Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

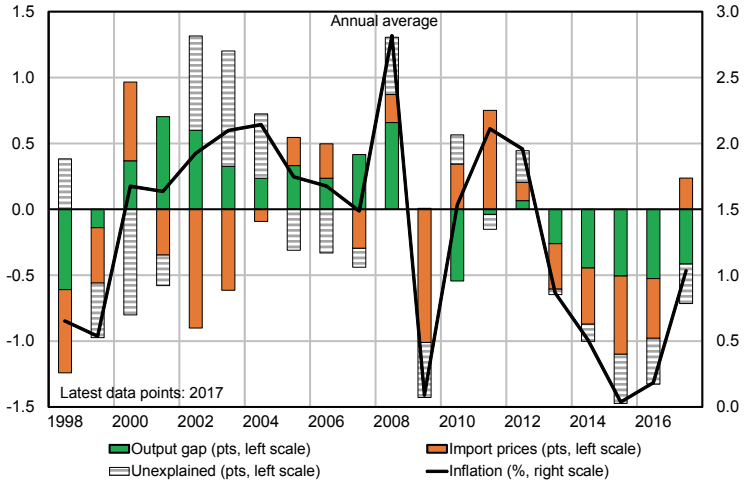
Trésor-economics

No. 233 • December 2018

Relation between inflation and the cycle in the past five years

- The business cycle has a significant effect on inflation, known as the Phillips effect: growth 1 point higher than its potential in a given year increases next-year inflation by 0.3 point. The correlation between inflation and the economy's position in the business cycle weakened in the 1970s and 1980s, but does not appear to have declined further in the past 15 years.
- In the past few years, French inflation has surprised some observers on the downside. Inflation was +0.2% in 2016 and +1.0% in 2017, after declining for four years in a row, from +2.0% in 2012 to 0.0% in 2015. Over the same period, the French economy performed significantly below its potential, by about 1.5 points on average between 2013 and 2016.
- Inflation weakness between 2013 and 2016 reflects the extended period of low economic growth and the decline in oil prices. Over 2013-2016, on average, weak economic activity had an estimated −0.5-point p.a. impact on inflation. The downtrend in oil prices over the period weighed on the consumer price index and had a comparable effect on inflation (−0.5 point). Lastly, measures to reduce labour costs (Competitiveness and Employment Tax Credit – CICE, and the Responsibility and Solidarity Pact), along with stiffer competition in the telecoms sector, have dampened the inflation rate further over the last few years.
- This recent period of sluggish inflation is expected to end gradually, reflecting–with a certain lag–the ongoing closing of the output gap. Thus, core inflation (i.e. excluding its most volatile components such as energy and food) is expected to rise steadily to +0.9% in 2018 and +1.1% in 2019, vs. +0.4% in 2017, at a pace consistent with the projected closing of the output gap.
- The modest level of inflation suggests that the output gap was still negative in 2017 despite economic surveys indicating pressure on the production system.

Dynamic contributions to inflation



Source: DG Trésor calculations.

How to read this chart: In 2017, inflation was +1.0%, i.e. −0.5 point below its long-term average of +1.5%. This 0.5-point divergence breaks down into −0.4 point for the output gap, +0.2 point for import prices, and −0.3 point for elements not captured by the model, such as the CICE and telecom sector competition.

1. Since the 2000s, the correlation between inflation and the business cycle has been stable in France

1.1 The connection between inflation and the business cycle was discovered 60 years ago

In 1958, economist A.W. Phillips[1] brought to light the existence of a relationship between the growth rate of nominal wages and the unemployment rate in the United Kingdom between 1861 and 1913. According to Phillips, a decline in unemployment increases workers' bargaining power and leads to higher wages. Two years later, economists Samuelson and Solow[2] referred to Phillips in their discussion of the trade-off for policymakers choosing between inflation and unemployment in the United States. Since then, the Phillips curve refers to the relationship between the inflation rate and the unemployment rate or any other proxy for the business cycle.[3]

In the late 1970s, economist R. Gordon[4] suggested a reformulation of the Phillips curve. Gordon's model is widely used in applied economic literature. In this model, inflation depends on three main factors:

- Lagged inflation, which reflects the persistence in the price trend
- The cycle, which captures the economy's aggregate demand
- Import prices, which track supply-side shocks (oil, foreign exchange, commodities, etc.)

