

## CAPACITY UTILISATION AND ITS RELATIONSHIP TO INFLATION IN THE EURO AREA

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### **Introduction**

Capacity utilisation indicators are currently very high in the euro area, and close to their highest rates of the last 20 years. The most popular of these indicators, the rate of capacity utilisation in manufacturing (CU), having risen continuously over the past two years, stood very close to its all-time high in 2007 Q3, despite being slightly down from Q2. Likewise, other indicators of the extent to which installed production capacity is being used and, generally, of the degree of slack in the economy, are at levels which appear to show that it has fallen significantly.

The demand pressures implied by the developments described above may be signalling the emergence of inflationary pressures in the euro area. These circumstances have been alluded to on several occasions this year by the ECB, which has been highlighting the existence of upside risks to medium-term price stability related to the ongoing improvement in euro area labour markets (which may give rise to higher-than-expected wage settlements) and to the high rate of capacity utilisation. The recent path of euro area inflation, which has remained contained, indicates that these inflationary pressures have not as yet materialised. In the specific case of the CU, moreover, the empirical evidence available shows that its relationship to inflation is weak in the euro area and that in countries such as the United States, for which studies covering longer periods are available, it has weakened over the last two decades. The CU therefore seems to have lost predictive power with respect to inflation.

Against this background, this article analyses the role of the CU in the set of information on which monetary policy decisions are based. The second section contains a descriptive analysis of the recent behaviour of measures of the rate of capacity utilisation in the euro area<sup>1</sup>. The third section reviews the empirical evidence on the relationship between the CU and inflation, and the fourth section analyses what factors may have given rise to the change that seems to have been detected in that relationship and, more importantly, how they may affect its relevance as a useful indicator for monetary policy. Finally, the conclusions are set out in the fifth section.

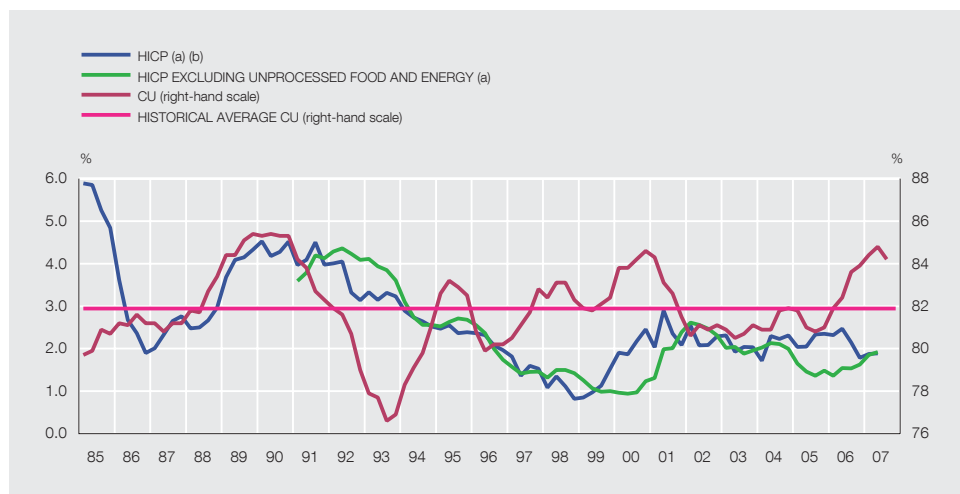
### **Recent developments in the rate of capacity utilisation**

The main indicator to approximate the degree of utilisation of installed production capacity is derived from the European Commission's quarterly Industry Survey, compiled since 1985. This indicator summarises the direct responses of all the employers surveyed regarding the percentage utilisation of their installed production capacity. In the last two years, during which euro area economic activity has recovered to a robust growth path, the rate of capacity utilisation in manufacturing has followed an upward path, which has only been interrupted in Q3 this year (probably reflecting the uncertainty generated by the recent turbulence in financial markets) (see Chart 1). In 2007 Q2, the manufacturing sector was operating, on average, at 84.8% of its full capacity, a much higher level than the average for the period 1985-2006 (81.8%) and very close to the all-time high (85.4%) recorded in 1990 Q2, when high CU rates coincided with high inflation rates.

