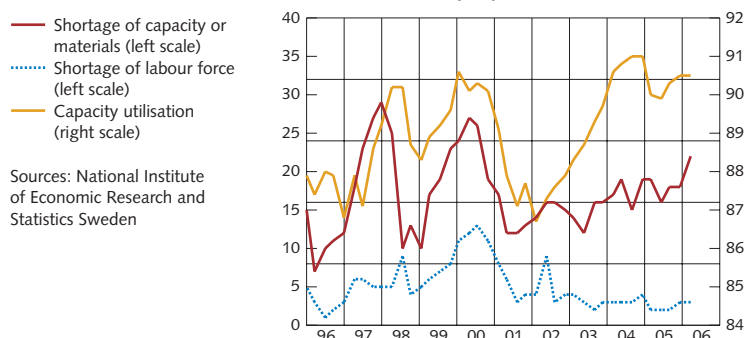


Figure B3. Bottlenecks and capacity utilisation in the manufacturing sector, proportion of companies
Per cent, seasonally adjusted data



between actual and trend GDP is referred to as the “output gap” in this context. It is also common for resource utilisation in the economy to be measured by an estimate of the amount of spare capacity in the labour market or the utilisation of existing production capacity in the form of machinery and buildings in firms (e.g. through surveys).

Resource utilisation is not a quantity that can be directly observed and no clear definition is provided in economic theory. Moreover, historical data are often subsequently revised. The picture of how high capacity utilisation was at a particular point in time can look different when new data are received and earlier data revised. This applies both for measures based on GDP data and measures based on the rate of utilisation of production factors.

In the remaining part of this box, some common measures of resource utilisation are first shown at the same time as an assessment is made about what these measures say about the present cyclical conditions. Subsequently, the historical correlations between inflation, resource utilisation and cost levels are shown.

Resource utilisation from a historical perspective

Figures B2–B4 show how different measures of resource utilisation in the Swedish economy have developed during the past decade. Figures B2 and B3 show the degree of resource utilisation in several service industries and the manufacturing industry, according to surveys. The figures show that the level of economic activity peaked during 2000 and subsequently slackened off. At the end of 2003 and the beginning of 2004, resource utilisation, measured in these ways, started to rise again. However, the picture is not entirely clear-cut. Firstly, it is unclear how the level of resource utilisation currently relates to the last peak in 2000. According to a couple of indicators, resource utilisation is approximately as high now as it was then, although the overall picture is none the less that there is far more spare capacity than in 2000. Secondly, the picture of resource utilisation changes if one looks at the shortage of labour in industry (in Figure B3), which is still low.

Figure B4 shows how GDP, employment and the number of hours worked deviate from their respective trends in the past 25 years.²² The exact dates of the peaks and troughs differ between the series, although all in all they produce a rather coherent picture. Once again, we obtain a picture of a cyclical stage which peaked around 2000 and then slackened off. It is worth noting that there is a slight time lag in the turning points in the labour market in relation to production. The overall picture is that resource utilisation is lower than in 2000. This year was characterised by an upturn while

²² Trend deviations have been calculated by an HP filter. Series which have been decomposed have been extended with the Riksbank's forecasts for 2006–2009.

the situation in 2006 may, if the forecasts are accurate, be considered as being approximately normal (average).²³

To sum up, utilisation of economic resources has increased in Sweden in recent years and is presently continuing to increase. From a historical perspective, the situation in 2006 can be described as being about normal. In manufacturing industry, the shortage of labour is as low as in the mid-1990s, although other measures and the situation in other industries indicate higher resource utilisation. Total employment and hours worked are not obviously below long-term trends even though this conclusion naturally depends on how one decides to calculate the trends.

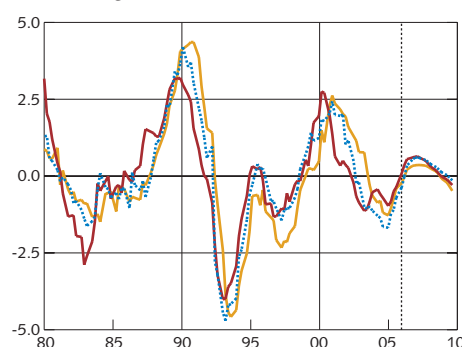
Resource utilisation and costs

While several different measures of resource utilisation in the economy indicated stronger economic performance in 2004 and 2005, inflation has been low. Initially, it was noted that Neo-Keynesian theory emphasises cost levels as an important driving force for inflation.

Figure B5 shows the actual development of inflation measured by UND1X (quarterly data) together with model-based measures of the marginal cost and output gap.²⁴ Marginal cost is calculated as the real labour cost per unit produced, which in the model is the same as labour costs in relation to GDP. The output gap is calculated as the difference between actual GDP and GDP in long-term equilibrium (steady state). When calculating this measure, the long-term trend of the GDP growth rate has been permitted to vary over time.²⁵

To start with, it can be noted that the measure chosen for the output gap will produce approximately the same picture as the above measure in Figures B2-B4. Moreover, in Figure

Figure B4. GDP, employment and hours worked
Percentage deviation from the trend

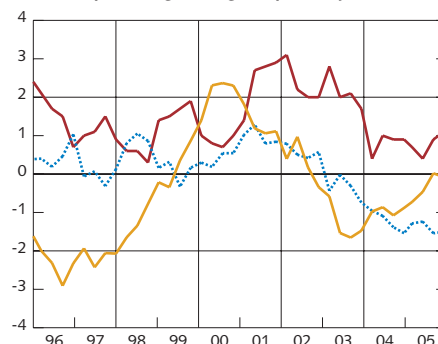


Hours worked
GDP
Employed

Note. Unbroken line after the vertical broken line refers to forecasts.

