An empirical assessment of the link between the output gap and inflation in the French economy[1]

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Introduction

There may be many reasons for making a diagnosis of the position of an economy in the economic cycle. Such a diagnosis makes it possible, for example, to assess the economy's growth potential, potential inflationary pressures and the structural position of government finances. This paper addresses the second of these three concerns. For the French economy it attempts to give an empirical analysis of the relationship between the position in the cycle, as determined by various indicators of the output gap, and inflation. It draws on previous work on the same subject, such as by Giorno et al. (1995) on estimations of the output gap and by Turner (1995) on the link between these indicators and inflation.

The choice of the methods used to estimate output gaps and their link with inflation was based on three criteria which we felt to be essential and which played a major role in our final decision.

1. The methods had to be *reproducible* by any economist using the same statistical data. This meant that we were unable to include so-called "expert" opinion.
2. They had to be *easy to apply* to different industrialised countries using standardised databases. For that reason it was important to limit the volume of data used in the calculations.
3. They had to *produce quick results*, so as to be systematically repeatable at low costs whenever the database is updated or changed.

These three criteria lie behind the original and specific features of the present study, as regards both construction of the output gap indicators (e.g. in the measurement of the capital stock and the estimation of an equilibrium rate of unemployment) and determination of the link between inflation and these indicators. The methods are deliberately crude. They cannot claim to provide a detailed diagnosis of the position of economies in the cycle or of the link between this position and inflation. The results must necessarily be compared with results obtained using other methods. It should also be borne in mind that this study is a reflection of work in progress. It does not in any way represent an official position of the Banque de France.

Section 1 looks at the methods used for estimating the output gap and their results, while the links with inflation are analysed in Section 2.

1. Estimations of the output gap[2]

Economists have put forward a variety of alternative methods for diagnosing an economy's position in the economic cycle. They may be based on a single variable, in which case only

[1] This paper reflects work in progress at SEMEF. It does not in any way represent an official position of the Banque de France. Some of the data processing for this study was carried out by Laurent Baudry, Lydie Gomez and Béatrice Saes-Escorbiac.

[2] This is a summary of more detailed arguments contained in Cette (1997).

data concerning output (GDP if the study is carried out at an aggregate level) are used. Alternatively they may be based on multiple variables, in which case the approach may be structural (e.g. based on explicit production functions) or non-structural (e.g. based on VAR models).

The *time horizon may be more or less distant*. Within this context, the methods may also assume a greater or lesser degree of flexibility with regard to factors of production. In single-variable studies, the choice of time horizon consists of "restricting", to a greater or lesser extent, the acceptable variations of potential output. In multiple-variable studies, it consists of symmetrically "restricting", to a greater or lesser extent, the acceptable modifications of the variables explaining potential output. Let us take structural methods as an example. If we consider the very short term, stocks of factors of production may be regarded as fixed and the gap between actual and potential output is explained simply by degrees of factor utilisation. If we consider the longer term, factor stocks may be regarded as adjustable, within more or less explicit limits. For example, for the labour factor this could be the immediately available manpower (i.e. the labour force) or potentially mobilisable manpower (i.e. the potential labour force after taking cyclical declines in participation rates into account). Over the very long term, stocks of the two factors may even be regarded as entirely adjustable (e.g. by recourse to immigration for the labour factor), in which case potential growth becomes indeterminate.

This variety of methodological options explains why so many estimations and methods have been proposed in the academic literature since the pioneering work of Okun (1962), who proposed a simple linear relationship between the deviation of unemployment from its natural level and the deviation of output from its potential level. A wide-ranging critical review of the literature is contained in Cour, Le Bihan and Sterdyniak (1997), referred to subsequently as CLS (1997). Likewise, there is no evidence that similar players in different countries (e.g. central banks) favour one particular methodological approach over another, or that different players (e.g. international organisations) favour one particular approach for the same purpose (e.g. formulating medium-term growth scenarios).

There is no shortage of examples of this diversity of methods. The US Federal Reserve uses a method based on Okun's law (cf. Kahn (1996)). The Bank of England uses a number of single- and multiple-variable methods (cf. Fisher, Mahadeva and Whitley (1997)). The Bundesbank uses a structural method in which the output gap is explained by degrees of factor utilisation alone (cf. Bundesbank (1995) and Westermann (1997)). The same pattern is to be found among international organisations, which use such estimations to formulate medium-term growth scenarios. The European Commission uses a single-variable method based on a smoothing of GDP (cf. Ongena and Röger (1997)). The IMF uses a structural method in which the output gap is explained by degrees of factor utilisation and by the gap between the unemployment rate and an estimation of the NAIRU (cf. De Masi (1997)). The OECD uses a number of single- and multiple-variable methods. Among the latter, particular emphasis is placed on a structural approach in which the output gap is explained by degrees of factor utilisation and by the gap between the unemployment rate and an estimation of the NAWRU (cf. Giorno, Richardson, Roseveare, Van Den Noord (1995), subsequently referred to as GRRV (1995), and Giorno and Suyker (1997)).

In the context of this wide diversity of methods, the approaches described here, which continue earlier work (cf. Villetelle (1994)), have a distinctly pragmatic cast. Rather than preferring one estimation to another, we have defined three alternative calculations of potential output and, as a corollary, of the output gap. Our diagnosis is enriched by a comparison of the different results. Two of the methods are single-variable methods. The third is a multiple-variable method with a structural component in which the output gap is explained by the degree of factor utilisation and by the gap between the actual and equilibrium rate of unemployment estimated in a specific way. This third method is the only one to display any original features, as the equilibrium rate of unemployment is defined as the rate which would stabilise firms' profit ratios in the short term. Several calculations of the profit ratio are envisaged. One of them takes into account the flow of firms' net interest payments. This makes it possible to include financial considerations when determining the equilibrium rate of unemployment and hence potential output and the output gap.

Notation and data sources

PIB	Gross domestic product (GDP) or output
PIBL	Smoothed output
PIBT	Trend-based output
PIBPi	Potential output. Four estimations are proposed corresponding to the profit ratios *TM*1 to *TM*4
EPIB	Output gap. The suffix *L*, *T* or *Pi* indicates the output indicator used to define the gaps. Hence $PIB = PIBL + EPIBL = PIBT + EPIBT = PIBPi + EPIBPi$
N	Domestic employment
K	Real productive fixed capital employed in productive activity
E or *NE*	as a suffix of the variables *PIB*, *N* or *K*, they indicate that these values relate respectively to non-financial firms only or to the rest of the economy. Hence $PIB = PIBE + PIBNE$; $N = NE + NNE$ and $K = KE + KNE$
$f(t)$	Hicks-neutral technological progress in non-financial firms. Hence: $PIBE = \alpha(KE_{-1}) + (1-\alpha)NE + f(t)$, where $0 \leq \alpha \leq 1$
TMi	Firms' profit ratio. Four profit ratios are calculated: a current profit ratio *TM*1 where gross operating surplus at factor cost (balance *N*2 of the operating account for firms in the national accounts) is related to the value added at market prices (balance *N*1 of the production account for firms), a profit ratio *TM*2 at market prices, a profit ratio *TM*3 at factor cost and a profit ratio *TM*4 at factor cost excluding net interest charges
α_j	Weighting coefficient for capital in the Cobb-Douglas function representing firms' combination of factors of production. The value of the coefficient is the average of the actual profit ratio between 1970Q1 and 1996Q2. Four values have been calculated: $\alpha1 = 0.256$ for *TM*1, $\alpha2 = 0.312$ for *TM*2 and $\alpha = 0.275$ for *TM*3. As *TM*4 is not really a profit ratio, it is assumed that $\alpha4 = \alpha3$
TC	Unemployment rate
TCi^*	Equilibrium rate of unemployment. Defined by the equation: $TCi^* = TC - \beta^{-1}\Delta TMi$, where $\beta = 0.5$ Four equilibrium unemployment rates are calculated, corresponding to the four profit ratios defined above.
π_N	Productivity per capita: $\pi_N = PIBE / NE$
δ	Retirement rate of capital goods
TUA	Production capacity utilisation rate (including recruitment)
EBE	Gross operating surplus : $EBE = P.PIBE - W.NE$
Pc	Consumer prices
P	Price of value added
Pm	Price of imports of goods and services
Pe	Average consumer price index of France's nine leading trading partners adjusted for exchange rates. The weighting given to each is the share of imports of goods and services from that country
W	Wages per capita
TI	Nominal interest rate
*	As a suffix of a variable, indicates its equilibrium level
Δ	In front of a variable, indicates its variation from one period to another
.	Above a variable, indicates its growth rate
l	As a suffix of a variable, indicates its smoothing
–	Above a variable, indicates its average
L	Lagging operator
$\phi(L)$	Lagging operator polynomial
*AV*1	Other variables affecting the rate of wage growth
*AV*2	$\Phi(L)\dot{P}_c - \dot{P}$

Lower-case variables correspond to their logarithm

Data sources: except where otherwise stated, all data used in this study are drawn from the quarterly national accounts

The chosen methods are deliberately simple. They cannot claim to provide a detailed diagnosis of the position of economies in the cycle. The results should rather be compared with those derived from other methods. We shall begin by describing the three methods used (Section 1.1) before discussing the main results (Section 1.2).