This report uses Gordon's model. A second variant of the Phillips curve, known as the "New Keynesian Phillips Curve" (NKPC), is based on expected inflation rather than past inflation. The NKPC appeared in the economic literature in the 1990s following the emergence of research on rational expectations, but its empirical validity is subject to debate (see Box 1).

Box 1: Modelling choices

Here Gordon's model is preferred to the more recent New Keynesian Phillips Curve (NKPC), which emerged in the 1990s[a] and is now present in "DSGE" models.[b]

Gordon's model is frequently used in applied economics and offers numerous advantages: it accurately describes historical price trends; it does not assume any particular type of expectation-formation; and it is easy to estimate.

By contrast, there is no consensus on the robustness of the NKPC, which is obtained by resolving a programme of firms' price-setting behaviour and which yields an equilibrium relationship between inflation, agents' inflation expectations (which are assumed to be rational) and a cycle variable.[c] Indeed, in this type of model:

- estimation of rational expectation Phillips equation parameters is subject to enormous uncertainty depending on the instrumental variables used.[d]
- disinflation announced ahead of time has no impact on economic activity if the central bank is credible. However, virtually all periods of disinflation in developed countries between 1960 and 1990 coincided with output declining beneath its potential[e] (granted, probably not all these policies were announced ahead of time by credible central banks).
- rational inflation expectations play a central role. However, experimental economics shows that economic agents do not use all available information and overemphasise private information sources based on personal consumption experience.[f]

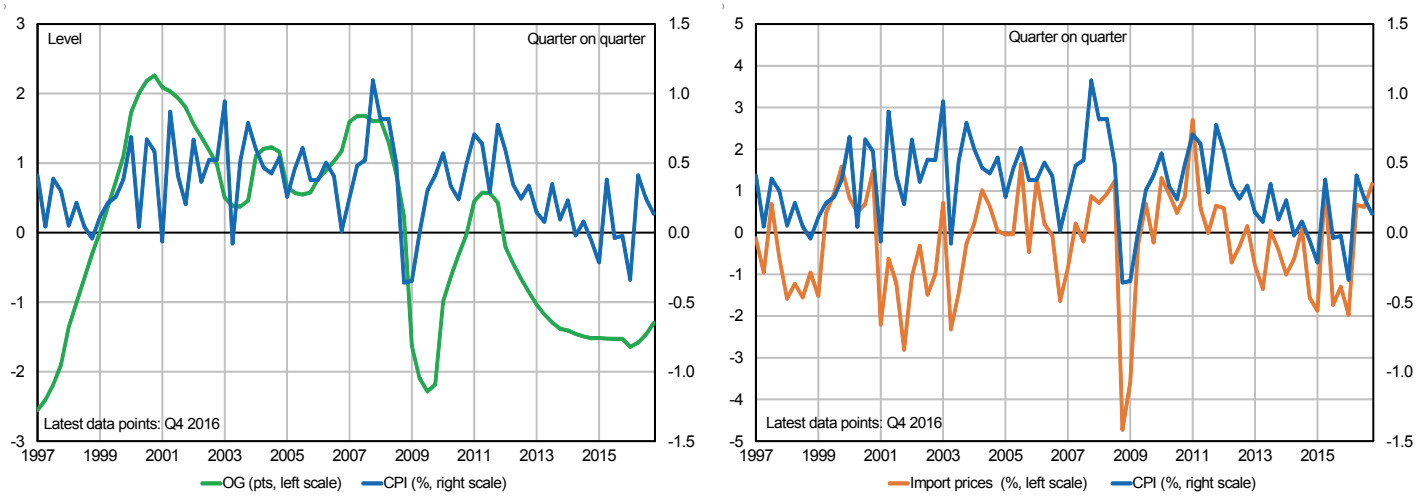
a. J. Gali and M. Gertler (1999), "Inflation dynamics: a structural econometric analysis", *Journal of Monetary Economics*, vol. 44(2), pp. 195-222.
b. Dynamic Stochastic General Equilibrium.
c. N. Mankiw (2001), "The inexorable and mysterious trade-off between inflation and unemployment", *Economic Journal*, vol. 111, pp. 45-61 and J. Rudd and K. Whelan (2006), "Can rational expectations sticky-price models explain inflation dynamics?" *American Economic Review*, vol. 96(1), pp. 303-320.
d. J. Rudd and K. Whelan (2007), "Modeling Inflation Dynamics: A Critical Review of Recent Research", *Journal of Money*, Credit and Banking, vol. 39(1), pp. 155-170.
e. L. Ball (1994), "What determines the sacrifice ratio?" in N. Mankiw (1994), Monetary Policy, University of Chicago Press, pp. 155-182.
f. A. Cavallo, G. Cruces and R. Perez-Truglia (2017), "Inflation Expectations, Learning and Supermarket Prices: Evidence from Survey Experiments", *American Economic Journal: Macroeconomics*, vol. 9(3), pp. 1-35.

