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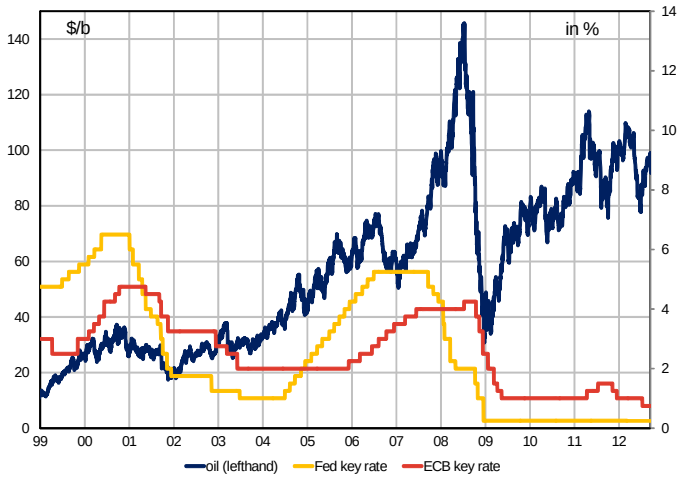
Should the monetary authorities react to oil price swings?

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 and Ministry of Foreign Trade

- Oil prices have been rising since June of this year, after falling in the second quarter of 2012 against a background of slowing economic activity and increased supply. The price of Brent has risen 50% since 2007, to $115 per barrel in October 2012.
- The steep increase in the price of oil in 2008, and again in 2010-2011, has sparked discussion on how the importing countries' monetary authorities might react, given the difficulties of coping with imported inflation, over which they have no direct influence without negatively affecting economic activity.
- In theory, the temporary uptick in the oil price does not require any systematic response from the central banks, since the ECB's mission is to maintain medium term price stability, while the Federal Reserve and the Bank of Japan target core inflation. However, oil price swings can affect the formation of rigid prices such as wages. They can also fuel second-round price effects, which, in the current extremely accommodating monetary policy context, could loosen the anchoring of inflation expectations.
- In advanced economies, monetary tightening in the name of price stabilisation does not appear to be required as long as inflation expectations remain firmly anchored. This is because our econometric estimates suggest that:
- Oil price rises have little impact on headline inflation in the long run, and no impact on core inflation in the United States and the eurozone. Oil prices partly feed through into inflation via wages, but the low probability of rising wages at present reduces the likelihood of second-round effects.
- Rising oil prices have a significant, albeit small, impact on inflationary expectations in the United States and in the eurozone. The impact is weaker in the eurozone, which may be due to the stronger probability that the ECB will react in response to an oil price rise, as suggested by past tightening moves (July 2008, and April and July 2011).

Oil price and key rates



Source: Data Insight.

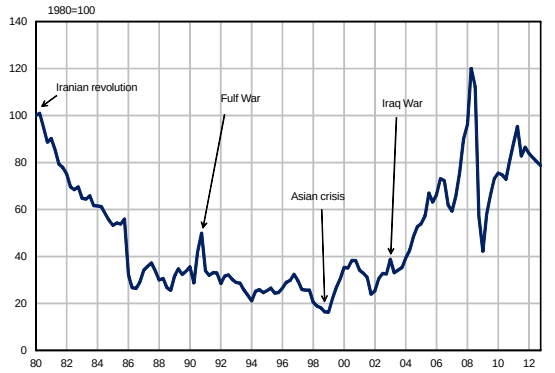
MINISTÈRE DE L'ÉCONOMIE ET DES FINANCES
MINISTÈRE DU COMMERCE EXTÉRIEUR

Oil prices climbed in 2010-2011, at a time of pressure on supply and political uncertainty in producer countries. After weakening in spring 2012 due to increased supply, sluggish economic activity and progress in negotiations with Iran, the price of oil has been on the rise again since the end of June, as geopolitical tensions have intensified. The price of Brent stood at $115/barrel in October 2012. In real terms, the dollar price of oil is approaching levels seen in the late-1970s and early-80s, before the oil counter-shock (see chart 1).

The response of the monetary authorities to more expensive oil differs according to their mandate (whether their priority is price stability or the stability of activity) and their perception of economic and financial conditions, as illustrated by the different responses of the Fed and ECB to the oil price rise in 2008 (see chart on cover page). In a context of heavy turbulence in the financial markets combined with downside risks to activity and upside risks to inflation, the Fed kept its key rate unchanged, arguing that inflationary expectations were sufficiently firmly anchored to warrant opting for the status quo. The ECB, on the other hand, was concerned to curb the risk of second round effects and raised its key rate by 25 bp in July 2008.