The European Commission's quarterly Industry Survey also contains other questions that provide additional qualitative indicators of the use of production capacity and, in general, of the

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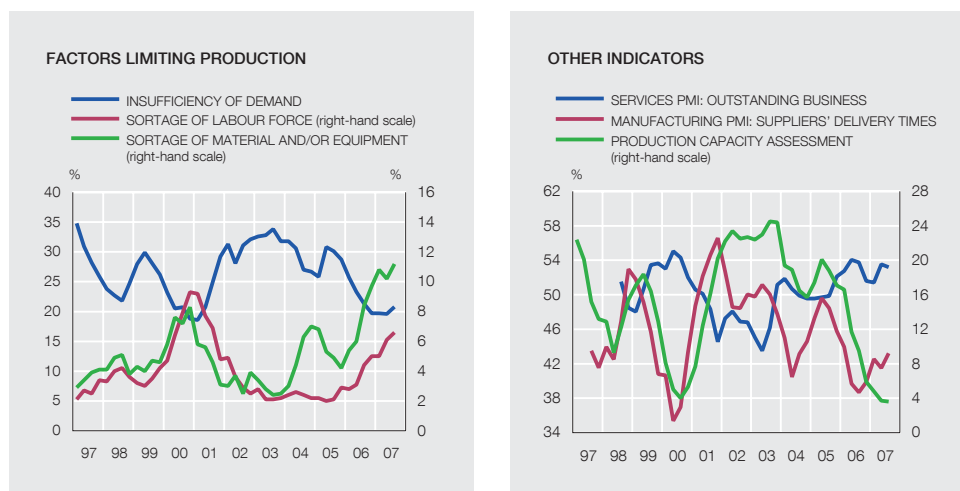
1. See the Appendix for a detailed description of all the indicators analysed.



SOURCES: European Central Bank, European Commission and Eurostat.

a. Year-on-year growth rate.  
 b. Prior to 1990 (1991, in terms of the year-on-year growth rate), the HICP data correspond to ECB calculations based on national and Eurostat data.

OTHER INDICATORS OF CAPACITY UTILISATION (a)



SOURCES: European Commission, Eurostat and Reuters.

a. For a detailed explanation of the various indicators, see the appendix.

degree of slack in the euro area economy. The recent trend in these indicators also shows a decrease in this slack. Thus, as seen in Chart 2, the assessment of current production capacity has fallen continuously since mid-2005, implying that the percentage of firms that consider their available production capacity insufficient to meet their projected demand has increased. In 2007 Q3, this indicator fell to 3.6, well below its average level in the period 1985-2006 (17.5), lower levels only being recorded in late 1989 and early 1990. The responses of the employers surveyed regarding the factors limiting their volume of production point in the same direction, since the proportion of firms that indicate demand insufficiency as the main limiting factor has fallen by almost 10 percentage points since 2005 Q2, while those of firms mentioning shortages of labour and of equipment have risen significantly since the end of 2005 to approach all-time highs.

Some of the individual indices obtained from surveys among purchasing managers also contain useful information on the capacity pressures in the economy, such as, for example, the manufacturing PMI sub-index measuring changes in suppliers' delivery times and the services PMI sub-index assessing outstanding business. Chart 2 shows how the first of these variables underwent a marked downward trend from mid-2005 and, although this trend has been reversed in 2007, the index remains below its historical average levels and below 50. This means that the firms surveyed consider that the time taken for their suppliers to deliver inputs to them was, on average, longer than in the previous month, suggesting that the latter are having difficulty meeting dynamic demand. Meanwhile, the services PMI sub-index measuring outstanding business has, in the most recent period, followed an upward path (albeit with some significant fluctuations) and, since 2005 Q4, has been above the neutral value of 50, which is compatible with an expansion of activity and greater use of capacity.

### **Empirical evidence**

Empirical studies that attempt to determine which variables may be useful to predict euro area inflation encounter the limitation that the euro area as such has only existed since 1999, so that the variables for the area as a whole prior to that date represent an aggregate that is, to some extent, artificial. Moreover, harmonised inflation data for the euro area countries are only available from 1991. Accordingly, the results of these studies are relatively modest and must be interpreted with caution. Some of them indicate that the variables with the greatest predictive power vary according to the specific period chosen<sup>2</sup>, while in many cases inflation is better predicted simply on the basis of its past values, without any systematic improvement in the results when an additional variable is included.