1.1 The methods used

The first estimation of the output gap (written as *EPIBL*) is based on a smoothing of the output logarithm using the Hodrick-Prescott filter. The usual standard value for the smoothing parameter (λ = 1,600) is applied to the quarterly data used here. We shall not go into the very numerous limitations of this method since they are discussed in detail in the literature (cf. for example Allard (1994), CLS (1997) and Berger and Teil (1996)). The main advantages of the method are that it is quick, easy to use and reproducible and that the results are easy to interpret.

The second method (written as *EPIBT*) is based on estimating a determinist output trend in order to obtain trend-based output, taking into account possible breaks in the trend when such are suggested by analysis of the residuals. The method is standard (cf. for example INSEE (1995)) and it calls for determination of the trend and possible breaks. Our estimations have been made using an algorithm designed by Berger and Teil (1996) which determines endogenously the most significant combination of significant breaks in the trend. Although this method is relatively sophisticated from a technical standpoint, it remains open to the usual criticisms made of any determinist approach (cf. for example Berger and Teil (1996)). It has the same advantages as the smoothing method and the fact that it is entirely reproducible is a particularly important feature for estimations of this type.The estimations carried out for France over the period 1960-95 show two breaks in the output trend, in 1973Q3 and 1980Q2. Accordingly, the underlying growth rate of French GDP is approx. 2.0% since 1980.

A third method (written as *EPIBP*) is based on a structural approach to the calculation of potential output, which combines the choice of factors of production with determination of an equilibrium rate of unemployment (*TCE*). The estimation is carried out in the following stages.

i) First, it is assumed that only non-financial firms are endogenous, whereas the rest of the economy is exogenous.

ii) Our estimation of firms' fixed capital stock is not derived from national accounts, which are based on assumptions that are inevitably fragile and that differ widely from one country to another. Indeed, we have estimated the capital stock, assuming the sudden death of capital goods and an average lifetime of 12 years. The sudden death hypothesis has only a marginal effect on the profile of the statistical series derived in this way (cf. Maddison (1993)). The assumption that capital goods have a lifetime of 12 years (48 quarters) is based on estimations carried out on large samples of French firms (cf. Cette and Szpiro (1988)).[3]

iii) Our specification of firms' choice of factors of production is based on a Cobb-Douglas function with constant returns to scale. It further assumes that technological progress $f(t)$ is Hicks-neutral and that factors of production are limited to the stocks of labour *NE* and capital *KE*; the mobilised capital stock *KE* at quarter *t* is the fixed capital stock at the end of the previous quarter. This gives:

$$pibe = \alpha(ke_{-1}) + (1-\alpha)ne + f(t), \text{ where } 0 \leq \alpha \leq 1 \qquad (1)$$

As usual, estimation of equation (1), with the additional assumption of a deterministic trend (with possible breaks) for the effects of technological progress $f(t)$, gives aberrant results for the α parameter (cf. Berger and Teil (1996)). Thus, the value of α was made equal to the average of firms' actual profit ratio *TM* over the period 1970Q1 to 1995Q4. Four profit ratios were calculated: a current profit ratio *TM*1 where gross operating surplus at factor cost (balance *N*2 of the operating account for firms in the national accounts) is related to value added at market prices (balance *N*1 of the production account for firms), a profit ratio *TM*2 at market prices, a profit ratio *TM*3 at factor cost, and a profit

[3] For a more detailed consideration of these matters, see Cette (1994).

ratio *TM*4 at factor cost excluding net interest charges.[4] A comparison of *TM*3 and *TM*4 shows the impact of changes in interest charges on the equilibrium rate of unemployment and the output gap. As *TM*4 does not really correspond to the share of capital in the primary distribution of income (it is not the complement of the share of labour costs in value added), only the first three profit ratios were used for the α coefficient. The α parameters calculated from these profit ratios are as follows: $\alpha 1 = 0.256$ for *TM*1, $\alpha 2 = 0.312$ for *TM*2 and $\alpha 3 = \alpha 4 = 0.275$ for *TM*3.

Equation (2) below was then used to calculate the Solow residual for technological progress $f(t)$ from each of the three profit ratios, here given the index j:

$$f(t)_j = pibe - \alpha_j(ke_{-1}) + (1 - \alpha_j)ne \tag{2}$$

iv) The fourth stage consisted of calculating the equilibrium rate of unemployment *TC**, which may be defined as the rate which implies no acceleration of wages (NAWRU) or prices (NAIRU) or no change in the profit ratio. We used the latter definition because it is more effective than the other two in limiting the difficulties of satisfactorily including the effects of changes in the terms of trade. This method for calculating the equilibrium rate of unemployment has the added advantage of being quick and easy to use (also in the context of macroeconomic forecasts) since the only data required is a series of non-financial firms' profit ratios. The equilibrium rate of unemployment is thus distinguished by the absence of short-term inflationary (or disinflationary) wage pressures due to a conflict between wages and profits in the distribution of primary income.

To illustrate the method, the equilibrium rate of unemployment *TC** is defined assuming that the change of the smoothed profit ratio *TM*1 (using a Hodrick-Prescott filter with $\lambda = 100$)[5] between two dates is proportional to the difference between the smoothed unemployment rate *TC*1 (using a similar Hodrick-Prescott filter) and the equilibrium rate *TC**:

$$\Delta TM1 = \beta\left(TC1 - TC^*\right) \tag{3}$$

Hence: $TC^* = TC1 - \frac{1}{\beta}\Delta TM1$, or: $TC^* - TC = (TC1 - TC) - \frac{1}{\beta}\Delta TM1$, where $\beta > 0$.

This link between changes in the profit ratio and the gap between the actual and equilibrium rate of unemployment is based on the method used in OECD studies to calculate the NAWRU (cf. GRRV (1995)), which links wage acceleration to the gap between the actual and equilibrium rate of unemployment. The method was originally put forward by Elmeskov (1993) and Elmeskov and Macfarlan (1993). We show in Annex 1 that under certain assumptions equation (3) can be deduced from a simplified price-wage loop. This calculation of the equilibrium rate of unemployment differs from previous, more sophisticated estimations of the NAIRU carried out at the Banque de France, based on structural or reduced price-wage loops (cf. Jackman and Leroy (1995)). The equilibrium rate of unemployment estimated here corresponds to a short-term approach. Although the calculation is based on variables that have been previously smoothed, smoothing is carried out over short periods and thus does not in any way correspond to a calculation of the structural rate of unemployment (cf. Layard, Nickell and Jackman (1991)).

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4 The calculation of non-financial firms' profit ratios was adjusted for the impact of the growth of the wage-earning class. For a more detailed consideration of these matters, see Cette and Mahfouz (1996).

5 The choice of short-period smoothings ($\lambda = 100$) is due to the fact that longer-period smoothings (e.g., $\lambda = 1{,}600$) cause the effects of the first oil shock to be reflected in the equilibrium unemployment rate even before 1973, which seems absurd to say the least.

The gap between the actual and equilibrium rate of unemployment combines two effects: the smoothing of the unemployment rate and changes in the smoothed profit ratio (equation (3)). The β parameter affects only the amplitude of the second effect and not its sign. The effect is positive before the first oil shock (the profit ratio improves), then negative until the early 1980s (the profit ratio deteriorates), then positive again until the early 1990s and has remained positive in recent years. There is little change in the behaviour of the parameter according to the different profit ratios used. In the recent period, the fall in firms' net interest charges (due to lower average interest rates and firms shedding debt) has caused the equilibrium rate of unemployment calculated from the profit ratio ($TM4$) to diverge significantly from the three others.

