BANQUE DE FRANCE
EUROSYSTÈME

Rue de la Banque
No. 68 ■ September 2018

How does a euro/dollar exchange rate shock affect inflation in France?

Louis de Charsonville
Caroline Jardet
Macroeconomic Analysis
and Forecasts Division

This Rue de la Banque *presents the findings of research carried out at the Banque de France. The views expressed in this post are those of the authors and do not necessarily reflect the position of the Banque de France. Any errors or omissions are the responsibility of the authors.*

In this paper, we analyse the impact of an exchange rate shock on inflation in France using the Model for Analysis and Projection of Inflation (MAPI) of the Banque de France (see Working Paper, *No. 637). We show that the depreciation of the euro between 2014 and 2016 led to a rise in inflation of around 0.3 percentage point in 2015, before taking into account second-round effects, mainly via the impact of oil prices in euros on the energy component of inflation. Conversely, the appreciation of the euro in early 2017 contributed to reducing inflation by 0.1 percentage point in 2017. However, the impact on inflation excluding energy and food is more diffused.*

The Model for Analysis and Projection of Inflation, MAPI

The Model for Analysis and Projection of Inflation (MAPI) is the reference tool for forecasting consumer price inflation in France in the framework of the Eurosystem's forecasting exercises. These exercises are conducted four times a year, in March, June, September and December. The June and December exercises are carried out with the help of national central banks.

MAPI is noteworthy in that it provides a disaggregated forecast of the price index. Twelve sub-components of the Harmonised Index of Consumer Prices (HICP) are projected, then aggregated to reconstitute headline inflation as measured by the HICP and its five main sub-components: processed and unprocessed food, manufactured goods, energy and services. The breakdown used (see Table 1) isolates goods and services whose prices are totally or partially regulated: tobacco, pharmaceuticals, gas, electricity and medical services. These are projected on the basis of announcements made by the government, notably in the Finance Act.

For the other components, MAPI is a reduced-form model composed mainly of error correction equations (ECM). These equations incorporate a set of exogenous variables obtained from two sources. On the one hand, MAPI includes so-called "technical" international assumptions common to the entire Eurosystem. These common assumptions are projections of exchange rates, interest rates, international trade prices, oil prices and other commodities.

T1 Breakdown of the HICP used in MAPI

Aggregates (2016 weightings)	Projected sub-components (2016 weightings)
Unprocessed food (7.6%)	Unprocessed food (7.6%)
Processed food (12.7 %)	Tobacco (2.2%) Non-tobacco (10.5%)
Manufactured goods (26.6%)	Pharmaceuticals (2.0%) Manufactured goods excl. pharmaceuticals (24.6%)
Energy (9.0%)	Petroleum products (4.6%) Gas (1.8%) Electricity (2.6%)
Services (44.2%)	"private" services and transport (31.5%) Medical services (2.5%) Rents (7.0%) Communication services (3.2%)

Sources: Eurostat and authors' calculations.
Note: HICP = Harmonised Index of Consumer Prices;
MAPI = Model for Analysis and Projection of Inflation.
The sum of weightings is not equal to 100 because of rounding.

T2 Explanatory variables of MAPI equations

Projected component	Explanatory variables	Source
Unprocessed food	World price of meat	Eurosystem
Processed food excl. Tobacco	Euro agricultural producer price	Eurosystem
	Labour cost	Banque de France
Manufactured goods excl. pharmaceuticals	Non-energy import price	Banque de France
	Labour cost	Banque de France
	Brent oil price in euros	Eurosystem
"Private" services	Labour cost	Banque de France
	Unemployment rate	Banque de France
	Brent oil price in euros	Eurosystem
Rents	GDP	Banque de France
	HICP excl. rents and tobacco	Banque de France

Source: Charsonville (de), Ferrière and Jardet (2017).

MAPI also includes forecasts of domestic macroeconomic variables from the macroeconometric model used by the Banque de France for medium-term projections (Mascotte).[1] These include variables relating to labour costs, import prices, unemployment rates and GDP growth rates (see Table 2). These variables are also affected by price developments, via so-called "second-round" effects and the "price-wage" loop. MAPI must therefore interact with a macroeconomic model in order to capture the entire macroeconomic closure.