In the specific case of the CU, there is not much empirical evidence regarding its predictive power, although it is included in some of the composite indicators that have been used to predict inflation<sup>3</sup>. Empirical analyses based on simple bivariate models, in which inflation is regressed on lagged values of itself and of the CU, generally show that the latter has low information content even within the sample for which the estimation is made.

This result seems to extend to more sophisticated analyses of the out-of-sample predictive power of the CU, as seen in a recent OECD study<sup>4</sup>, which evaluates (for the case of the euro area) the extent to which various indicators provide useful information to forecast inflation at horizons of a year or more. The study compares the inflation forecasts (measured in terms of the year-on-year growth rate of the HICP) of two types of recursively estimated model: a baseline model, which includes only lagged inflation and oil price changes as explanatory variables, and other models which also include the indicator whose predictive power it is wished to assess. The criterion for comparison is the relative size of the mean absolute forecast errors at different horizons of each model. As seen in Table 1, which contains some of the results of this study, for the periods 1995-2000 and 2000-2005, the CU never improved the predictive power of the baseline model at different horizons. Other measures, such as the output gap or the gap between the unemployment rate and the NAIRU, showed greater predictive power for future inflation.

The limitation referred to at the beginning of this section may explain why the empirical evidence available does not attribute any significant predictive power for inflation to the CU. For this reason, it is especially useful to observe the experience of other countries. The United States and Canada, in particular, have abundant literature documenting the weakening of the positive relationship between the CU and (both headline and underlying) inflation<sup>5</sup>. In fact, in

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2. See Banerjee et al. (2005). This study does not even include the CU in its analysis. 3. See Angelini et al. (2001). 4. See OECD (2007). 5. See, for example, Emery and Chang (1997) or Dotsey and Stark (2005).

Mean absolute forecast error, n years ahead (pp)	1995-2000				2000-2005			
	n = 1	n = 2	n = 3	n = 4	n = 1	n = 2	n = 3	n = 4
	Baseline (a)	0.87	1.66	1.39	1.56	0.45	0.73	1.01
<b>Slack indicators (b)</b>								
<i>Output gap</i>	<b>0.62</b>	<b>1.33</b>	1.91	1.59	<b>0.40</b>	<b>0.29</b>	<b>0.48</b>	<b>0.39</b>
<i>Output gap in real time</i>	1.07	<b>1.41</b>	<b>1.28</b>	1.65	0.47	<b>0.66</b>	<b>0.93</b>	<b>0.75</b>
Unemployment – NAIRU	0.94	<b>1.32</b>	1.54	<b>1.42</b>	<b>0.36</b>	<b>0.28</b>	<b>0.46</b>	<b>0.55</b>
CU	1.40	2.94	1.98	3.18	0.50	1.06	1.51	2.00

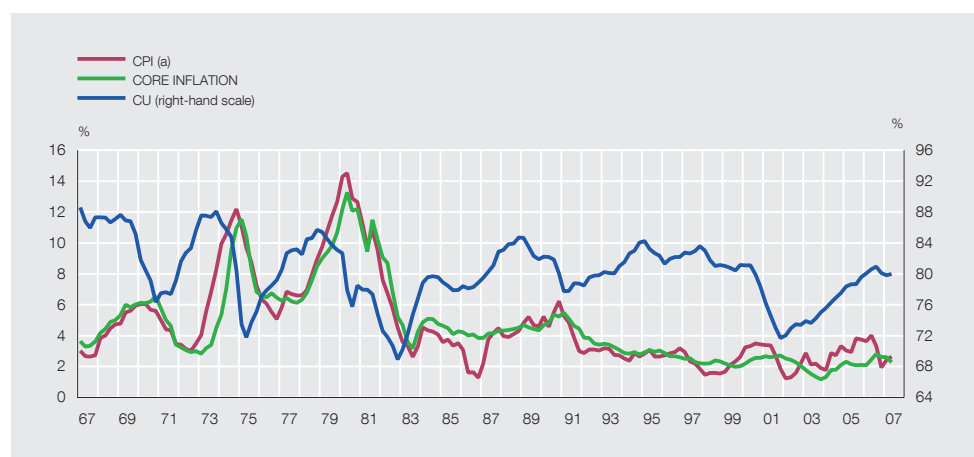
SOURCE: OECD (2007).