Another factor shaping the monetary authorities' response is the nature of the oil price shock (supply shock versus demand shock) and of their impact on different economies.

Chart 1: Real price of oil (WTI deflated by US CPI)



Source: Data Insight, calculated by DG Trésor.

1. Oil price increases have a negative impact on the activity of net importing countries

1.1 Although oil shocks have less of a recessionary impact than in the 1990s, monetary tightening could exacerbate this effect

1.1.1 An increase in the price of oil has a recessionary effect on aggregate supply and demand

Oil price rises have had a negative impact on activity in the past. In the United States, Hamilton's standard work on the subject (1983[1]) stresses that most American recessions between 1945 and the early-1980s were preceded by an oil price rise. According to estimates by Jones et al. (2004)[2] for the period 1940-2001, a 10% rise in the price of oil is associated with a 0.5% loss of real US GDP after two years. Balke et al. (2002)[3] analyse the asymmetry of oil shocks and show that, in the period 1965-1997, oil price rises led to pronounced contractions in activity in the United States, whereas price falls had a smaller impact. In the eurozone (ECB, 2010[4]), a 10% increase in the price of oil reduced activity by 0.24% after 3 years, in the period 1980-2010. The impact is slightly more pronounced in Belgium, Germany and Italy (−0.40%). On the other hand, it is below the European average in France, Ireland, Austria and Luxembourg (−0.05%). These disparities stem from structural differences between these countries, such as their dependence on oil, the energy intensity of their manufacturing and consumption, or the degree of nominal rigidities in their respective economies.

The impact of an oil shock on activity may be transmitted via the supply and the demand channels. This is because an oil shock represents a negative aggregate supply shock, in the sense that higher domestic production costs can limit firms' ability to invest and hire. On the aggregate demand side, increased oil prices adversely affect household purchasing power. Kilian (2008)[5] identifies the mechanisms whereby energy price variations directly affect household consumption: (i) more expensive oil reduces households' disposable income, especially so since energy demand is relatively inelastic; (ii) oil price swings create uncertainty, which may encourage consumers to postpone purchases of durable goods or, more generally, their purchases of other kinds of goods, especially when they increase their precautionary saving; (iii) households postpone the acquisition of energy-intensive durables such as cars. Oil price increases can also feed expectations of monetary tightening, which could reinforce the negative impact of the higher price of oil on aggregate supply and demand.

Empirical studies suggest that the supply channel is weak, and that the demand channel is preponderant. In the eurozone, according to ECB simulations (ECB, 2010), the negative impact of more expensive oil on activity occurs mainly via the demand channel, with demand being depressed by the drop in disposable income caused by inflationary pressures. Lower demand also depresses investment, despite the decline in real long-term interest rates brought about by higher inflation (for a given monetary policy stance).

1.1.2 The recessionary impact of more expensive oil may be reinforced by monetary tightening in the name of stabilising prices

Monetary tightening can exacerbate the recessionary impact of an oil shock. According to estimates of VAR by Bernanke et al. (1997)[6] in the United States for the period 1965-1995, a 10% increase in the price of oil leads

(1) J. Hamilton, (1983), "Oil and the macroeconomy since World War II", *Journal of Political Economy*, 91 (2), pp. 228-248.
(2) D. Jones, P. Leiby and I. Paik, (2004), "Oil price shocks and the macroeconomy: what has been learned since 1996", *Energy journal*, 25 (2).
(3) N. S. Balke, S.P. Brown, M.K. Yucel, (2002), "Oil price shocks and the U.S. economy: Where does the asymmetry originate?", *Energy Journal*, 23 (3), pp. 27-52.
(4) ECB, (2010), "Oil prices: their determinants and impact on euro area inflation and the macroeconomy", *Monthly Bulletin*, August 2010.
(5) L. Kilian, (2008), "The Economic Effects of Energy Price Shocks," *Journalof Economic Literature*, 46(4), 871-909.
(6) B.S. Bernanke, M. Gertler, M. Watson, (1997), "Systematic Monetary Policy and the Effects of Oil Price Shocks," *Brookings Papers on Economic Activity*, 1, 91-142.

to a 150 bp rise in short-term interest rates and to a 0.7% drop in real GDP. According to the authors, these recessions would have been avoided had monetary policy remained unchanged, although inflation would have been higher.

Using the same methodology, Carstrom and Fuerst (2006)[7] suggest that an oil shock triggers monetary tightening and reckon that a 10% rise in the price of oil raises short-term rates by 200 bp while cutting real GDP by 0.5%. In the absence of monetary tightening, the loss of activity would be confined to −0.2%. These studies suggest that monetary policy ought at least to remain unchanged in order to avoid bolstering the recessionary impact of oil price shocks, and should probably even be eased.