Sources: Statistics Sweden and the Riksbank

Figure B5. UND1X and the model-based measure of output gap and marginal cost
Percentage deviation from trend (gap and cost) and annual percentage change respectively (UND1X)



UND1X
Marginal cost
Output gap

Source: The Riksbank

B5 the correlation between inflation and the output gap in the same quarter is lower (0.15) than the correlation between inflation and cost pressures (0.35). The correlations are stronger looking at inflation in a particular quarter and cost pressures or the output gap a few quarters earlier. According to Figure B5, there seems on average to have been positive correlations in such a way that a rising output gap or cost levels has been accompanied by rising inflation. However, during 2004 and 2005, cost levels fell and the output gap increased.

According to economic theory, one should not expect stable correlations over time, but the strength of the correlations will depend on what happens to inflation expectations and the

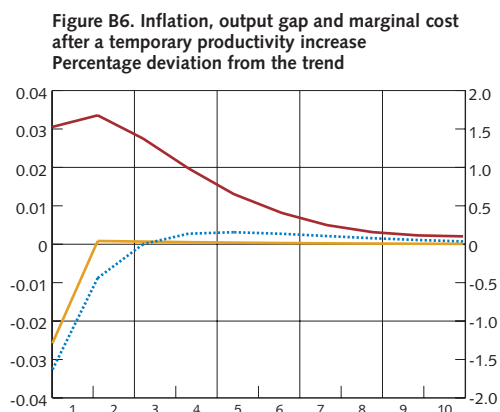
23 There are a lot of different approaches in economic theory to the meaning of a "normal" level of economic activity. It may, for instance, mean "equilibrium", "stable prices", etc. See Rogerson R., "Theory ahead of language in the economics of unemployment", *Journal of Economic Perspectives* 11, 1997 for a discussion on this topic. The concept of normal is used in this box to describe a situation where the economy is in neither a boom nor a recession.

24 For a description of the model, see Adolfson, M., S. Laséen, J. Lindé and M. Villani, "Bayesian Estimation of an Open Economy DSGE Model with Incomplete Pass-Through", *Sveriges Riksbank Working Paper Series* No. 179, 2005.

25 The output function in the model is given by $Y = \varepsilon \cdot z^{1-\alpha} \cdot K^\alpha \cdot H^{1-\alpha} \cdot \theta$, where Y denotes GDP, z a permanent productivity shock, ε a temporary productivity shock, K input of capital services, H number of hours worked, θ a fixed production cost and α a parameter. The output gap is calculated as the difference between actual GDP and GDP in long-term equilibrium (steady state) $\ln Y - \ln Y^*$, where Y^* denotes the trend (steady state) level of GDP. Note that the output gap is affected by disturbances to the long-term trend in GDP since z varies over time.

— Output gap
(left scale)
 Inflation
(left scale)
 — Marginal cost
(right scale)

Note. The time axis shows the quarter after the supply shock.
 Source: The Riksbank



disturbances the economy is exposed to. This is one reason why there is no simple empirical correlation between resource utilisation and inflation. The same applies, of course, to the correlation between inflation and real marginal cost. When interpreting economic development, it is therefore important to identify the type of disturbance that has affected the economy at different times.

The present situation in Sweden, with an approximately normal resource utilisation at the same time as cost pressures and inflation are unusually low, is easier to understand if, in line with Neo-Keynesian theory, changes in supply conditions are taken into consideration as a driving force for development.²⁶ Figure B6 shows model-based calculations of how inflation, real marginal cost and the output gap are affected by a temporary increase in the level of productivity. This increase in productivity is temporary insofar as productivity returns to its normal level after a while. The increase in productivity reduces the firms' costs leading to falling prices. Since the disturbance is temporary, the long-term trend equilibrium of GDP is not affected. The increased production opportunities therefore lead to an increase in both output and the output gap. The correlation between inflation and the output gap will thus be negative in this case and not positive as in traditional explanations of the Phillips curve

relationship. This example illustrates that upturns in productivity could be a reason why inflation has remained at a low level while cyclical conditions have generally improved. However, this does not mean that changes in demand do not have any effects on inflation and the level of economic activity.

Conclusion

To sum up, the correlation between inflation, the cost levels, and different measures of resource utilisation, both theoretical and empirical, are discussed in this box. Important messages have been that there are no simple correlations between inflation, cost levels and resource utilisation, and the correlation between different economic variables depends on the disturbances the economy is exposed to. In recent years, inflation has been low at the same time as various measures of resource utilisation have indicated an upturn. This suggests that inflation in Sweden is affected by changes in the supply side of the economy, including increased productivity (technological improvements) and not just by the demand situation.

There are of course other circumstances that are important to bear in mind when interpreting the Swedish inflation path. The low cost pressure in Sweden not only depends on high productivity but also on wage increases being low from a historical perspective. This in turn is connected with the relatively low resource utilisation in the labour market which in turn depends on the good productivity development and previous weakening of economic performance in Sweden and internationally. In recent years, the path of inflation has also been affected to a large extent by low import prices. Sweden is a small open economy where around one-third of household consumption is imported and therefore import prices are an important explanatory factor.

²⁶ Inflation expectations are a determinant for the inflation path in both the Neo-Keynesian and the traditional Phillips curve. During the past six years, however, the determinants of inflation two years ahead have been relatively constant at around 2 per cent. This indicates that the inflation outcomes in recent years cannot be explained by changes in households' and firms' inflation expectations.