a. In this model, inflation (measured as the year-on-year rate of growth of the HICP) is regressed on its own lagged values and on (current and past) oil price changes. The estimation is based on quarterly data from 1980 onwards.

b. For each indicator, an equation is estimated for inflation in terms of its own lagged values, (current and past) oil price changes and the indicator itself (lagged values), in order to assess its predictive power. The models with a smaller forecast error than the baseline for the same forecast horizon are highlighted in bold.

RELATIONSHIP BETWEEN CU AND INFLATION. UNITED STATES

CHART 3



SOURCES: US Bureau of Labor Statistics and Federal Reserve System.

a. Year-on-year growth rate.

these countries there was a clear structural change in the relationship between these two variables around the mid-1980s. Before then, high CU levels tended to anticipate higher future inflation, but this appears to have stopped happening from the mid-1980s, as seen in the case of the United States in Chart 3.

### **Factors that might explain the change in the relationship between inflation and the CU**

The implications of the CU's loss of predictive power for inflation, referred to in the previous section, with regard to its relevance to monetary policy decisions, will obviously depend on the ultimate reasons for the changes in the relationship between these two variables. As mentioned above, most studies analysing the relationship between inflation and the CU and how it may have changed over time refer to the US and Canadian economies. However, the arguments used in these studies can also be applied to the European case.

First, since the CU is measured in the industrial sector (which includes manufacturing, mining and electricity, gas and water supply), some studies suggest that the CU may be losing its ability to forecast inflation because the industrial sector accounts for an increasingly small proportion of output, which has gradually shifted to the services sector.

Another factor that may have played an important role is the increasingly volatile behaviour of energy prices, which may have distorted the relationship between inflation and the CU by adding noise to it in recent years. However, the OECD study mentioned above takes this effect into account for the euro area case and, even then, the CU is still not useful to forecast inflation.

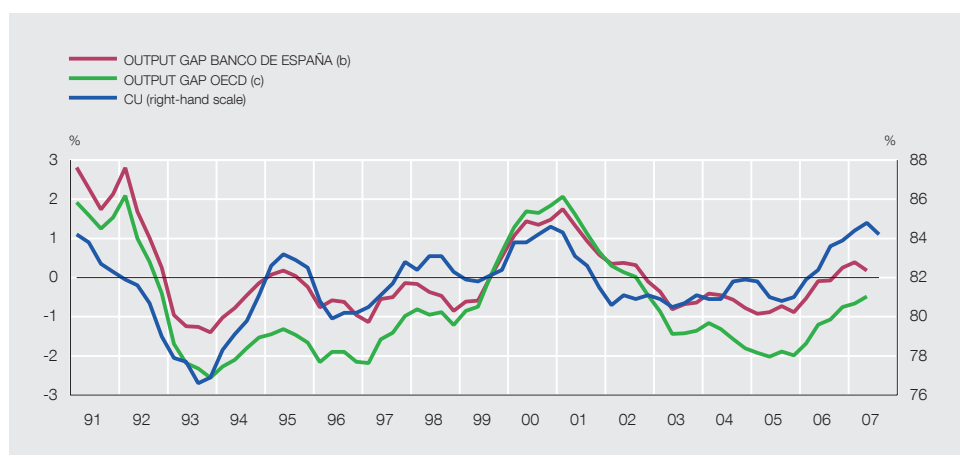
It is also important to consider the possible influence of technological change. Technological progress over the last two decades has led to greater flexibility in the relationship between factors of production and output and, owing to its effects on equipment investment and on the capital stock, may have altered the relationship between the CU and inflation. In the past it was much more common for a firm to respond to changes in demand by varying its output, without altering (given the costs involved) its installed production capacity, which meant that the CU fluctuated with demand. More recently, however, this dynamic may have been affected by the fall in the relative price of capital goods and the reduction in the cost of adjusting installed capacity, which will have modified the equilibrium value of the level of the CU. From a theoretical perspective, the effect of technological change on the level of the CU is indeterminate and, moreover, may be different in the short and in the long run. On the one hand, the decline in the price of capital goods reduces the opportunity cost to firms of maintaining excess capacity, this being an incentive for them to install more capacity and operate with a low CU, which enables them to expand production significantly during demand peaks. On the other hand, the use of automated design and modular tooling, along with the improvements in inventory management, allow for cheaper and faster capacity expansion when it is actually needed, giving incentives for firms to reduce their excess capacity and to operate normally at a high CU. The eventual impact on capacity utilisation will depend on these two opposing forces.