Some authors challenge the findings of Bernanke et al. (1997), however: Hamilton and Herrera (2004)[8], for example, note that the scale of the impact of oil shocks on activity observed by Bernanke et al. (1997) is sensitive to the number of VAR lags assumed, and they emphasise that keeping key rates unchanged would not be sufficient to stabilise activity. According to their simulations, even a large-scale monetary easing would not avoid a slowdown in activity.

1.1.3 The recessionary impact of more expensive oil has been less pronounced since the beginning of the 1990s

The recessionary impact of more expensive oil has been less pronounced and more short-lived since the early-1990s (Hamilton, 2009[9], Blanchard and Gali, 2010[10], Herrera and Pesavento, 2009[11]). As estimated by Blanchard and Gali, a 10% rise in the price of oil led to a loss of around 0.4 percentage point of US GDP over the period 1970-1983, versus a loss of 0.15 pp since 1984.

The weaker recessionary impact of the 1990s oil shocks may stem from:

- The diminished importance of energy in the industrialised economies (Blanchard et al., 2010, Le Barbanchon, 2007[12]);
- Changes in the way monetary policy is conducted, weakening the mechanism for the pass-through of oil prices to producer and consumer prices, and to a better anchoring of inflationary expectations (Blanchard et al., 2010, Herrera and Pesavento, 2009, Kilian and Lewis, 2011[13])
- A less inflationary environment (Taylor, 2000[14]): some studies suggest that in low-inflationary regimes, companies have less pricing power than in more inflationary ones, which diminishes the pass-through of commodity price fluctuations to consumer prices, and consequently limits their negative impact on demand
- A change in central banks' targets, with a growing number of them pursuing a core inflation target rather than a headline inflation target (Nordhaus, 2007[15]): this change of target has tended to make the monetary authorities react less to oil price rises, and therefore attenuates the strengthening of oil shocks' recessionary impact resulting from monetary tightening
- More open international trade: cheaper manufactured goods, especially imports from the emerging economies, are thought to offset the inflationary effects of more expensive oil (Pain et al., 2006[16])

1.2 The impact of more expensive oil on activity varies according to the nature of the shock that caused the price of oil to rise

1.2.1 Oil supply shocks have a more pronounced recessionary impact than demand shocks, which affect the price of oil, while demand shocks appear to entail greater inflationary pressures in Europe

Three types of shock can affect the price of oil:

- Exogenous supply shocks to macroeconomic conditions in importing countries can affect the oil industry, e.g.: political uncertainty in North Africa and the Middle East in 2011
- Shocks to aggregate global demands, as with the strong demand in the emerging countries in the early-2000s, or, conversely, the fall in global demand in 2008
- Demand shocks specific to the oil market, reflection precautionary demand (Kilian, 2009[17])

The macroeconomic implications of oil price shocks can vary according to their nature, e.g. supply shocks versus demand shocks.

In the United States, Kilian (2009) suggests, with the aid of an estimated VAR over the period 1975-2005, that higher oil prices resulting from a shock to aggregate demand boosts US GDP in the short run, but that inflation rises in the long run. On the other hand, a rise in the price of oil resulting from a supply shock in a context of political tension in the OPEC countries depresses US GDP in the long run, and has no significant impact on inflation in a context of weakening activity.

(7) C.T. Carlstrom, T.S. Fuerst, (2006), "Oil Prices, Monetary Policy, and Counterfactual Experiments," *Journal of Money*, Credit and Banking, 38, 1945-1958.
(8) J.D. Hamilton, A.M. Herrera, (2004), "Oil Shocks and Aggregate Economic Behavior: The Role of Monetary Policy: Comment," *Journal of Money*, Credit, and Banking, 36, 265- 286.
(9) J. Hamilton, 2009, "Understanding crude oil prices", *Energy Journal*, 30 (2), pp. 179-206.
(10) O. Blanchard, J. Gali, (2010), "The macroeconomic effects of oil shocks: why are the 2000s so different from the 1970s?" J. Gali, M. Gertler (Eds.), International Dimensions of Monetary Policy, University of Chicago Press, Chicago, Illinois.
(11) A.M. Herrera, E. Pesavento, (2009), "Oil price shocks, systematic monetary policy and the 'Great Moderation' Macroeconomic Dynamics", 13 (2009), pp. 107-137.
(12) Le Barbanchon, (2007), "The changing response of oil price shocks in France: a DSGE type approach", Insee *Working Paper* G2007/07, November.
(13) L.T. Kilian, (2011), "Does the Fed respond to oil price shocks?", *Economic Journal*, 121, September, pp. 1047-1072.
(14) J. Taylor, (2000), "Low inflation, pass-through, and the pricing power of firms", *European Economic Review* 44 (7), 1389-1408.
(15) WD. Nordhaus, (2007), "Who's afraid of a big bad oil shock?", *Brookings Papers on Economic Activity*, 2, pp. 219-240.
(16) N. Pain, I. Koske, M. Sollie, (2006), "Globalisation and inflation in the OECD economies", *Working Paper*, Economics Department, OECD.
(17) Kilian, L., (2009), "Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market", *American Economic Review*, 99 (3), pp. 1053-1069.