(1) A. Phillips (1958), "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957", *Economica*, vol. 25, pp. 283-299.
(2) P. Samuelson and R. Solow (1960), "Analytical Aspects of Anti-Inflation Policy", *American Economic Review*, vol. 50, no. 2, pp. 177-194.
(3) For a comprehensive view of the successive variants of the Phillips curve in the history of economic thought, see H. Le Bihan (2009), "The Phillips Curve at Fifty", *Revue de l'OFCE*, no. 111.
(4) R. Gordon (1977), "The Theory of Domestic Inflation", *American Economic Review*, vol. 67, pp. 128-134.

1.2 In France, a 1-point increase in the output gap increases next-year inflation by 0.3 point

Based on a specification of Gordon's model (see Box 2 for details on this specification), the consumer price index (CPI) is charted against the output gap (OG) and import prices. The variables used are shown in Chart 1 below.

Charts 1a and 1b: Variables used in the Phillips equation



Source: INSEE, DG Trésor calculations.

Box 2: Econometric specification of the estimated Phillips curve

The following Phillips equation was estimated for the period from Q1 1997 to Q4 2016:

$$\Delta CPI_t = 0.33 + 0.11\ \Delta CPI_{t-2} + 0.07\ OG_{t-1} + 0.15\ \Delta ImpP_t + u_t$$

Where ΔCPI is the quarterly growth rate of the total consumer price index corrected for seasonal variation; OG is the output gap estimated by Gatier and Herlin (2017)[a]; $\Delta ImpP$ is the quarterly growth rate of relative import prices (i.e. the ratio of total import prices to GDP prices).[b]

This equation explains 58% of the variance of quarterly inflation (R^2 adjusted).[c]

The constant can be interpreted as inflation expectations partly anchored to a target, in this case, an annualised 1.5%. In other words, the equation tends towards this inflation rate when the output gap and import price shocks are nil. The value of this freely estimated constant is consistent with the data: for the sample considered, average annual inflation works out at +1.3% (measured by the HICP, average annual inflation was +1.5% in France and +1.7% in the euro area over the same period).

In this Phillips equation, while there is circularity between inflation estimations and output gap estimations, this circularity is very limited. The output gap is measured using a structural method (also known as the production function methodology) that does not directly use an inflation indicator: inflation only comes into play indirectly via the evaluation of the unemployment gap (i.e. the difference between actual unemployment and structural unemployment), which is one of the elements used to evaluate the economy's potential labour factor.

a. Gatier A. and A. Herlin (2017), "Potential growth in France", *Trésor-Economics* no. 206.
b. Here we follow the applied economics literature on the Phillips curve, which commonly uses relative import prices to capture supply shocks.
c. The variables are stationary. All the coefficients are significant after the Newey-West adjustment. The absence of serial correlation in the residuals is not rejected (p-value of the Breusch-Godfrey test: 0.24).

Table 1: Elasticity or semi-elasticity of the CPI to permanent shocks

Change in average annual CPI	Year 1	Year 2
1-pt change in output gap	0.11	0.44
1% change in import prices	0.40	1.08

Change in average annual inflation	Year 1	Year 2
1-pt change in output gap	0.11	0.33
1% change in import prices	0.40	0.68

Source: DG Trésor calculations.
How to read this table: A permanent 1-point increase in the output gap increases the CPI by 0.11 point in year 1 and by 0.44 point in year 2, equivalent to +0.11 point inflation in year 1 and +0.33 point in year 2.