In practice, the macroeconomic closure of forecasts is obtained by means of several successive iterations between the two models. The inflation forecasts made in MAPI are integrated into Mascotte. New macroeconomic projections are calculated, then re-integrated into MAPI, and so on until forecasts converge.

Transmission channels of a euro/dollar exchange rate shock

In MAPI, a shock to the euro/dollar exchange rate affects the HICP via two channels:

- on the one hand, via its impact on the effective exchange rate (EER);[2]

- on the other, via its impact on the price of a barrel of oil in euros.[3]

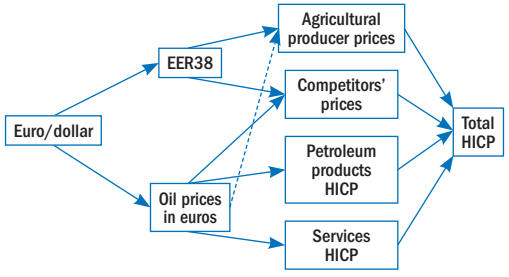
In what follows we assess the effect of a 10% shock on the euro/dollar exchange rate,[4] distinguishing the effects through both channels. This assessment only accounts for first-round effects.

Shock to the effective exchange rate

A shock to the euro/dollar exchange rate has a direct impact on the effective exchange rate depending on the weight of dollar-denominated imports in total French imports. The effective exchange rate is taken into account in MAPI via the EER38 variable, which corresponds to the weighted average of the exchange rates of the euro with the currencies of France's 38 largest trading partners (see Chart 1).

1 Model for the analysis, projection and simulation of quarterly economic conditions.
2 We assume that the other components of the EER are not impacted by the change in the euro/dollar exchange rate.
3 We assume that the price of a barrel of oil in dollars is not impacted by the change in the exchange rate.
4 In our simulation, a rise in the exchange rate corresponds to an appreciation of the euro.

C1 Transmission channels of a EUR/USD shock



Source: Charsonville (de), Ferrière and Jardet (2017).
Note: EER 38 = weighted average of the exchange rates of the euro with the currencies of France's 38 largest trading partners.

T3 Impact of a 5% shock to the EER 38
(percentage points)

	1 year	2 years	3 years	Long-term
Processed food HICP	-0.12	-0.16	-0.16	-0.16
Manufactured goods HICP	-0.38	-0.88	-1.16	-1.53
Total HICP	**-0.12**	**-0.26**	**-0.33**	**-0.43**
HICP excl. energy	-0.13	-0.28	-0.36	-0.47
HICP excl. energy and food	-0.15	-0.33	-0.44	-0.58

Source: Authors' calculations.
Note: EER 38 = weighted average of the exchange rates of the euro with the currencies of France's 38 largest trading partners.

T4 Impact of a EUR 10 shock on the price of a barrel of oil (initial price of EUR 55)
(percentage points)

	1 year	2 years	3 years	Long-term
Processed food	0.00	0.07	0.08	0.08
Manufactured goods	0.03	0.07	0.09	0.11
Energy	2.98	2.99	2.99	2.99
Services	0.00	0.04	0.02	0.00
Headline HICP	**0.28**	**0.30**	**0.30**	**0.31**
HICP excl. energy	0.01	0.03	0.04	0.05
HICP excl. energy and food	0.01	0.03	0.04	0.05

Source: Authors' calculations.

This variable affects two components of inflation:

• the processed food component of the HICP via agricultural producer prices;

• the manufactured goods component of the HICP via competitors' export prices (average of the export prices of France's trade partners weighted by the structure of French imports) and our non-energy import prices.

The impact of an effective exchange rate shock on agricultural producer prices (Eurosystem assumption) is measured using an auxiliary model.[5] The final effect on the HICP is then obtained via the response functions to a shock to agricultural producer prices calculated from the MAPI equations.

Competitors' prices have a direct effect on non-energy import prices. These are included in the estimate of the manufactured goods component of the HICP.[6] The non-energy import prices used in MAPI are taken from Mascotte. In our assessment, we therefore use Mascotte's response functions to the impact of the exchange rate shock to non-energy import prices. The impact on the total HICP is obtained via the response functions to a shock to non-energy import prices calculated from the MAPI equations.[7]

Shock to the price of a barrel of Brent crude oil in euros

A shock to the euro/dollar exchange rate also has a direct impact on the price of a barrel of Brent crude oil in euros provided that the dollar price of a barrel is not affected by this exchange rate variation.