For the other advanced economies, Baumeister et al. (2009)[18] compare the impact of supply and demand shocks with the aid of a structural VAR (SVAR) over the period 1986-2008. Like Kilian (2009), the authors estimate that a demand shock leads to a temporary rise in activity in the net oil importing countries. On the other hand, the impact of a supply shock results in a permanent fall in activity, the decline being faster and more pronounced in Japan and the United States than in Europe. In Europe, the more noticeable currency depreciation that follows a shock to supply fosters the emergence of more powerful inflationary pressures than those prompted by a demand shock. The United States and Japan experience a smaller currency depreciation following a supply shock than in Europe, and the inflationary impact of supply and demand shocks is similar.

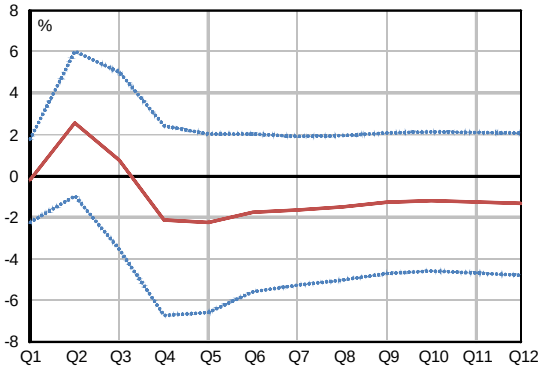
The different the impacts that demand and supply shocks have on activity may depend on how gradual they are: positive endogenous demand shocks are likely to be more gradual. This makes it easier to absorb these shocks, contrary to sharp, exogenous shocks to production (Archanskaia et al., 2011).

1.2.2 The rise in the price of oil is mainly driven by growth in demand

The rise in the price of oil over the past decade can mainly be accounted for by the growth in aggregate world demand. Barsky and Kilian (2002) estimate that rising global demand has affected the price of oil not only in the course of the 2000s, but also on the occasion of previous oil shocks, even though these are conventionally thought to have stemmed from supply shocks. According to the authors, the oil shocks of the 1970s thus resulted from the conjunction of constraints on production capacity and strong global demand. Kilian (2009) estimates that, beyond a temporary, small-scale, short-term effect, disruptions to oil production have little impact on the price of oil. On the other hand, shocks resulting from the growth in aggregate global demand or from precautionary demand for oil strongly affected the price of oil over the period 1973-2007. Archanskaia et al. (2011)[19], using a stochastic general equilibrium (DSGE) model, find that oil shocks can be explained by constraints on supply in the period 1970-1992, and then by growth in global demand in the period 1992-2006.

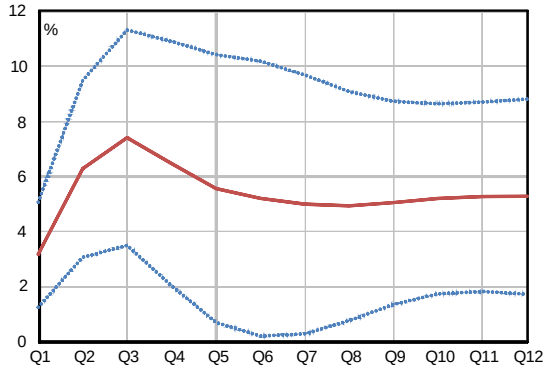
Consistent with the findings of some of the literature, our simulations based on a VAR suggest that swings in global demand have more of an impact on the price of oil than supply constraints in the producer countries. As a result, a 1% increase in global oil production, used as a proxy for a supply shock, leads to a 1.2% fall in the price of oil in the long term (see chart 2). A 1% increase in global industrial output, used as a proxy for a demand shock, leads to a 5% rise in the price of oil in the long term (see chart 3).

Chart 2: Cumulative impact of a 1% supply shock on the price of oil



Source: DG Trésor calculations.

Chart 3: Cumulative impact of a 1% demand shock on the price of oil



Source: DG Trésor calculations.