A recent study analysing the relationship between technology and capacity utilisation in the United States<sup>6</sup> found that in the period 1974-2000 technological change had a negative, albeit small, long-term effect on the CU. Specifically, controlling for output growth, the level of investment and other factors, technological change reduced the level of the CU by between 0.2 and 2.3 pp. The study suggests that these changes in the relationship between technology and the CU may, in turn, involve changes in the relationship between the CU and inflation because, if firms have been able to maintain greater excess capacity, the average firm may be better prepared to react to a period of strong demand without moving to the highest part of its marginal cost curve.

Another factor that may explain the weakening of the relationship between the level of the CU and inflation is the growing liberalisation of international trade, which has been accompanied by a significant increase in trade flows. First, this process tends to reduce inflation, since the availability of cheap imports has a direct effect on consumer prices (through their inclusion in the basket of consumption and the reduction in the production costs of certain domestically produced goods), as well as an indirect impact on the prices of domestic competitors, through the downward pressure it exerts thereon. Moreover, owing to the process of internationalisation of production, goods prices are set to a greater extent on international markets, which might imply a lower upward impact of domestic market pressures on the price level than when

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6. See Bansak et al. (2004).



SOURCES: European Commission, Eurostat, OECD and Banco de España.

- a. The output gap is defined as the difference between actual and potential GDP as a percentage of potential GDP.  
 b. Potential GDP has been obtained by applying a Hodrick-Prescott filter to actual GDP.  
 c. OECD estimates.

the economy was more closed. As a result, purely domestic measures, such as the CU, would have suffered a loss of predictive power for inflation<sup>7</sup>. However, there are studies in which measures of domestic slack are replaced by measures of global slack and their results do not show that these global indicators have greater predictive power for domestic inflation or that globalisation can justify the lower influence of domestic slack measures on inflation<sup>8</sup>.

If the loss of predictive power of the CU with respect to inflation is basically a result of the factors mentioned above, the relevance of this indicator to assessing the risks to price stability present in the economy would obviously be significantly weakened. However, there are other arguments that should also be considered before a final conclusion is reached.

Some authors, such as Woodford (1994), have pointed out that the fact that an indicator does not display significant predictive power with respect to inflation may ultimately be because that variable is already taken into account by the central bank when taking monetary policy decisions pre-emptively. However, this argument would appear to be more relevant to monetary policy strategies strictly based on a limited set of indicators than to the Eurosystem's strategy, in which decisions are taken on the basis of a very broad information set.

On the other hand, there are studies which show that the CU has not lost its ability to measure the amount of slack in the economy and, thus, to detect demand pressures that may give rise to inflationary pressures<sup>9</sup>. In this respect, Chart 4 shows the strong correlation between the CU and the output gap in the case of the euro area.

Finally, the improvement in monetary policy management would also explain the smaller response of inflation to changes in demand pressure indicators, like the CU. In this respect, it should be noted that the greater credibility of central banks has helped better anchor economic agents' inflation expectations. As various studies have indicated<sup>10</sup>, phenomena such as

7. See, for example, Dexter et al. (2005). 8. See Ihrig et al. (2007). 9. See, for example, Tal (2000). 10. See the speech of Frederic S. Mishkin, entitled "Inflation Dynamics", at the Annual Macro Conference, Federal Reserve Bank of San Francisco (March 2007).

the lower persistence of inflation (which indicates how long the effects of a particular shock to inflation last) the reduction in the slope of the Phillips curve (which implies that changes in economic slack have less impact on inflation) and the smaller current inflation reaction to oil price and exchange rate shocks may be explained by the favourable effects of the new monetary policy regime on the expectation formation process.