In MAPI, the price of a barrel of oil has a direct impact on the energy component of the HICP, via petroleum products, and on the services HICP, in particular due to transport prices. This direct effect is calculated from the MAPI equations.

A shock to oil prices in euros also affects food and manufactured goods prices via its impact on agricultural producer prices and competitors' prices (see Chart 1).

In order to assess the response to an oil price shock to these two variables, we develop two auxiliary models: one for agricultural producer prices (the same one that is used to assess the effect of a shock to the EER38); one for competitors' prices.

Table 4 shows the responses in the MAPI model to a EUR 10 shock to the price of a barrel of oil when the initial price of a barrel is EUR 55. Again, these effects are first-round effects, without any closure effect. They also appear a little weaker, especially in their indirect component via inflation excluding energy and food prices, than other assessments for France.[8]

5 *See "MAPI: Model for Analysis and Projection of Inflation in France", Working Paper, No. 637, Banque de France.*
6 *In our estimation, service prices do not seem to be significantly impacted by non-energy import prices. An exchange rate shock affects services prices via its effect on oil prices in euros (see Chart 1).*
7 *In other words, the elasticity of import prices to the exchange rate is derived from Mascotte equations; the elasticity of the headline HICP to import prices is derived from the MAPI equations.*
8 *See "The impact of oil prices on inflation in France and the euro area", Eco Notepad, Banque de France, February 2018. Using an accounting approach, the authors find that a EUR 10 increase in oil prices results in a 0.4 point rise in consumer prices in France. The estimate is based on unchanged oil demand, and is therefore an upper bound of the expected effect on inflation. In addition, the effect via inflation excluding energy is indirect and spread over time, which makes it difficult to estimate in MAPI.*

T5 Impact of a 10% appreciation of the euro against the dollar

(percentage points)

	1 year	2 years	3 years	Long-term
Processed food	-0.02	-0.07	-0.07	-0.07
Manufactured goods	-0.07	-0.17	-0.23	-0.31
Energy	-1.64	-1.65	-1.65	-1.65
Services	0.00	-0.01	-0.01	-0.01
Headlinel HICP	**-0.17**	**-0.21**	**-0.23**	**-0.23**
HICP excl. energy	-0.03	-0.08	-0.10	-0.10
HICP excl. energy and food	-0.03	-0.09	-0.11	-0.11

Source: Authors' calculations.

Final effect of a euro/dollar exchange rate shock

Table 5 shows the effect of a 10% appreciation of the euro against the dollar in the MAPI model. The final effect of an appreciation of the euro is obtained by summing the effects via the effective exchange rate component and via the price of a barrel of oil in euros. A 10% appreciation of the euro against the dollar corresponds to a 0.73% increase in the EER38. Under the chosen assumption, a 10% increase in the exchange rate implies a 10% decrease in the price of Brent crude oil in euros. For a starting price of EUR 55 a barrel, this corresponds to a drop of EUR 5.5.

Impact of the exchange rate on inflation between 2014 and 2017

We use MAPI to model the impact of a euro/dollar exchange rate shock on inflation in France over two periods: from 2014 to 2016, when the euro depreciated and in Q2 2017 when the euro appreciated.

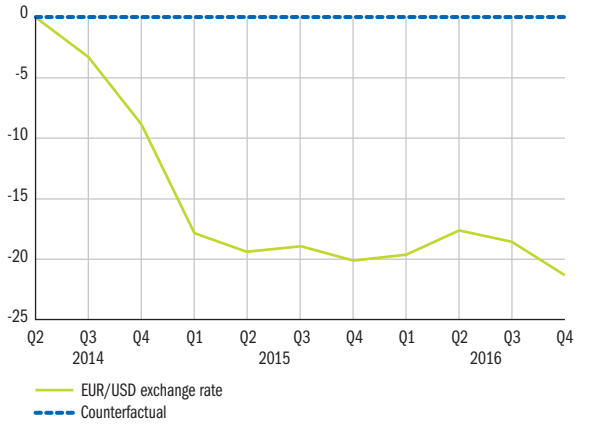
The inflationary impact of the depreciation of the euro between 2014 and end-2016

From mid-2014, the euro fell sharply against the dollar (down by 18% between Q2 2014 and Q1 2015, see Chart 2). We study the effect of this shock on inflation by calculating the impact of quarterly variations in the euro/dollar exchange rate between Q2 2014 and the Q4 2016 using MAPI (see Chart 2).