Note:We use VAR models to represent the interdependencies between time series and to simulate the impact of shocks on the system's variables. Non-structural VAR models circumvent the need to impose a structural model by explaining each endogenous variable in terms of its specific lags and those of the model's other variables. The following VAR is estimated: $y_t = \mu + A_1 y_{t-1} + \ldots + A_j + y_{t-j} + \varepsilon_t$ where y_t is a vector of endogenous variables such that y_t = [oil production, global industrial output, oil price], A_1, A_j the matrices of the coefficients to be estimated, and ε_t ua vector of innovations uncorrelated with the endogenous variables and uncorrelated with their own past values. After testing the absence of any cointegration relationship, the endogenous variables, which are stationary in the primary differences, are integrated in logarithmic differences. Minimising the Schwarz criterion suggests a number of optimal three-quarter lags in the VAR. The impulse response function simulates the impact on the price of oil of a one standard deviation shock to oil production and global output innovation. The Cholesky decomposition method allows us to ascribe a single variable to each variable, and to ensure that a given shock to a variable has no contemporaneous impact on another variable. Shocks are normalised to 1%, which is not far from one standard deviation, and thus illustrate the impact of a shock of ordinary amplitude.

(18) C. Baumeister, G. Peersman, I. van Robays, (2009), "The economic consequences of oil shocks: differences across countries and time", *Workingpaper* 09/630, Ghent University, Faculty of Economics and Business Administration.

(19) Archanskaia, E., J. Creel, P. Hubert, (2011), "The nature of oil shocks and the global economy". *Energy Policy,* vol. 42, pp-509-520.

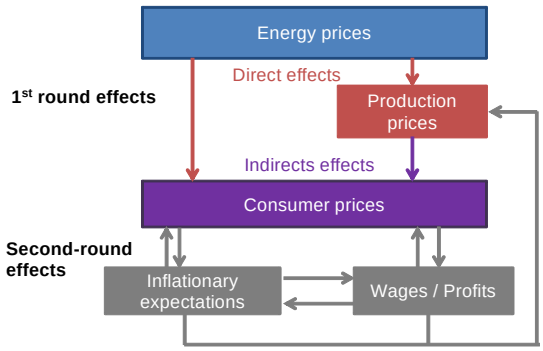
2. More expensive oil has only a limited impact on inflation in the advanced economies

2.1 Theoretically, monetary policy can ignore variations in flexible prices such as the price of oil

Neo-Keynesian theory, which dominates contemporary monetary analysis, suggests that the monetary authorities ought to respond more firmly to variations in sticky prices than to variations in flexible ones. This is because relative price distortions prompted by the existence of nominal rigidities in certain prices and in wages prevents economies from adjusting as effectively as they might in the event of shocks. This would justify intervention by the monetary authorities to stabilise rigid prices. Benigno and Woodford[20] (2004) suggest linking the different weightings to the different components of inflation in the reaction of the monetary authorities: they could thus entirely ignore those components that are perfectly flexible, while positively weighting those that are rigid. Jacquinot et al. (2009)[21] view oil prices as perfectly flexible, both globally and at the level of the eurozone. These findings suggest that oil price variations call for no response on the part of the monetary authorities.

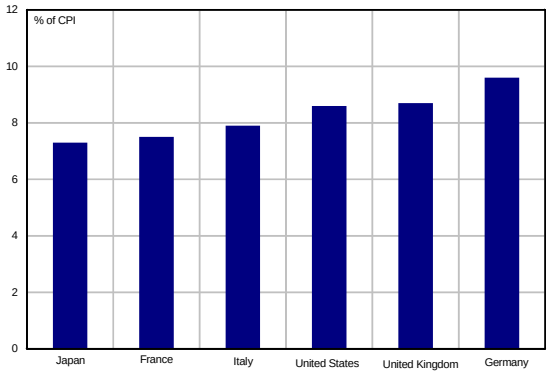
Oil price fluctuations nevertheless contain information that is relevant for monetary policy: they may signal the existence of a shock demanding an economic policy response. Moreover, when fluctuations in flexible prices such as oil impact the formation of prices for which there are nominal rigidities, such as wages, this may call for action by the monetary authorities: a rise in the price of oil may therefore feed second round effects and threaten medium-term price stability.

Figure 1 : Pass-through of energy price variations to consumer prices



Source: ECB 2010.

Chart 4: The contribution of energy to the consumer price index in 2010



Source: OECD.