The main coefficient of interest in the Phillips curve is the sensitivity of inflation to economic activity, also called the "Phillips curve slope". The model estimates this slope at 0.33 in the medium run.[5] Thus, a lasting 1-point reduction in the negative output gap increases average annual inflation by 0.33 point in year 2 (see Table 1).

This model is consistent with the macroeconomic literature showing a Phillips curve slope (i.e. inflation sensitivity to the output gap) of +0.3 point[6] for France. In some research, the NAIRU gap (i.e. the difference between actual and structural unemployment) is used as the cycle variable. Phillips curve slopes calculated using the NAIRU gap are always higher in absolute value than those calculated with the output gap, between −0.8 and −1.1 in year 2.[7] This is consistent with the data because in France, a 1-point increase in the output gap results in around a 0.4-point reduction in the NAIRU gap.[8]

The time lag observed econometrically is consistent with the microeconomic literature on the price-setting behaviour of French firms. Using the price data collected by INSEE for the period 1994-2014, Berardi and Gautier (2016)[9] calculated that the average time between price changes is around 12 months. Stripping out energy price data (as energy prices show the most frequent changes) and temporary price changes due to sales or promotions, the average time between price changes is higher, at around 17 months.

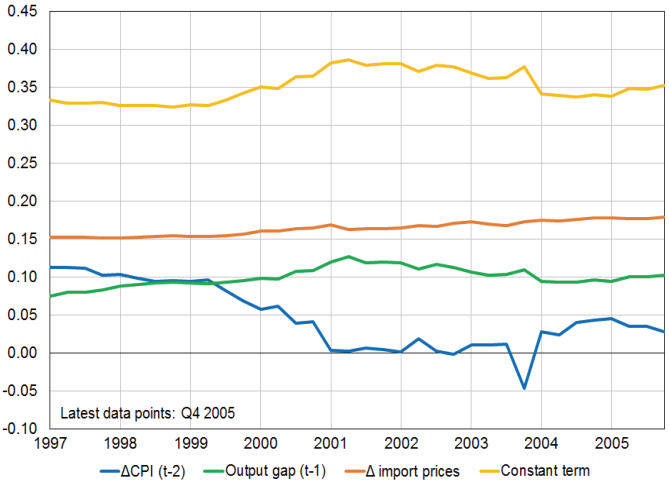
1.3 The correlation between inflation and the business cycle has been stable since the early 2000s

To observe whether the magnitude of the Phillips curve coefficients have changed over time, we carried out a series of recursive rolling regression tests.[10] By gradually reducing the estimation window, we can see whether or not the recent macroeconomic trend demonstrates a weakening in the inflation/cycle correlation compared to the estimated slope of the Phillips curve for the full sample.

The slope of the Phillips curve does not appear to have declined since the early 2000s (see Chart 2) following a widespread flattening of the curve in the advanced economies from the mid-1970s to the late 1980s.[11] This flattening trend has been variably attributed to central banks' increased credibility, a decline in workers' bargaining power, the role of globalisation, and menu costs in a low-inflation regime.