We do not take into account the impact of this exchange rate shock on economic output and its spillover effects on inflation (via the unemployment rate, wages, etc.). The absence of macroeconomic closure mitigates the effect of this shock. Nor do we consider the monetary policy response to this shock. We also assume that the dollar price of a barrel of oil is not impacted by the change in the euro/dollar exchange rate. Finally, we assume that the change in the euro/dollar exchange rate does not affect the other components of the EER, which also mitigates the effect of this shock.

C2 EUR/USD exchange rate variation

(%)

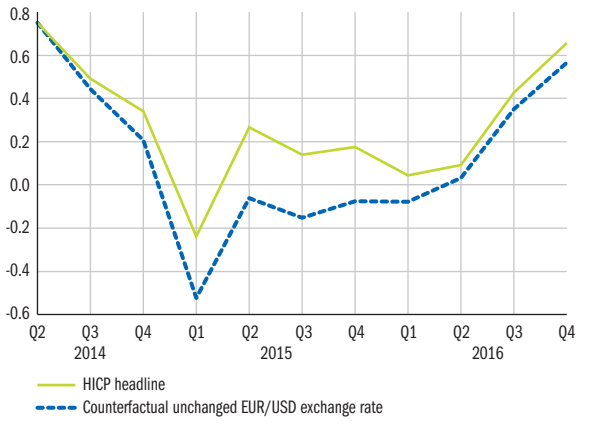


Sources: ECB and authors' calculations.

We then compare actual inflation with the level of inflation that would have prevailed in the absence of these shocks, i.e. with a counterfactual scenario where the euro/dollar exchange rate would have remained unchanged between Q2 2014 and Q4 2016. Our simulations show that, in the absence of any depreciation of the euro, headline inflation would

C3 Counterfactual HICP inflation scenario with unchanged exchange rate

(%)



Sources: Eurostat and authors' calculations.

have been lower by an average of 0.15 percentage points (pp) over the period from Q2 2014 to Q1 2016, and by 0.33 pp in Q2 2015. Furthermore, the period of negative inflation would have been longer: it would have extended from Q4 2014 to Q1 2016 (instead of ending in Q1 2015, see Chart 3).

The strongest impact on inflation comes from the energy component, which passes on price variations instantaneously via the price of a barrel of oil in euros (see Chart 4). Thanks to this inflationary impact, the deflationary effects of the concomitant sharp drop in oil prices from mid-2014 were mitigated.

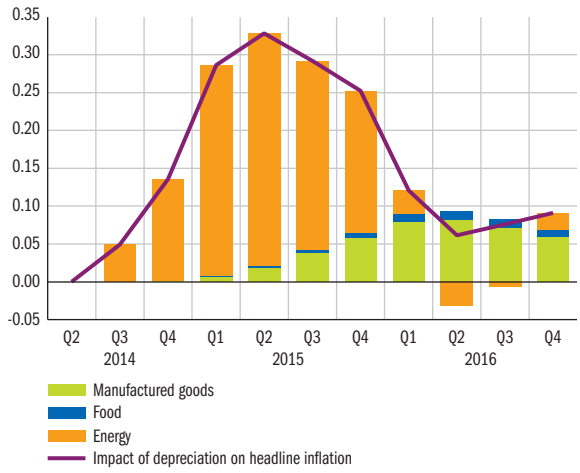
According to the MAPI model, the impact on inflation excluding energy and food, known as "supercore inflation", is more limited and comes in later because the effect via non-energy import prices ripples down the production chain with a lag, and thus feeds through to the end prices of manufactured goods with some delay.