2.2 More expensive oil can impact inflation via first and second round effects, and pose a threat to medium-term price stability

Theoretically, energy price variations can be passed on consumer prices via both first and second round effects (see figure 1). For example, a rise in the price of oil has a direct first round effect on the energy component of the consumer price index, which accounts for almost 10% of the total index in the advanced economies (see chart 4). Higher energy prices also have an indirect first round effect on consumer prices, since they raise the cost of producing energy-intensive goods and services such as transport or industrial goods. Depending on producers' and distributors' margin-setting strategies, higher production costs can in turn feed more or less partially through into consumer prices.

Second round effects refer to the response of wage-earners and producers. If they expect inflation to rise, they may amplify the first round effects by demanding higher wages or raising their sale prices. It is hard to distinguish first round from second round effects, empirically.

Second round effects pose a more lasting threat to price stability. First round effects imply that a temporary rise in the price of energy has a temporary inflationary impact. The more energy-intensive an economy and the more flexible the wages in it, the more this temporary impact is pronounced (see chart 4). On the other hand, second round effects pose a more enduring threat to price stability, since wage increases and higher sale prices fuel inflation, which in turn feeds inflationary expectations, putting further upward pressure on wages and prices.

2.3 Oil prices have little impact on consumer prices in the advanced economies

Matching the findings in the literature[22], our econometric estimates (see box 1) suggest that more expensive oil has little long-term impact on inflation and has no effect on core inflation. The long-term impact of oil price swings on headline inflation is weak, and is generally nil on core inflation. In line with the literature, the estimated pass-through has fallen over time. This decline, which has been observed in the advanced countries starting in the 1980s[23], may be accounted for by firmer anchoring of inflationary expectations against a background of inflation targeting, diminished wage adjustment (see box 2) and the reduced role of energy in the economy (Blanchard and Gali, 2007).

(20) Benigno, P., M. Woodford (2004), "Optimal Stabilization Policy when Wages and Prices are sticky: The Case of a Distorted Steady-state", *NBER working paper* 10839.
(21) Jacquinot, P., Kuismanen, M., Mestre, R. and Spitzer, M., (2009), "An Assessment of the Inflationary Impact of Oil Shocks in the Euro Area", *The Energy Journal*, 30, 1, pp. 49-84.
(22) Peersman G. et I. Van Robays, (2009), "Oil and the euro area economy", *Economic Policy.*, 24(60), pp. 603-651.
(23) Blanchard, O., J. Gali, (2007), "The Macroeconomic Effects Of Oil Price Shocks: Why Are The 2000s So Different From The 1970s?", *NBER Working paper* No. 13368.

Box 1: **The long-term impact of an oil price rise on inflation**

Error correction estimates highlight the long-term relationship between the consumer price index (CPI) and the price of oil in the advanced economies.

The long-term equation $IPC_t = \alpha + \beta\ PIB\ reel_t + \theta\ petrole_t + \delta\ taux\ de\ change_t + \varepsilon_t$ (PIB reel: real GDP, pétrole: oil; taux de change: exchange rate) is estimated on quarterly data. The long-term pass-through of oil to inflation corresponds to the coefficient θ.

For example, a 1% rise in the price of oil leads to a 0.02% increase in headline inflation over the long term in Germany, over the period 1990-2012, and had no impact on core inflation. The orders of magnitude are consistent with the literature.

Table 1: Long-term impact of a 1% increase in the price of oil on inflation

	1990-2012				2000-2012			
	Headline CPI		Underlying CPI		Total CPI		Underlying CPI	
	coef.	t.stat.	coef.	t.stat.	coef.	t.stat.	coef.	t.stat.
Germany	**0.02**	**2.24**	**0.00**	**3.28**	**0.02**	**1.77**	**0.00**	**14.54**
Belgium	**0.05**	**4.24**	0.01	0.36	**0.04**	**4.57**	0.00	0.78
Canada	**0.01**	**2.12**	**0.01**	**2.25**	**0.02**	**3.33**	0.00	1.32
United States	**0.06**	**12.45**	0.01	0.92	**0.05**	**6.09**	0.01	1.41
France	**0.03**	**5.54**	0.00	1.04	**0.02**	**3.04**	0.00	0.68
Italy	**0.11**	**2.51**	0.00	0.45	**0.01**	**1.73**	0.00	0.25
Japan	–	–	–	–	**0.02**	**1.88**	0.00	1.09
Netherlands	**0.05**	**1.69**	0.01	0.34	0.00	0.06	0.02	1.01
United Kingdom	**0.00**	**6.84**	**0.00**	**3.49**	**0.00**	**6.58**	**0.00**	**3.36**

Note: Unit root tests suggest that the series are integrated of order one. Johansen cointegration tests suggest the exist of a cointegration relationship at the 5% threshold. The long-term equation is estimated by ordinary least squares (OLS) with Newey-West correction, robust to heteroscedasticity and to self-correlation. The coefficients are normalised for interpretation as percentages and are shown in bold when they differ significantly from zero.