(5) The quarterly short-run Phillips curve slope is +0.07. The quarterly medium-run Phillips curve slope is +0.07/(1−0.11), taking into account the inflation persistence coefficient. The annualised medium-run Phillips curve slope is 4×0.07/(1−0.11).
(6) See S. Fries, J.S. Mésonnier, S. Mouabbi and J.P. Renne (2016), "National neutral rates of interest and the single monetary policy in the euro area", Banque de France WP 611, and L. De Charsonville, T. Ferrière and C. Jardet (2017), "MAPI: Model for Analysis and Projection of Inflation in France", Banque de France WP 637.
(7) See O. Blanchard, E. Cerutti and L. Summers (2015), "Inflation and Activity – Two Explorations and their Monetary Policy Implications", IMF WP 230, and E. Chantrel, C. Sutter, M. Lequien and A. Montaut (2014), "How strong of a rebound can be expected in the French economy?" *INSEE Conjoncture* in France.
(8) See J. Bardaji (2011), "Impact of the crisis on employment and wages in France", *Trésor-Economics* no. 83, and L. Ball, D. Leigh and P. Loungani (2013), "Okun's law: Fit at 50?" IMF WP 10.
(9) N. Berardi and E. Gautier (2016), "Adjustments in consumer prices in France in periods of low inflation", Banque de France Bulletin no. 41.
(10) This recursive regression method, which Murphy (2018) recently used to study changes in the Phillips curve in the United States, is an alternative to a rolling regression with a fixed window. The recursive approach ensures that the rolling coefficients are derived from estimates using stationary variables. See A. Murphy (2018), "The Death of the Phillips Curve?" Federal Reserve Bank of Dallas WP 1801. A rolling regression with a fixed window covers intervals in which the output gap variable is not necessarily stationary. However, this method yields similar conclusions.
(11) For an overview, see Y.E. Bara, J.B. Bernard, T. Blaize, B. Campagne, L. François and Y. Osman (2017), "Why is global inflation still so low?" *Trésor-Economics* no. 208, and M. Aglietta, G. Dufrénot and A. Faivre (2018), "Inflation et macroéconomie dans la globalisation", *L'économie mondiale 2019*, *La Découverte*, pp. 37-52.

Chart 2: Rolling coefficients



Source: DG Trésor calculations.

How to read this chart: Each data point represents the coefficient estimated using the Phillips equation between the rolling date on the x-axis and Q4 2016. For example, the import price coefficient went from 0.15 (estimation for the period from Q1 1997 to Q4 2016) to 0.18 (estimation for the period from Q4 2005 to Q4 2016).

The sensitivity of inflation to the past inflation trend remains low. There is disagreement about the cause of this low sensitivity. One possible explanation is that inflation expectations have become better anchored as monetary policy has gained credibility. Another possible interpretation is that economic agents do not consider inflation in their economic decision-making when inflation levels are very low.[12]

Lastly, the sensitivity of total inflation to import prices has gradually increased. This trend can be attributed to the growing import penetration rate.[13]

Furthermore, the test for non-linearity of the Phillips curve for France does not yield conclusive results (see Box 3).

Box 3: Could the Phillips curve be non-linear in France?

The relatively slow rebound in inflation following a cyclical upswing could prompt speculation that the Phillips effect only appears when economic activity is above a certain threshold. In other words, the Phillips curve might be non-linear. This question–which dates back to Phillips' seminal article–was recently broached again by American economists[a] during the US economy's cyclical rebound following the Great Recession.

There are several contemporary explanations why the Phillips curve might not be linear:

- Output slack: When the economy is at the cycle trough, companies can ramp up production, if needed, without raising prices by taking up slack in production capacity. This is no longer possible as the negative output gap closes.
- Menu costs: When the economy is at the cycle trough with low inflationary pressure, companies change their prices infrequently because the menu costs are higher than the gains from price hikes. This is no longer true at the cycle peak when inflation is more dynamic.
- Sticky wages: When the economy is at the cycle trough with low inflationary pressure, workers are reluctant to accept reductions in nominal wages. This wage stickiness curbs deflationary pressure.

We tested this effect using the standard threshold model method, which consists of simultaneously estimating the threshold values of regime changes and of Phillips equation coefficients in each regime.[b] This method identifies non-linearity at an output gap of –1.5 points, with a non-significant Phillips slope at a deep cycle trough.

However, from an economic standpoint, the results of this estimation do not make sense. It is hard to understand why a very large output gap would have zero effect on inflation. Also from a statistical standpoint, this result is weak: the non-linearity is driven by specific data points, notably by quarters (Q1 1997 and Q4 2009) when the output gap was very wide and inflation was being fuelled by tobacco price increases. Lastly, as the assumption of linearity is not rejected for core inflation data, a linear equation is relevant for understanding the correlation between inflation and the business cycle in France.

a. J. Fuhrer and G. Olivei (2010), "The Role of Expectations and Output in the Inflation Process: An Empirical Assessment", Federal Reserve Bank of Boston, Public Policy Brief no. 10-2, and R. Peach, R. Rich and A. Cororaton (2011), "How Does Slack Influence Inflation?" Federal Reserve Bank of New York, *Current Issues in Economics and Finance*, vol. 17, no. 3.

b. J. Bai and P. Perron (2003), "Computation and Analysis of Multiple Structural Change Models", *Journal of Applied Econometrics*, vol. 18, no. 1, pp. 1-22.