As explained in Annex 1, we decided to set $\beta = 0.5$ as a standard value. We then used equation (3) to calculate four equilibrium unemployment rates ($TC1^*$ to $TC4^*$) from the four previously defined profit ratios ($TM1$ to $TM4$).

v) We then calculated non-financial firms' potential employment (NE^*) as the difference between total potential employment in France and employment excluding non-financial firms, smoothed using a Hodrick-Prescott filter (with $\lambda = 1{,}600$). Total potential employment in France was calculated by applying the previously calculated equilibrium rate of unemployment to the labour force (according to ILO definitions) smoothed using a Hodrick-Prescott filter (with $\lambda = 1{,}600$). Four series of non-financial firms' potential employment were calculated in this way, corresponding to the four series of equilibrium rates of unemployment.

vi) The next stage was to calculate non-financial firms' potential value added by applying the production function represented by equation (1) to potential quantities of factors. The potential effect of technological progress ($f(t)^*$) was estimated by its smoothed value using a Hodrick-Prescott filter (with $\lambda = 1{,}600$), the potential capital stock by its actual level ($K^* = K$), and non-financial firms' potential employment as described above. Four series of non-financial firms' potential value added were calculated in this way, corresponding to the four series of non-financial firms' potential employment and of the corresponding values for the factor weighting parameter.

vii) Finally the level of potential output ($PIBP$) was calculated by adding non-financial firms' potential value added to the value added of the rest of the economy smoothed using a Hodrick-Prescott filter (with $\lambda = 1{,}600$). Four series of potential output ($PIBP1$ to $PIBP4$) and of potential output gaps ($EPIBP1$ to $EPIBP4$) were calculated in this way, corresponding to the four series of non-financial firms' potential value added.

Clearly, this third approach, like the other two, has a number of weaknesses relating to the various simplifying assumptions included in the calculation. Like all estimations of potential output, the ones proposed here are crude and, inevitably, relatively imprecise. Thus, the indicators should be considered more for what they show, when they are consistent with each other or when their divergence can be interpreted, rather than for their actual levels.

1.2 Main results

We should emphasise that these estimations have been carried out using data from the national accounts, supplemented by Banque de France forecasts[6] for the French economy. Consequently the results for recent years may differ significantly from those of other studies based on similar methods but using other forecasts to extend historical data series.

i) The estimated potential growth rates lead to a fairly common diagnosis: potential output growth in France slowed considerably over the period, falling from approx. 4.0-5.0% (depending on the indicators) before the first oil shock to approx. 1.5-2.0% in recent years. The two

6 These forecasts estimate average annual output growth in France at 1.1% in 1996, 2.3% in 1997 and 2.8% in 1998.

main slowdowns occurred after the first oil shock and in the early 1990s (see Table 1). As this broad analysis has already been developed in numerous other papers on the subject (cf. for example GRRV (1995), Giorno and Suyker (1997) and Bouthevillain (1996)) we shall not go into further detail here.

Table 1

Potential and actual growth of French output (in percentages)

Output indicator	**Abbrev.**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Actual	*PIB*	4.5	4.3	2.5	0.8	1.2	-1.3	2.8	2.2	1.1*
Smoothed	*PIBL*	3.0	2.8	2.3	1.8	1.3	1.2	1.3	1.5	1.7
Trend-based	*PIBT*	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Current potential	*PIBP*1	3.2	3.0	2.4	1.7	1.0	0.9	1.3	1.7	1.8
Potential at market prices	*PIBP*2	3.2	3.0	2.4	1.7	1.1	1.0	1.4	1.7	1.8
Potential at factor cost	*PIBP*3	3.2	3.0	2.4	1.7	1.0	1.0	1.4	1.7	1.8
Potential at factor cost excl. interest charges	*PIBP*4	3.0	2.8	2.4	1.6	1.1	1.2	1.5	1.6	1.7

* Forecast.

For two main reasons the low potential growth rates of recent years should not be regarded as definitive. First, recent figures for real growth have not yet been finalised and are thus liable to change. Secondly, estimations of potential output for recent years could be modified (on account of the smoothing or trend adjustment methods) according to actual growth in 1996 and subsequent years. Thus, the same estimation methods will give higher potential growth rates for the years 1993-95 if actual growth is higher in subsequent years.

Table 2

Gaps between potential and actual output in France (in percentages)

Potential output indicator	**Abbrev.**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Smoothed	*EPIBL*	0.1	1.5	1.7	0.7	0.5	-2.0	-0.5	0.2	-0.5
Trend-based	*EPIBT*	0.4	3.4	3.9	2.7	1.8	-1.5	-0.7	-0.5	-1.5
Current potential	*EPIBP*1	-0.1	1.1	1.2	0.3	0.5	-1.7	-0.3	-0.2	-0.5
Potential at market prices	*EPIBP*2	-0.1	1.1	1.2	0.3	0.5	-1.9	-0.5	-0.1	-0.6
Potential at factor cost	*EPIBP*3	-0.1	1.1	1.2	0.3	0.5	-1.8	-0.4	-0.1	-0.6
Potential at factor cost excl. interest charges	*EPIBP*4	-0.2	1.2	1.4	0.5	0.5	-2.0	-0.7	-0.2	-0.8

ii) There is nothing unusual about the variations in output gaps and the position in the cycle to which they correspond (cf. for example the studies cited above), so we will not comment on them in any further detail here (see Table 2 and Chart 1). The fact that output gaps are relatively small in the last two years can be attributed to the same reasons as those given earlier concerning potential output growth.

A consideration of the links between the various output gaps, the gaps between actual and equilibrium rates of unemployment and the capacity utilisation rate,[7] gives the following results (cf. Annex 3, Table A3-1).

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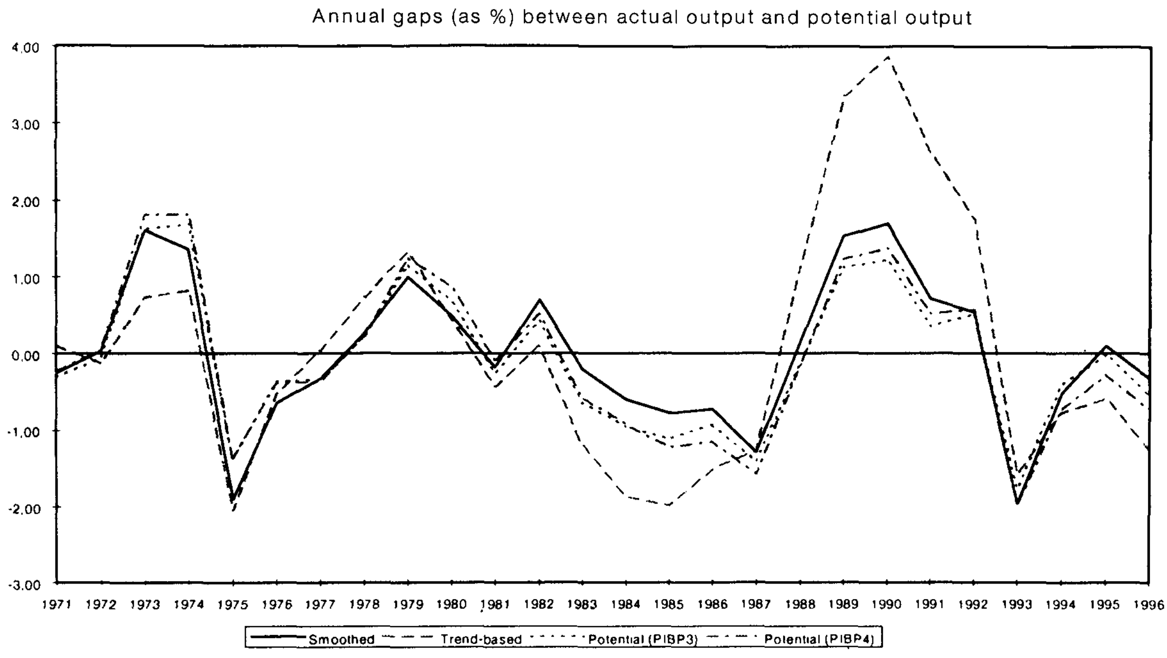
[7] In this case manufacturing firms' production capacity utilisation rate including recruitment (*TUA*) measured by INSEE from its quarterly economic survey.