The pass-through is higher in the United States than in Europe, which may be due to the economy's greater energy intensity and to the lower proportion of taxes in oil prices in the United States.

Within the eurozone, the higher pass-through observed over the period 1990-2012 for Belgium, Italy and, to a lesser extent, France, could be attributable to the indexation of wages against inflation (automatic indexation in Belgium; automatic indexation until 1993 in Italy, less systematic thereafter; and limited indexation of the French SMIC minimum wage), which set these economies apart from most other European economies (Peersman and van Robays, 2009). The weaker pass-through of the oil price rise to headline inflation over the period 2000-2012 in Europe, which appears to have been particularly pronounced in Italy, could be accounted for by reduced currency volatility since the introduction of the euro and the stabilisation of inflation: oil prices formerly prompted a sharp depreciation of the lira within the European Monetary System, thereby bolstering inflation, which was higher in the 1990s.

The inflationary impact of more expensive oil partly transits through wage adjustment According to an econometric study by the ECB based on a VAR estimate (ECB, 2010), the direct impact of a 10% rise in the price of oil on the CPI is close to 0.20%. The indirect first round and second round effects are between 0.20% and 0.29% after three years (see table 2), and pass mainly through wages. The limited impact of indirect first and second round effects can be explained in particular by the absence of any wage indexation mechanism in most European countries (e.g. Germany, Austria, Ireland, the Netherlands or Portugal), or limited automatic indexation (e.g. the limited indexation of the minimum wage in France).

Table 2: Impact of a 10% rise in the price of oil on the eurozone CPI

	Direct 1st round effects	Indirect 1st round effects	2nd round effects	Total
1971-2009	0.20%	0.25%		0.45%
1971-2000	0.39%	0.29%		0.68%
1980-2009	0.26%	0.20%		0.46%

Source: BCE 2010.

Box 2: **History of wage indexation systems**

In response to rising unemployment in the 1970s and after, several advanced countries attempted in the 1980s and early-1990s to render real wages more flexible.

In the Netherlands, the system of automatic adjustment of wages in line with the cost of living, introduced in 1969, was abolished in 1982 under the Wassenaar agreement, in return for cuts in working hours. In Denmark, the wage-indexation system (dyr-tidsregulering) was definitively scrapped in 1982. In Italy, the "scala mobile" system of automatic wage adjustments was abolished in 1992. Since 1993, the budget forecast for inflation serves as a basis for wage negotiations. In France, indexation was abolished in 1983. Indexation mechanisms remain, however, as with the adjustment of the minimum wage whenever inflation reaches a level corresponding to a rise of at least 2% relative to the index observed at the date of determining the immediately previous minimum wage. Indexation too has been reduced in countries with informal indexation systems, such as the United States, where cost-of-living adjustment (COLA) clauses-the outcome of bargaining between labour unions and employers-were pared back in the course of the 1980s. Thus in 1976, 61% of unionised workers' contracts contained COLA clauses, versus 22% in 1995, when the Bureau of Labor Statistics ceased collecting data.

Four European Union countries still have automatic indexation mechanisms, namely Belgium, Cyprus, Malta and Luxembourg. Adjustments are made annually or half-yearly and are based on either the CPI, as in Cyprus and Luxembourg, on the RPI (Malta), or on the CPI excluding certain items, as in Belgium. In Luxembourg, the adjustment applies only after the CPI exceeds a certain threshold (2.5%). Other countries, such as Spain, have a high level of indexation resulting from collective bargaining. Indexation has been reined in since the onset of the crisis, however (see the collective bargaining rounds for 2010-2012 and 2012-2014 and the labour market reform adopted in February 2012).

3. The appropriate response to a rise in the price of oil depends on the position in the cycle and nature of the shocks affecting the oil price

3.1 As a general rule, for as long as inflationary expectations remain firmly anchored, more expensive oil does not call for monetary intervention to stabilise prices

The monetary authorities are justified in responding to an oil price shock when the shock poses a threat to medium-term price stability. However, our econometric estimates (see box 1) suggest that the inflationary effects and risks of second round effects are limited, especially so in the current economic conditions of wage restraint and high unemployment. Consequently, the objective of stabilising inflation in the medium-term being pursued by the main central banks does not call for any immediate response to the rise in the price of oil. Regardless of their target (headline or core inflation), the monetary authorities can allow first round effects to play themselves out while taking steps to ensure that no second round effect emerges.