(12) O. Blanchard (2018), "Should We Reject the Natural Rate Hypothesis?" *Journal of Economic Perspectives*, vol. 32, no. 1, pp. 97-120.

(13) J. Carluccio, E. Gautier and S. Guilloux-Nefussi (2018), "Dissecting the Impact of Imports from Low-Wage Countries on French Consumer Prices", Banque de France WP 672.

2. The observed inflation trend suggests that the French economy is still performing below its potential

2.1 The combination of cyclical and import price effects explains most of the inflation developments

The Phillips equation used above allows for a fresh interpretation of the recent inflation trend in France. The econometric results provide a satisfactory dynamic simulation for the past few years. Thus, over the recent period from 2013 to 2017, weak inflation is attributable in equal parts to the extended period of lacklustre economic activity and to sluggish import prices.

Yet there are significant residuals: although the recent period did not see a statistical change in the inflation/cycle correlation, actual inflation since 2014 has been lower than predicted by the Phillips curve. The negative residuals unexplained by the equation over this period correspond in part to elements not captured in the model. These elements have had a deflationary effect; they include governmental measures to lower labour costs, as well as increased competition in certain sectors such as telecommunications. Nevertheless, these elements appear to explain only a small portion of the model residuals for the past few years (see Table 2 and Box 4).

Table 2: Tentative explanation for model residuals, 2014-2017

(points of inflation)	2014	2015	2016	2017
Inflation unexplained by Phillips equation	**−0.1**	**−0.4**	**−0.3**	**−0.3**
Elements not captured by the model	**+0.25**	**−0.05**	**−0.05**	**−0.15**
o/w telecom sector effect	0.0	0.0	0.0	−0.1
o/w CICE effect	−0.15	−0.15	−0.15	−0.15
o/w indirect taxation effect	+0.4	+0.1	+0.1	+0.1

Source: DG trésor calculations.

Box 4: The inflation contributions of sector-specific and economic policy elements

i) The "telecom sector effect" is the accounting contribution of the annual change in the telecommunications services CPI to total inflation. In 2017, telecommunications services prices declined a sharp 3.5% due both to price reductions by certain telecoms operators and to an increase in services accessible through phone and data plans (with an end to roaming fees in Europe and an increase in data included in data plans). In the CPI, this is reflected in lower prices at a constant level of quality.

ii) The "CICE effect" is the production price effect, as evaluated by the CICE Monitoring Committee for 2013-2014,[a] which is then applied unchanged to the following years.

iii) The "indirect tax effect" in 2014 is the effect of the VAT hike, following the calculation in Gautier and Lalliard (2013).[b]

iv) The "indirect tax effect" in 2015, 2016 and 2017 is the effect of increases in the domestic tax on consumption of energy products (TICPE).

a. Calculations based on R. Monin and M. Suarez-Castillo (2018), "The CICE impact on prices: a twofold analysis on individual and sectoral data", *INSEE working document*.
b. E. Gautier and A. Lalliard (2013), "How do VAT changes affect inflation in France?" Banque de France Bulletin no. 32.

The weak price momentum over the recent period thus appears to be more consistent with a negative output gap similar to the scenarios in the Budget Bills than with INSEE's recent quarterly surveys indicating pressure on the production system and therefore suggesting a positive output gap.[14]

2.2 Inflation forecasts assume the closure of the output gap, as presented in Budget Bills

The inflation forecasts in Budget Bills are mainly based on a sector approach. Forecasts are made for the main sector price indices, then these forecasts are aggregated to obtain a forecast for total and core inflation.[15] This is the preferred

(14) D. De Waziers (2018), "What do business surveys tell us about the position of the economy in the business cycle?" *Trésor-Economics* no. 223.
(15) For more details, see R. Faquet (2017), "An examination of inflation forecasts in budget bills", *Trésor-Economics* no. 198.

forecast method: firstly, the various price indices react to different factors to varying extents, and secondly, this method captures information on indirect taxes and on administered prices.