Chart 1



The smoothed output gap (*EPIBL*) and the four output gaps (*EPIBP*1 to *EPIBP*4) from a structural approach entirely correlate with each other (the correlation is of the order of 99%). The correlation with the trend-based output gap (*EPIBT*) is smaller (75-80%). The output gaps also correlate with the four gaps between actual and equilibrium rates of unemployment, and the correlation is strong (60-70%) for the four "structural" gaps (*EPIBP*1 to *EPIBP*4) and less strong (40-50%) for the other two (*EPIBL* and *EPIBT*). All output gaps correlate fairly strongly (75-85%) with the production capacity utilisation rate, though the correlation is less strong (60%) for the trend-based output gap.

The four gaps between actual and equilibrium rates of unemployment (*TC*1*–*TC* to *TC*4*–*TC*) correlate entirely with each other (the correlation is of the order of 99%), while the correlation with the production capacity utilisation rate is much less strong (20-30%). This suggests that output gap indicators do indeed synthesise the pressures on both goods and labour markets. It also suggests, however, that the indicators of labour market pressures provide different information from the indicators of pressures in the goods market.

The econometric results that explain output gaps in terms of the pressures in the two markets show that a gap of one point more (less) between actual and equilibrium rates of unemployment increases (reduces) the output gap by 0.8-0.9 of a point, and that one point more (less) on the production capacity utilisation rate increases (reduces) the output gap by 0.3 of a point. The effect of each pressure variable seems fairly robust with regard to both the presence of the other and to the method used to estimate the output gap. These results confirm that the potential output gap indicators developed here reflect pressures exerted in the goods and labour markets simultaneously.

Two results relating to the level of estimated output gaps deserve particular attention.

First, the trend-based output gaps (*EPIBT*) are larger over the last two years than the other output gaps. This result is simply due to the fact that the average output trend since 1987 (when the second and last break in the trend occurred) is higher than the growth rates of the other potential output indicators which were dampened by low actual rates of GDP growth in the most recent years.

Secondly, the potential output gap at factor cost excluding net interest charges (*EPIBP*4) was 0.2 of a point larger in 1996 than the potential output gap at factor cost (*EPIBP*3). This difference is due to the fall in firms' net interest payments (expressed in points of value added) in recent years as they have shed debt and as interest rates have fallen (cf. Cette and Mahfouz (1996)). This fall in interest charges has influenced the comparative trends in the two output gaps through its impact on estimations of the equilibrium rate of unemployment (see below).

Table 3

Gaps between the actual and equilibrium rate of unemployment in France (in percentage points)

Equilibrium rate of unemployment indicator	**Abbrev.**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Current	*TC*1*	0.6	0.2	-0.3	-0.2	-0.2	0.3	0.4	-0.4	0.1
At market prices	*TC*2*	0.7	0.3	-0.3	-0.2	-0.2	0.4	0.6	-0.2	0.3
At factor cost	*TC*3*	0.7	0.3	-0.3	-0.2	-0.2	0.4	0.5	-0.3	0.2
At factor cost excl. interest charges	*TC*4*	0.7	0.1	-0.5	-0.4	-0.3	0.6	0.9	0.1	0.5

Chart 2

iii) Variations in the short-term equilibrium rate of unemployment diverge relatively little from variations in the actual unemployment rate (Table 3 and Chart 2), because the former do not correspond to unemployment rates below which inflationary pressures would inevitably appear, but merely to unemployment rates which (under various simplifying assumptions) would allow various profit ratios to stabilise in the short term, taking actual wage pressures on the labour market into account. In other words, these equilibrium unemployment rates are liable to fall substantially in future periods if the situation on the labour market can be improved without a parallel fall in firms' profit ratios, caused either by wage pressures or by increased competitive pressures on price formation.

The gap between actual and equilibrium unemployment rates is distinctly negative from the first oil shock until the end of the 1970s (firms' profit ratios fell significantly), but positive throughout the 1980s (firms' profit ratios rose significantly). It was between 0.5 and 1 of a point in 1994 and between 0.1 and 0.5 of a point in 1996. Because of the fall in firms' net interest payments in recent years, the equilibrium rate of unemployment which takes this element into account (*TC*4*) is lower than those that do not (e.g. *TC*3*).

2. A link between the output gap and inflation

2.1 The expected link between the output gap and inflation

What influence might an economy's position in the economic cycle have on inflation? The Phillips-curve equation alone cannot provide the answer, because the continuing upward drift of unemployment and the absence from the equation of any indicator of pressures on the goods market mean that it cannot reflect the short-term inflationary pressures in the economy, the time horizon on which we have focused. We, therefore, substituted a cyclical indicator of inflationary pressures in the goods market. In this way we, alternatively, tested the output and the capacity utilisation gaps. The former, whether derived from a smoothed trend (*EPIBL*) or by calculating potential output (*EPIBP*3), is supposed to synthesise pressures on all goods and labour markets, and the latter, pressures in the goods market alone.

The output or capacity utilisation gap may have a dual influence on inflation. At times of economic recovery, for example, there is a certain time lag before the effect is reflected in staffing levels and the capital stock. Firms, therefore, use factors of production more intensively before recruiting and investing. The resulting decline in unit costs attenuates price growth at an unchanged marginal profit rate. At the same time, however, growing pressures in the goods market and increasing wage claims as conditions in the labour market improve cause prices to accelerate, still assuming that margins remain stable. The combined effect, summarised in a single, reduced equation, is thus theoretically indeterminate, though most studies conclude that the overall effect is positive. Inflation may accelerate even though output has not reached its potential level. The faster output gap is absorbed, the stronger this factor affects inflation, which is then liable to accelerate (Turner (1996)).

Price acceleration during the upper phase of the cycle may be more pronounced than the deceleration observed when the output gap is negative (cf. Turner (1995), Clark et al. (1996)). This possible assymetry, not tested in this study, is based on the Keynesian idea of an inflected supply curve that is almost vertical beyond the level of potential output.

2.2 The estimation period and the equation

A cyclical indicator of activity reflects cyclical movements in inflation but cannot explain a structural change such as the marked price deceleration over the periode 1982-86. Consequently it is preferable for the estimation periode not to include this transition phase. Being a time of instability, it could blur any measurement of the effect that the output or capacity utilisation gap might have on inflation. The estimation period using quarterly data, which is, therefore, discontinuous, included two phases corresponding to periods of high then low inflation. The first period begins in 1973 and stops in the first quarter of 1982, before the wage and price freeze was decided and put into effect. The second, which follows the last devaluation of the French franc, begins in the second quarter of 1987 and continues until the end of 1994.[8] Choosing a truncated period like this means that, for each of the two phases, price formation is assumed to have remained stable, give or take a constant. The assumption underlying this choice is implicit in the fact that there is only one break in the series, which affects the constant and not the behaviour of the explanatory variables. Statistical tests clearly show a change in average inflation (Ponty (1997)) which, although difficult to situate precisely, seems to have taken place during the price deceleration phase. It may also correspond to a far-reaching change in expectations following a change in economic policy. Recent research by Fisher et al. (1997), which is not based on a truncated period as is the case here, takes official price growth objectives into consideration in expectations of inflation.

Inflation in France does not result solely from internal pressures related to activity, whether measured by the output or the capacity utilisation gap. It also depends on variations in prices outside France. Growth of the import deflator can take this into account, but it has the disadvantage of including the margin behaviour of foreign exporters on the French market, largely determined by inflation in France. Consequently we shall see whether another indicator, namely the average inflation adjusted for the exchange rate of France's main trading partners, might no be more relevant. Lastly, one or more autoregressive terms will be included in order to correct any autocorrelation of residuals. The equation, in its most general form, is as follows:

$$\dot{p}_c = \sum_i a_i \dot{p}_{c-i} + \sum_j b_j GAP_{-j} + \sum_k c_k \dot{p}_{m-k} + d + d' 1_{[87Q2-94Q4]}$$

GAP : indicator of internal pressures:

output gap ($EPIBL$ or $EPIBP3$)

capacity gap $\left(ECAP = TUA - \overline{TUA}\right)$

$1_{[87Q2-94Q4]}$: dummy corresponding to the period 1987Q2 to 1994Q4

2.3 Results

Over the survey period, all the internal pressure indicators exert a positive and significant influence after two quarters. Only the capacity utilisation gap required smoothing[9] (see Table 4). The influence proves to be relatively unaffected by the choice of the variable designed to reflect external inflationary pressures. However, we preferred to include changes in the import deflator in subsequent regressions because the regressions seemed to be of higher quality from a statistical standpoint (see Tables A3-1 to A3-4 in the Annex).