## Conclusions

The recent developments in capacity utilisation in the euro area, characterised by a notable upward trend and above-historical-average rates since late 2005, are one of the factors that the euro area monetary authority has been highlighting when justifying its diagnosis that the risks to medium-term price stability remain high. This concern corresponds to the role that has traditionally been associated with the various indicators of economic slack in forecasting future inflation developments. In the case of the CU, the subject of this article, the empirical evidence available suggests that the relationship between the CU and inflation is currently weak in the euro area, and that in countries like the United States, for which the studies cover longer historical periods, it has weakened over the last twenty years. The implications of these developments for the relevance of this indicator to the monetary policy decision making process depend crucially on what the main factors responsible for these changes are.

On one hand, the loss of representativeness of an indicator that is based on the behaviour of the industrial sector (given the growing weight of the services sector), technological progress and the influence of international trade are factors that may explain the fall in the predictive power of the CU for inflation. These arguments would point to a loss of specific weight of the CU in the set of information that is useful to the European monetary authority. However, there are other considerations that should be taken into account before a final conclusion is reached. The high correlation between the CU and the output gap indicates that the path of the former may be useful to assess the degree of slack in the economy or, what comes down to the same, the existence of demand pressures that may anticipate the appearance of inflationary pressures. Further, the more pre-emptive nature of monetary policy and the greater credibility of central banks may also explain the change in the empirical relationship between several indicators, including the CU, and inflation, without this entailing less relevance of the former to the monetary policy decision making process. In the case of the euro area, the credibility of the ECB's commitment to its mandate has helped to anchor medium and long-term inflation expectations at levels compatible with its definition of price stability facilitating, in turn, the achievement of more contained and stable inflation.

19.10.2007.

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## APPENDIX

There follows a detailed description of the various indicators of capacity utilisation analysed in this article. First, the indicators obtained from the responses to different questions contained in the quarterly Industry Survey compiled by the European Commission are the following:

- CU: value obtained as average of the responses to the question “*at what capacity is your company currently operating (as a percentage of full capacity)?*”
- Assessment of current production capacity: summarises the responses to the question “*Considering your current order books and the expected change in demand over the coming months, how do you assess your current production capacity: more than sufficient (+), sufficient (=) or not sufficient (-)?*” The measure is obtained as the difference between the percentage of firms that answer “more than sufficient” and those that answer “not sufficient”. Accordingly, falling values would be associated with higher UCP levels.
- Factors limiting production: in this case employers respond to the question “*What main factors are currently limiting your production: none, insufficient demand, shortage of labour force, shortage of material and/or equipment, financial constraints or other factors?*” The value of each factor represents the percentage of employers that consider it to be the main factor.

The article has also analysed the behaviour of certain sub-indices derived from the monthly Reuters agency surveys among purchasing managers of manufacturing and services companies in certain euro area countries, from which the so-called Purchasing Managers’ Indices are obtained. In particular, within the manufacturing PMI, the Suppliers’ Delivery Times sub-index, obtained from the responses of purchasing managers to the question whether they consider that, with respect to the previous month, the time taken for their suppliers to deliver inputs to them has been shorter, the same, or longer than in the previous month, can be used as an indicator of economic slack. The value of the index is obtained as the sum of the percentage of respondents who indicate a faster speed of delivery and of half of the percentage of those who indicate no change with respect to the previous month. Accordingly, if the level of the index is below 50 this means that delivery times are, on average, longer than in the previous month, which would be associated with stronger demand. For this reason, this sub-index is included with a negative sign in the synthetic manufacturing PMI. At the same time, on the basis of the surveys performed to obtain the services PMI an index of outstanding business is calculated, which shows whether firms consider, on average, that their volume of outstanding business has increased (value of index over 50), remained constant (equal to 50) or fallen (less than 50) with respect to the previous month, so that this index is a proxy of the degree of slack existing in the services sector.