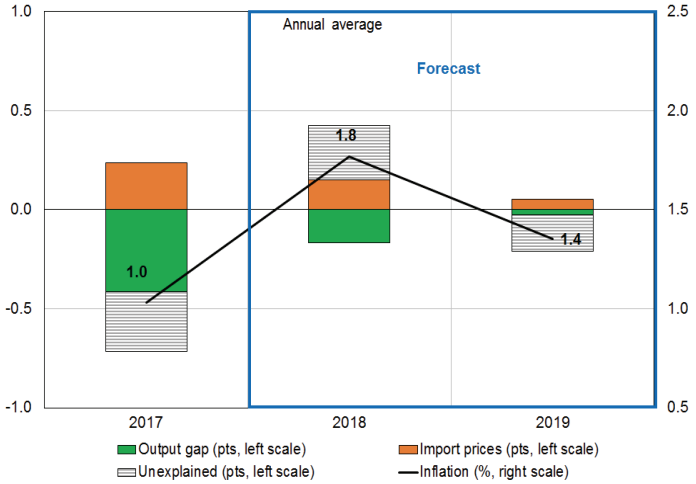
According to the Phillips equation used here to "reinterpret" the forecast, the trajectory for the closing of the output gap presented in the 2019 Budget Bill (see Table 3) is likely–all else being equal–to feed into higher inflation in 2018 and 2019 (see Chart 3). The Budget Bill forecasts core inflation (i.e. stripping out the most volatile components) of +0.9 % in 2018 and +1.1% in 2019, after +0.4% in 2017. This pace is consistent with a closing of the output gap.[16]

Table 3: Inflation and output gap in the 2019 Budget Bill

(%)	2017	2018	2019
Output gap	−0.6	−0.2	+0.2
Inflation	1.0	1.8	1.4
Inflation predicted by the Phillips curve	1.3	1.5	1.5

Sources: 2019 Budget Bill. DG Trésor calculations.

Chart 3: Dynamic contributions to inflation, 2017-2019



Source: DG Trésor calculations.

The uneven trend in the unexplained portion of inflation in 2018 and 2019 reflects two specific phenomena that the model is unable to capture. The unexplained portion in 2018 comes from higher indirect taxation (which is not factored into the estimated Phillips equation) for tobacco (a +0.3-point impact on the CPI) and energy (a +0.2-point impact). The slight negative contribution of the unexplained portion in 2019 can be interpreted as a continuation of the negative residuals observed between 2013 and 2017, with the underlying factors still weighing on inflation.

Romain Faquet

(16) In 2018, the reduction in housing benefit for social housing tenants is set to reduce core inflation by around 0.1 point as from June 2018.

Publisher:
Ministère de l'Économie
et des Finances
Direction générale du Trésor
139, rue de Bercy
75575 Paris CEDEX 12

Publication manager:
Michel Houdebine

Editor in chief:
Jean-Luc Schneider
(01 44 87 18 51)
tresor-eco@dgtresor.gouv.fr

English translation:
Centre de traduction
des ministères économique
et financier

Layout:
Maryse Dos Santos
ISSN 1962-400X
eISSN 2417-9698

Recent Issues in English

Décember 2018

No. 232. Competition and market concentration in the United States
Emma Hooper, Louise Rabier

November 2018

No. 231. The global network of central bank swap lines
Benoît Campagne, Julien Lecumberry, Myriam Morin Wang, Morgane Salomé

October 2018

No. 230. Investigating France's shrinking agricultural and agri-food trade surplus
Olivia Touze, Florent Dauba, Xavier Ory

No. 229. The New Silk Road
Julien Dumond, Martin Landais, Pierre Offret

https://www.tresor.economie.gouv.fr/Articles/tags/Tresor-Economics

Direction générale du Trésor (French Treasury)

@DGTrésor

This study was prepared under the authority of the Directorate General of the Treasury (DG Trésor) and does not necessarily reflect the position of the Ministry of Economy and Finance.