The medium-term elasticity of the output gap (0.14) is twice as large as that of the capacity utilisation gap (0.07). However, the two indicators displayed such highly dissimilar variations of amplitude that their elasticities are not comparable as they stand. But once the indicators have been centred on the mean and reduced by the standard deviation, they prove to be identical and close to 0.15 (see Table 5 and, in the Annex, Table A3-7). Thus, a one-point centred and reduced gap maintained for one year would entail price acceleration of 0.6 point. The absence of any speed limit effect in the regressions is due perhaps to the fact that the output gaps used in this study are short-term gaps which are quickly absorbed. The medium-term impact of an acceleration of imported inflation on price growth in France seems to be relatively weak. When import price growth accelerates by one point quarter-on-quarter, inflation in France increases by only about 0.1 point.

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[8] Quarters subsequent to the fourth quarter of 1994 were not included in the estimation because "extremity effects" can adversely affect the reliability of the output gap.

[9] Four quarters were smoothed as follows : $TUA_{\text{smoothed}} = (TUA + 1.5TUA_{-1} + 1.5TUA_{-2} + TUA_{-3})/5$.

Table 4

Measurement of inflation with alternative indicators of internal pressures (*IPI*) and with growth of the import deflator

IPI	$\dot{P}_{-1}$	IPI_{-2}	$\dot{P}_m$	**constant (x100)**	**break in constant (x100)**	R^2	σ **(x100)**
Smoothed ouput gap	0.29 (3.2)	0.09 (2.0)	0.09 (5.9)	1.57 (6.2)	-1.14 (-6.9)	0.88	0.40
Potential output gap	0.28 (3.0)	0.10 (2.2)	0.08 (5.9)	1.59 (6.3)	-1.14 (-5.5)	0.88	0.40
Capacity utilisation gap (smoothed)	0.31 (3.4)	0.05 (2.1)	0.09 (6.0)	1.56 (6.3)	-1.15 (-5.5)	0.88	0.40

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Table 5

Medium-term elasticities between inflation and the ouput (or capacity utilisation) gap and imported inflation

Medium-term effect	**Impact of one point on the output gap**	**Impact of one point on the capacity gap**	**Impact of one point on the *centred and reduced* output or capacity gap**	**Impact of one point on imported inflation**
Impact over 1 quarter	0.14	0.07	0.15	0.12
Impact maintained over 1 year	0.6	0.3	0.6	0.5

These effects appear to be stable from one phase to another: most breaks in behaviour prove to be insignificant. Thus, the output or production capacity gap and imported inflation appear to have the same influence on price growth in periods of both high and low inflation (see Tables A3-5 and A3-6 in the Annex). However, some results are sensitive to the definition of the estimation period. The effect of the smoothed or potential output gap no longer appears to be significant when the years 1973-75 relating to the first oil shock are left out. But the robustness of the equations would need to be further assessed by making a sweep of this kind over the entire period. Dynamic simulation[10] of the equations over each of the two phases sheds some initial light (see Charts 3 to 5). The main swings in price growth seem to be fully taken into account until the early 1990s. However, actual and simulated curves diverge somewhat thereafter: during the period 1993-94, when the capacity utilisation gap was used as an indicator of inflationary pressures; and more clearly during the period 1995-96 when the output gap was used.[11]

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[10] Simulated price growth, shown in graphic form, is calculated quarter-on-quarter. The curve is smoother and easier to interpret than the quarterly growth curve simulated directly from the equation.

[11] Simulated price growth for the years 1995-96 (i.e. beyond the estimation period) could not take account of every possible change in the manner of price formation occuring during those years. Moreover, there may be "extremity effects".