Appreciation of the euro exchange rate in early 2017: a disinflationary impact

The euro/dollar exchange rate rose sharply in 2017 (up by 10% between Q1 and Q4). We study the impact of this appreciation on inflationary developments in France using the same methodology as in the previous section. We compare two inflationary scenarios: in the first, the euro/dollar exchange rate remains at its Q1 2017 value until Q4 2020 (counterfactual scenario). In the second scenario, the exchange rate remains at its Q4 2017 value (as in the December 2017 Eurosystem forecast, see Chart 5).

C4 Breakdown of the impact on inflation

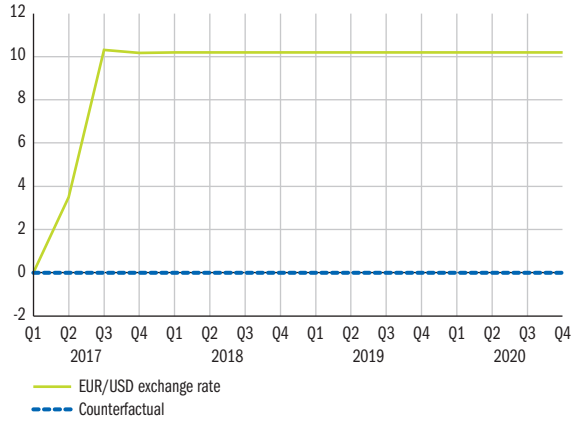
(percentage points)



Source: Authors' calculations.

C5 Comparison of exchange rate scenarios

(%)

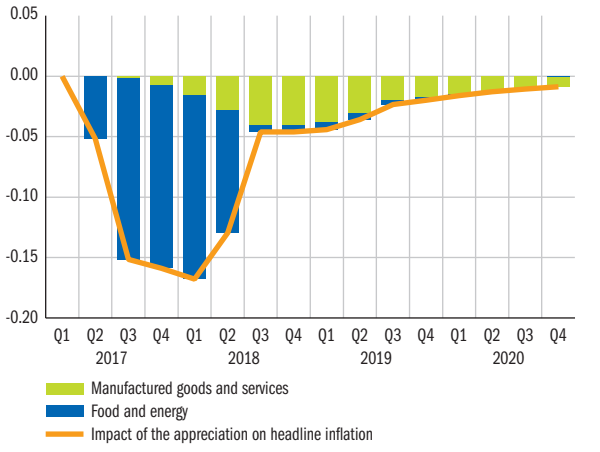


Sources: ECB and authors' calculations.

Again, the shock is mostly transmitted via the fall in the price of crude oil in euros, which reduces the energy component of headline inflation (see Chart 6). On the other hand, its impact on the index excluding energy and food is smaller and delayed. The exchange rate appreciation observed at the start of 2017 should therefore continue to weigh on inflation excluding energy and food until 2020.

C6 Breakdown of the impact of the appreciation of the euro at the start of 2017

(percentage points)



Source: Authors' calculations.
Note: The impact of the appreciation on total inflation is measured as the difference between inflation in the "forecast" exchange rate scenario and the "counterfactual" exchange rate scenario.

Conclusion

These two episodes show the impact of exchange rate fluctuations on consumer price inflation in France using the MAPI forecasting model. Thanks to this model we are able to identify the channels through which these fluctuations are transmitted to inflation and its components. We thus show that the impact of the exchange rate via oil prices in euros is strong and instantaneous. While the impact via inflation excluding energy and food is smaller and spread over time. However, these estimates are reduced due to the absence of macroeconomic closure.

References

Banque de France (2017)
Economic projections, December.
Download the document

Charsonville (de.) (L.), Ferrière (T.) and Jardet (C.) (2017)
"MAPI: Model for analysis and projection of inflation in France", No. 637, August.
Download the document

European Central Bank (2017)
Eurosystem staff macroeconomic projections for the euro area, December.

Kalantzis (Y.) and Ouvrard (J.-F.) (2018)
"The impact of oil prices on inflation in France and the euro area", *Eco Notepad*, Banque de France, February.
Download the document

Published by
Banque de France

Managing Editor
Olivier Garnier

Editor-in-Chief
Françoise Drumetz

Production
Press and Communication Department

September 2018
www.banque-france.fr