Chart 3

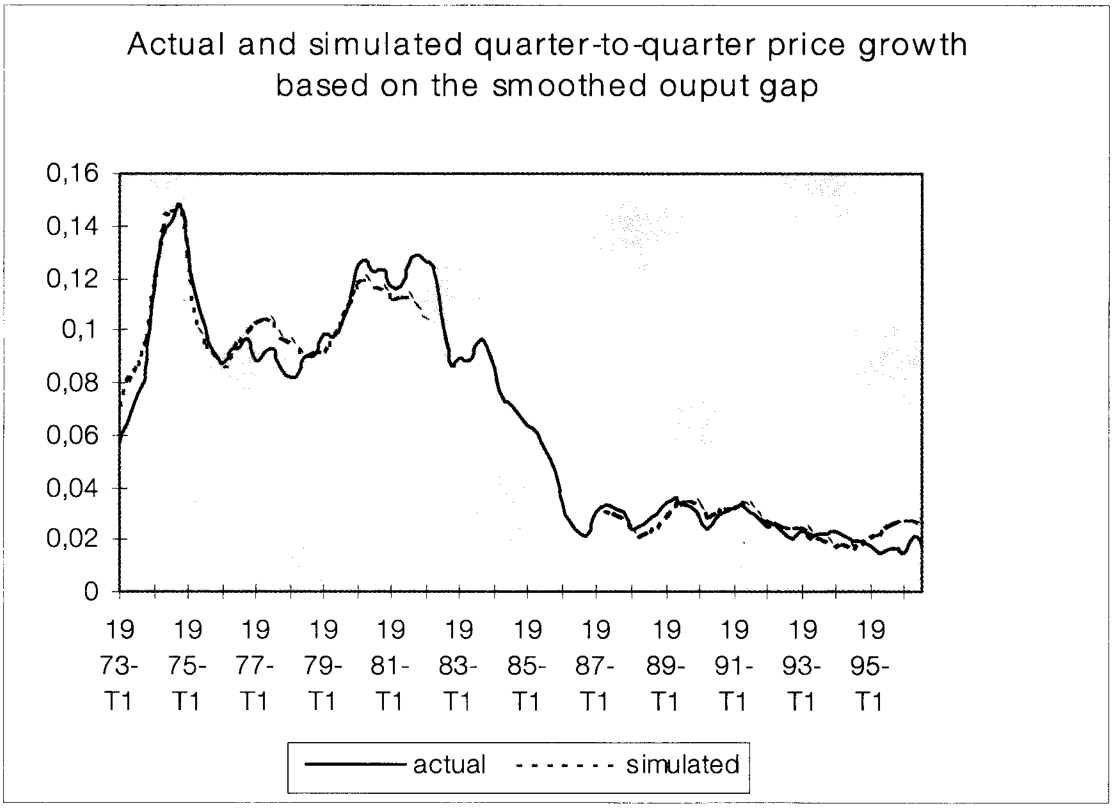


Chart 4

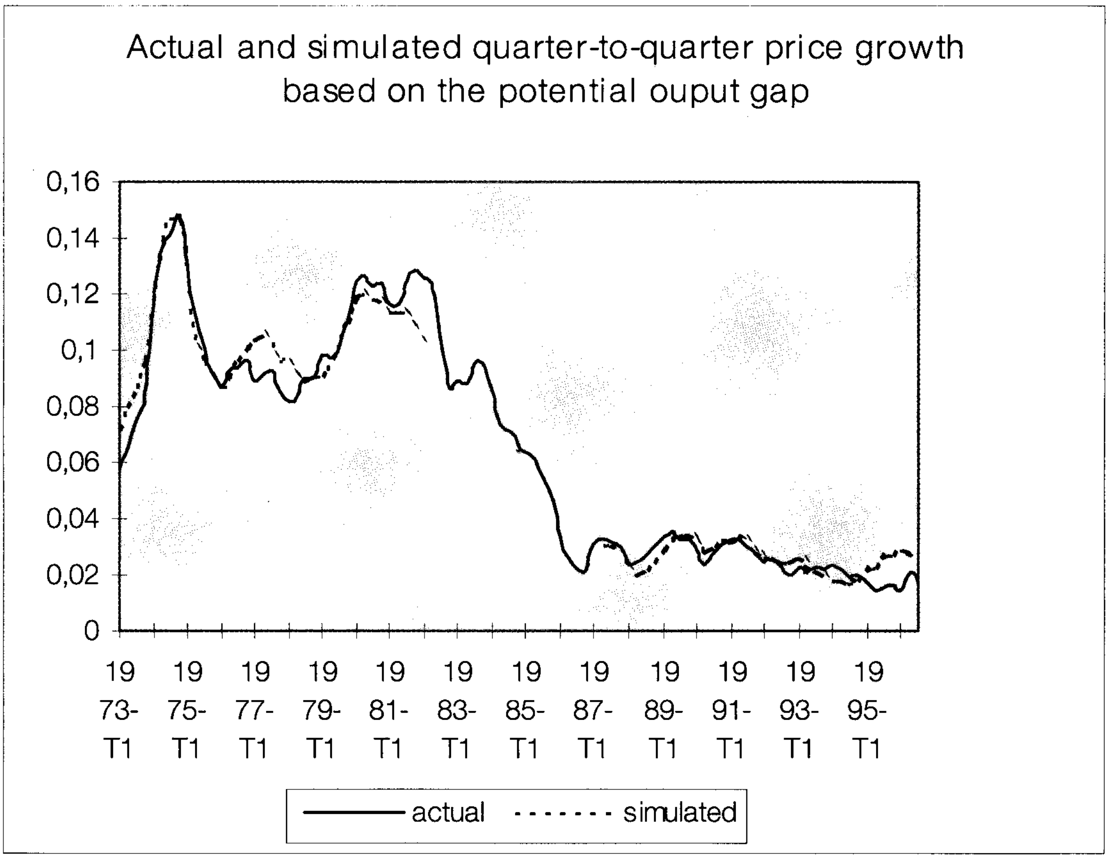
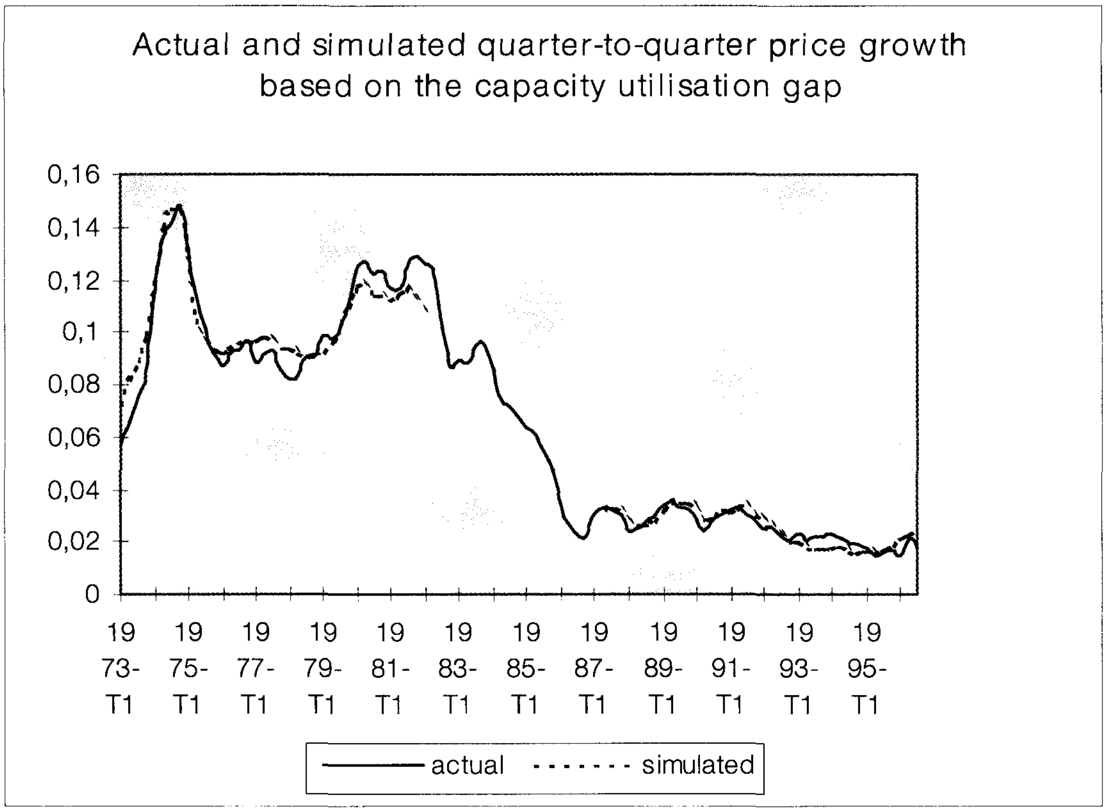


Chart 5



Conclusion

The methods proposed here for constructing output gap indicators and linking them to inflation meet three initial conditions : they are reproducible, easy to use and quick to produce results. They are based on a single or multiple-variable approach, including a structural component in the latter case. The results are mutually consistent and correspond to the results of the many other studies on the subject. The equilibrium rate of unemployment, defined here as the unemployment rate at which firms' marginal profit rates are stabilised in the short term, is calculated by comparing real pressures on wage growth with assumed pressures on the labour market, the latter being measured by the gap between the actual and equilibrium rate of unemployment. This method also makes it possible to identify the influence of changes in firms' net interest payments on short-term labour market pressures. These estimations, like all estimations of such indicators, are based on a large number of assumptions which we have endeavoured to clarify, though some of them are inevitably open to discussion. Our estimations should therefore be treated with the utmost caution.

The output or capacity utilisation gaps are found to exert an influence on price growth in France. The influence proves to be of the same size and does not appear to be affected by the inflationary climate. Whether inflation is high or low, there is an average inflation rate around which price growth fluctuates in response to internal and external pressures according to stable patterns of behaviour.

Annex 1

Firms' profit ratios and the equilibrium rate of unemployment: in search of a simple link

We shall first show, from a simplified wage-price loop and a few robust assumptions, how it is possible to link variations of the profit ratio with the gap between the actual and equilibrium rate of unemployment, and then go on to propose an empirical calibration of the parameter of this link.

A. Link between variations of the profit ratio and actual and equilibrium rates of unemployment

i) Profit ratio equation

$$TM = 1 - \frac{W.NE}{P.PIBE} \Rightarrow 1 - TM \frac{W.NE}{P.PIBE} \Rightarrow \text{by approximation:} \tag{A1}$$

$$\Delta TM = \dot{P} + \dot{\pi}_N - \dot{W} \text{ and} \tag{A2}$$

$$\dot{P} = \dot{W} - \dot{\pi}_N + \Delta TM \tag{A2'}$$

ii) Wage formation. Our starting point is a standard augmented Phillips-curve equation:

$$\dot{W} = \phi(L)\dot{P}_c - \beta TC + AV1, \text{ where: } \beta > 0, \text{ and } \phi(1) = 1 \text{ by assumption} \tag{A3}$$

$$\Rightarrow \quad \dot{W} = \dot{P} + \left(\phi(L)\dot{P}_c - \dot{P}\right) - \beta TC + AV1 \tag{A3'}$$

$AV = \phi(L)\dot{P}_c - \dot{P}$ represents the influence on wage growth of lags in wage indexation and deviations between $\dot{P}_c$ and $\dot{P}$ due to changes in the terms of trade or indirect taxation.

iii) TM is not directly influenced by the labour market*

$$TM = \frac{EBE}{P.PIBE} = \frac{EBE}{P.KE}.\frac{KE}{PIBE} \Rightarrow TM^* = \left(\frac{EBE}{P.KE}\right)^*.\left(\frac{KE}{PIBE}\right)^* \tag{A4}$$

$\left(\frac{EBE}{P.KE}\right)^* = TI + \delta$ if resources are well allocated and $\left(\frac{KE}{PIBE}\right)^*$ depends on technological factors.

The equilibrium profit ratio does not, therefore, depend on the labour market situation. ΔTM^* is assumed to be very weak, so that:

$$\Delta TM^* \approx 0 \tag{A5}$$

iv) From one period to another, changes in the equilibrium prove that:

$$\text{(A2'), (A3') and (A5)} \Rightarrow \begin{cases} \dot{P}^* = \dot{W}^* - \dot{\pi}_N \\ \dot{W}^* = \dot{P}^* + AV2^* - \beta TC^* + AV1 \end{cases} \Rightarrow \beta TC^* + \dot{\pi}_N - AV1 - AV2^* = 0 \quad \text{(A6)}$$

v) Changes in actual situations prove that:

$$\text{(A2') and (A3')} \Rightarrow \Delta TM = \beta TC^* + \dot{\pi}_N - AV1 - AV2 \qquad \text{(A6')}$$

By differentiating (A6') and (A6), and assuming $AV2 \approx AV2^*$, we obtain:

$$\Delta TM \cong \beta\left(TC - TC^*\right) \qquad \textbf{\textit{QED}} \qquad \text{(A7)}$$

B. Calculating the parameter β

From the previous equation we may assert:

$$\Delta^2 TM \cong \beta\left(\Delta TC - \Delta TC^*\right) \Rightarrow \beta \cong \frac{\Delta^2 TM}{\left(\Delta TC - \Delta TC^*\right)} \qquad \text{(A7')}$$

Assuming $\Delta TC^* \cong \Delta TCl$ in the short term, we obtain:

$$\beta \cong \frac{\Delta^2 TM}{\left(\Delta TC - \Delta TCl\right)} \qquad \text{(A8)}$$

The average value of the β coefficient obtained by applying equation (A8) is not homogeneous for the different profit ratios used and is even negative for the profit ratio at market prices (cf. Table A1, columns 1 and 3). This is because the denominator of the equation assumes values very close to zero in certain quarters or in certain years. We have decided to impose $\beta = 0.5$ as a standard value, for three reasons.

1. β = 0.5 is the value for which the various estimations of the output gap (using all the different methods described) are the same in 1993, the year in which the output gap was the smallest (approx. –2.0%) in the last ten years.

2. β = 0.5 corresponds to the average value resulting from application of equation (A8), for the four profit ratios under consideration and for the two smoothing parameters used for the HP filter (λ = 100 and λ = 1,600), if the quarterly values of β are reasonably bounded within the interval [0;1] (cf. Table A1, columns 2 and 4). These bounds seem reasonable because the β parameter cannot be negative. Moreover, if β = 0 the unemployment rate does not influence the profit ratio and β>1 the influence is negligible and there is little difference between the actual and equilibrium rate of unemployment (cf. Annex 2).

3. If equation (A6') is deduced from a standard wage-price loop, the β parameter corresponds to the effect of the level of unemployment on wages growth (equation (A3)). The calibration β = 0.5 corresponds to estimates of the augmented Phillips-curve equations used in the main French macroeconomic models (cf. G5M (1996)). In augmented Phillips-curve equations, when the level of unemployment influences wages growth (as in the Hermes model, for example), the

estimated β parameter is generally close to 0.5. When it is the logarithm of the unemployment rate that influences wages growth (as in the Amadeus model, for example), the estimated β parameter is close to 0.03 which, for unemployment rates in the region of 12%, is also consistent with a value β = 0.5.

Table A1

Average value of β obtained by applying equation (A8) to the interval 1970Q1 to 1995Q4

	Smoothing parameter of HP filter: λ = 1,600		**Smoothing parameter of HP filter: λ = 100**	
	Without bounds	**β bounded in the interval [0;1]**	**Without bounds**	**β bounded in the interval [0;1]**
*TM*1	3.14	0.48	10.72	0.50
*TM*2	-0.77	0.48	-2.83	0.50
*TM*3	1.41	0.49	2.88	0.51
*TM*4	1.19	0.51	2.38	0.53

Note: *TM*1: current profit ratio; *TM*2: profit ratio at market prices; *TM*3: profit ratio at factor cost; and *TM*4: profit ratio at factor cost excluding interest charges.

Annex 2

Table A2-1

Correlations between output gaps, gaps between actual and equilibrium unemployment rates and the production capacity utilisation rate (quarterly data: 1970-95)

	EPIBL	*EPIBT*	*EPIBP1*	*EPIBP2*	*EPIBP3*	*EPIBP4*	*TC1*–TC*	*TC2*–TC*	*TC3*–TC*	*TC4*–TC*	*TUA*
EPIBL	-	0.81	0.97	0.97	0.97	0.97	0.45	0.44	0.44	0.53	0.74
EPIBT	0.81	-	0.79	0.78	0.78	0.80	0.40	0.37	0.39	0.49	0.59
EPIBP1	0.97	0.79	-	0.99	0.99	0.99	0.58	0.57	0.57	0.63	0.68
EPIBP2	0.97	0.78	0.99	-	0.99	0.99	0.57	0.57	0.57	0.64	0.70
EPIBP3	0.97	0.78	0.99	0.99	-	0.99	0.59	0.58	0.59	0.65	0.69
EPIBP4	0.96	0.79	0.99	0.99	0.99	-	0.60	0.60	0.60	0.69	0.69
TC1–TC*	0.47	0.44	0.63	0.62	0.63	0.64	-	0.99	0.99	0.94	0.20
TC2–TC*	0.47	0.40	0.61	0.62	0.63	0.64	0.99	-	0.99	0.97	0.21
TC3–TC*	0.47	0.42	0.62	0.62	0.63	0.65	0.99	0.99	-	0.97	0.20
TC4–TC*	0.57	0.52	0.68	0.69	0.70	0.74	0.94	0.97	0.97	-	0.30
TUA	0.82	0.60	0.77	0.79	0.77	0.77	0.23	0.24	0.24	0.33	-

Table A2-2

Some results of econometric estimations explaining output gaps in terms of pressures in the labour and goods markets – explained variable: *EPIBPi*, with *i*: 1 to 4

Data	Quarterly: 1970-2 to 1995-4				Annual: 1971 to 1995			
	Explanatory variables			R^2	Explanatory variables			R^2
i	*TCi*–TC*	*TUA*	*Ct*	DW	*TCi*–TC*	*TUA*	*Ct*	DW
1	1.15 (7.1)		0.00040 (0.5)	0.33 0.47	1.18 (3.8)		0.00040 (0.3)	0.39 1.63
		0.32 (9.4)	-0.27 (-9.5)	0.47 0.53		0.34 (5.8)	-0.28 (-5.8)	0.60 1.06
	0.92 (7.9)	0.27 (10.2)	-0.23 (-10.2)	0.68 0.87	0.90 (4.9)	0.29 (6.9)	-0.24 (-6.9)	0.81 2.03
2	1.05 (7.0)		0.00047 (0.5)	0.33 0.46	1.07 (3.8)		0.00048 (0.3)	0.38 1.60
		0.33 (9.8)	-0.28 (-9.8)	0.49 0.54		0.35 (6.1)	-0.29 (-6.1)	0.62 1.07
	0.82 (7.7)	0.28 (10.5)	-0.24 (-10.5)	0.68 0.86	0.79 (4.8)	0.30 (7.1)	-0.25 (-7.1)	0.81 1.95
3	1.10 (7.3)		0.00038 (0.4)	0.34 0.47	1.12 (3.9)		0.00039 (0.3)	0.40 1.62
		0.32 (9.5)	-0.27 (-9.5)	0.47 0.52		0.34 (5.9)	-0.29 (-5.9)	0.60 1.04
	0.87 (8.1)	0.28 (10.3)	-0.23 (-10.3)	0.68 0.90	0.84 (5.0)	0.29 (7.0)	-0.25 (-7.0)	0.81 1.98
4	1.14 (9.5)		0.00030 (0.4)	0.47 0.49	1.16 (5.2)		0.00031 (0.2)	0.54 1.70
		0.35 (9.6)	-0.30 (-9.6)	0.48 0.46		0.38 (5.7)	-0.32 (-5.7)	0.59 0.87
	0.87 (9.6)	0.27 (9.8)	-0.23 (-9.8)	0.73 0.86	0.85 (6.2)	0.29 (6.7)	-0.24 (-6.7)	0.85 2.02

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Annex 3

Results of estimates of inflation equations

Table A3 - 1

Measurement of inflation with internal pressure indicators: external pressures based on import deflator growth

Alternative internal pressure indicators (*IPI*)	$\dot{P}_{c_{-1}}$	IPI_{-2}	$\dot{P}_m$	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.29 (3.2)	0.09 (2.0)	0.09 (5.9)	1.57 (6.2)	-1.14 (-6.9)	0.88	0.40
Potential output gap	0.28 (3.0)	0.10 (2.2)	0.08 (5.9)	1.59 (6.3)	-1.14 (-5.5)	0.88	0.40
Capacity utilisation gap	0.33 (3.6)	0.03 (1.5)	0.09 (5.8)	1.51 (6.0)	-1.11 (-5.3)	0.88	0.41

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Table A3 - 2

Measurement of inflation with *smoothed*[12] internal pressure indicators: external pressures based on import deflator growth

Alternative smoothed internal pressure indicators (*IPIs*)	$\dot{P}_{c_{-1}}$	$IPIs_{-2}$	$\dot{P}_m$	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.30 (3.2)	0.09 (2.0)	0.09 (6.0)	1.56 (6.2)	-1.13 (-5.5)	0.88	0.40
Potential output gap	0.29 (3.1)	0.11 (2.0)	0.09 (6.1)	1.55 (6.2)	-1.10 (-5.4)	0.88	0.40
Capacity utilisation gap	0.31 (3.4)	0.05 (2.1)	0.09 (6.0)	1.56 (6.3)	-1.15 (-5.5)	0.88	0.40

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Table A3 - 3

Measurement of inflation with internal pressure indicators: external pressures based on average foreign consumer price growth

Alternative indicators of internal tensions (*IPI*)	$\dot{P}_{c_{-1}}$	IPI_{-2}	$\dot{P}_e$	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.29 (2.5)	0.12 (2.4)	0.07 (2.4)	1.68 (5.6)	-1.28 (-5.2)	0.83	0.48
Potential output gap	0.27 (2.3)	0.14 (2.5)	0.07 (2.4)	1.71 (5.7)	-1.27 (-5.3)	0.84	0.48
Capacity utilisation gap	0.33 (3.0)	0.05 (2.0)	0.07 (2.2)	1.61 (5.4)	-1.25 (-5.0)	0.83	0.49

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

12 $IPIs = (IPI + 1.5IPI_{-1} + 1.5IPI_{-2} + IPI_{-3})/5$.

Table A3 - 4

Measurement of inflation with *smoothed*[13] internal pressure indicators: external pressures based on average foreign consumer price growth

Alternative smoothed internal pressure indicators (*IPIs*)	$\dot{P}_{c-1}$	$IPIs_{-2}$	$\dot{P}_{e}$	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.30 (2.6)	0.11 (2.0)	0.07 (2.4)	1.65 (5.5)	-1.26 (-5.1)	0.83	0.49
Potential output gap	0.30 (2.6)	0.12 (1.9)	0.08 (2.4)	1.62 (5.4)	-1.21 (-5.0)	0.83	0.49
Capacity utilisation gap	0.31 (2.8)	0.06 (2.2)	0.07 (2.4)	1.64 (5.5)	-1.28 (-5.2)	0.83	0.48

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Table A3 - 5

Test of any break in the influence of the output or capacity gap on inflation from one sub-period to the other

Alternative indicators of internal tensions (*IPI*)	$\dot{P}_{c-1}$	IPI_{-2}	break in the IPI influence	$\dot{P}_{m}$	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.27 (2.8)	0.13 (1.9)	-0.07 (-0.8)	0.08 (5.6)	1.64 (6.2)	-1.19 (-5.5)	0.89	0.40
Potential output gap	0.26 (2.5)	0.15 (2.0)	-0.08 (-0.8)	0.08 (5.5)	1.66 (6.2)	-1.19 (-5.5)	0.89	0.40
Capacity utilisation gap (smoothed)	0.31 (3.2)	0.06 (1.9)	-0.03 (-0.6)	0.09 (6.0)	1.58 (6.3)	-1.16 (-5.5)	0.89	0.40

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

Table A3 - 6

Test of any break in the influence of import deflator growth on inflation from one sub-period to the other

Alternative indicators of internal tensions (*IPI*)	$\dot{P}_{c-1}$	IPI_{-2}	$\dot{P}_{m}$	break in $\dot{P}_{m}$ influence	constant (x100)	break in constant (x100)	R^2	σ (x100)
Smoothed ouput gap	0.30 (3.1)	0.09 (2.0)	0.09 (5.6)	-0.01 (-0.1)	1.57 (6.1)	-1.14 (-5.3)	0.88	0.41
Potential output gap	0.28 (2.9)	0.10 (2.1)	0.09 (5.5)	-0.0 (-0.0)	1.59 (6.1)	-1.13 (-5.4)	0.88	0.41
capacity utilisation gap (smoothed)	0.31 (3.3)	0.04 (2.1)	0.09 (5.9)	-0.02 (-0.4)	1.55 (6.1)	-1.14 (-5.4)	0.88	0.41

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

13 $IPIs = \left(IPI + 1.5 IPI_{-1} + 1.5 IPI_{-2} + IPI_{-3}\right)/5$.

Table A3 -7

Measurement of inflation with alternative centred and reduced indicators of internal pressures

Alternative indicators of internal tensions (*IPI*)	$\dot{P}_{c-1}$	IPI_{-2}	$\dot{P}_m$	**constant (x100)**	**break in constant (x100)**	R^2	σ **(x100)**
Smoothed ouput gap	0.29 (3.2)	0.11 (2.0)	0.09 (5.9)	1.59 (6.2)	-1.14 (-5.5)	0.88	0.40
Potential output gap	0.28 (3.0)	0.11 (2.2)	0.08 (5.9)	1.61 (6.3)	-1.14 (-5.5)	0.88	0.40
Capacity utilisation gap (smoothed)	0.31 (3.4)	0.11 (2.1)	0.09 (6.0)	1.56 (6.3)	-1.15 (-5.5)	0.88	0.40

Note: The numbers in brackets correspond to the Student t-distribution of the estimated coefficients.

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Comments on: "An empirical assessment of the link between the output gap and inflation in the French economy" by John Baude and Gilbert Cette

by Wilhelm Fritz

It is the purpose of this paper to analyse empirically the short-term relationship between variations in output during business cycles and changes in the inflation rate of the French economy.

In the first section the authors present three methods of calculating potential GDP: a Hodrick-Prescott filter, an estimation of trend-GDP which allows for breaks (the number and location of significant break-points being determined endogenously), and a third approach based on constant profit ratios. As it proves difficult to obtain a reliable estimate of the profit ratio defined as the coefficient on capital in a Cobb-Douglas production function, the authors set it equal to the average of the ratios between profits and GDP. No less than four such indicators are presented: two ratios are based on profits and GDP at, respectively, factor costs and market prices; a third relates profits at factor costs to GDP at market prices; and the fourth is a factor-costs-based profit ratio adjusted for net interest charges. One would assume that at least the first three definitions do not differ much in terms of their variability during the business cycle.

To derive unemployment and output gaps, for each of these profit ratios an "equilibrium unemployment rate" is determined such that no distributional pressures build up between capital and labour; i.e. the profit ratios have to be stable. Observed variations in profit ratios then determine the sign of the unemployment gap, and, by further assuming a proportional relationship, also its level. Changes in the unemployment gap determine, via the production function, the output gap, which obviously implies that the authors regard the size of the labour force as pre-determined. These relationships were not estimated econometrically.

This approach to determining the position in the business cycle is meant as an alternative to the derivation of a "non-accelerating wage or inflation rate of unemployment" (NAWRU or NAIRU). While the latter two can be interpreted as *structural* measures (i.e. the component of unemployment which is independent of the business cycle), the authors' equilibrium rates move with the actual rate during the cycle. They exceed the actual rate when wage growth accelerates and/or output price inflation decelerates. In these cases, employees are immediately penalised by less employment. In the definition where the profit ratio is calculated net of capital costs, employees also have to bear the burden of higher interest rates. Furthermore, even temporary changes in interest rates – such as the 1993 trough and the 1994 peak – feed immediately into the unemployment gap. Maybe for such reasons, the authors decided to smooth their profit ratio indicators to a certain degree by applying a Hodrick-Prescott filter before they calculated the unemployment gaps.

To conclude this section the authors present the various measures of the output- and unemployment gaps and the correlations between them. They also introduce a capacity utilisation indicator at this stage, arguing that this primarily captures pressures in the goods markets. Given the way that the unemployment gaps have been derived, it is hardly surprising that deviations of actual GDP and unemployment from their equilibrium levels are highly correlated. More to the point, it appears that equilibrium unemployment has increased in step with actual unemployment, so that their estimates are observationally equivalent to one that estimates equilibrium unemployment by a hysteresis model.

Section 2 examines the relationship between the position in the business cycle and inflation. To determine inflation, the authors use the constructed GDP gap indicators which captures, in one variable, inflationary pressures in both goods and labour markets. Alternatively, they replace the output by the capacity utilisation gap. More surprising in this context is their choice of a worldmarket price indicator instead of a variable which reflects inflationary expectations in domestic markets. The latter would have the advantage that it can be influenced by monetary policy while a central bank with a nominal exchange rate target has little influence on the former. The authors' decision to exclude the episode of a marked decrease in inflation rates between 1982 to 1986 from their sample has the advantage that they do not have to pay much attention to potentially non-stationary variables in specifying their reduced-form equations.

The overall result of these efforts is that increases both in capacity utilisation and actual output relative to potential significantly accelerate inflation and that domestic inflation responds almost equally strongly to changes in import prices. Given a high correlations between the capacity utilisation rate and the output gaps it is not surprising that the alternate specifications reveal the same dynamics; i.e. inflation responds to internal pressures with a two quarter lag. During the more recent sample period the simulated inflation rate exceeds the observed inflation rate, which raises the question whether the estimated relationships are actually stable beyond the sample period.