However, these findings assume that inflationary expectations are firmly anchored. In the current economic and financial conditions, the main central banks ought to continue with their extremely accommodating monetary policy into the medium term. Firmly anchored inflationary expectations are essential in order to ensure that this policy threatens neither medium-term price stability, nor the credibility of the monetary authorities. Moreover, although an oil price rise as a result of increased aggregate demand seems unlikely today, oil prices could resume their upward path in the event of tensions in the producer countries, as illustrated by the present uncertainties over Iran, and thereby affect inflationary expectations.

The fact that more expensive oil has so little impact on inflationary expectations suggests that the monetary authorities have room to pursue their present accommodating policy without jeopardising medium-term price stability. Our econometric estimates (see box 3) underline the fact that inflationary expectations are positively influences by rising oil prices in the United States and in the eurozone. Even so, the impact of more expensive oil on inflationary expectations is extremely weak, in keeping with the findings in the literature[24]. These results suggest that maintaining accommodating monetary conditions in the face of rising oil prices ought not to fuel inflationary expectations.

Box 3: The impact of more expensive oil on inflationary expectations

The following equation is estimated by OLS in order to show the impact of a rise in the price of oil on inflationary expectations in the United States and the eurozone:

$$\Delta anticipations_t = c + \alpha\ \Delta\ petrole_t + \beta\Delta\ alimentation_t + \theta\Delta VIX_t + \delta\Delta NEER_t + \mu\Delta\ bid-ask_t + \mu\Delta\ taux\ directeurs_t + \varepsilon_t$$

The dependent variables are inflationary expectations at different maturities. The control variables include non-oil commodity prices (CRB indexes), inflation swaps market liquidity (bid-ask spreads), exchange rates (effective nominal exchange rates or euro-dollar for the eurozone), variations in key rates, and financial markets volatility (VIX). Only the coefficients associated with the oil price variation are indicated, in bold when they differ significantly from zero.
A 10% rise in the price of oil is associated with a 1 basis point rise in medium-term (5 years) inflationary expectations in the eurozone, and 6 basis points in the United States.

Table 3: Long-term impact on inflation of a 1% rise in the price of oil

Exceptations derived from swaps												Breakeven inflation			
Eurozone															
1 yr		3 yrs		5 yrs		7 yrs		10 yrs		5 yrs in 5 yrs		5 yrs		10 yrs	
coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
0.03	1.82	**0.03**	2.13	**0.01**	2.03	**0.04**	3.91	**0.01**	2.33	**0.00**	0.50	**0.01**	3.38	**0.01**	2.02
États-Unis															
1 yr		3 yrs		5 yrs		7 yrs		10 yrs		5 yrs in 5 yrs		5 yrs		10 yrs	
coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
0.08	6.11	**0.02**	0.57	**0.06**	3.20	**0.06**	6.97	**0.04**	2.84	**0.05**	2.59	**0.06**	3.37	**0.05**	2.44

3.2 When activity is weak, monetary easing may be necessary in order to head off the risk of deflation

The mandates of the Fed and the ECB allow for monetary easing to compensate for the negative effects of more expensive oil on aggregate demand.

In the eurozone, the ECB's mandate's emphasis on medium-term price stability makes monetary easing unlikely in the event of an oil price rise in a period of expansion. Monetary easing is permissible in the event of a downturn, however. That is because, when aggregate demand is flat and surplus capacity exists, an oil price rise triggered by a supply shock, as in 2011, can depress demand and lead to the emergence of deflationary pressures. This could necessitate intervention by the monetary authorities in order to keep prices stable in the medium term.

Monetary intervention to support activity is more likely in the event of an oil price shock in the United States, since the Fed's mandate gives priority to maximising employment while maintaining stable prices. In the present context of near-zero policy rates, a further decline in real long-term

(24) For the United States, see Celasun, O., R. Mihet, L. Ratnovski, (2012), "Commodity prices and inflation expectations in the United States", *IMF Working Paper* 12/89 and E. Harris, B. Kasman, M. Shapiro, K. West, (2009), "Oil and the macroeconomy: lessons for monetary policy", University of Chicago.

rates could be achieve via quantitative easing, although quantifications of its impact on activity vary greatly.

3.3 Monetary policy responses depend on the causes of the oil price rise and the contribution of national activity to the emergence of these shocks

Monetary policy needs to take the causes of oil rises into consideration, and these causes need to be analysed before framing an appropriate response. The literature suggests that the macroeconomic impact of oil price shocks depends in part on the nature of these shocks. Ideally, then, what is required is not a one-size-fits-all monetary policy response, rather one based on identification of the nature of the shock and targeting the causes of the oil price rise (such as a demand shock, for example).

For an effective national response to an oil price rise in a global market, it is important to distinguish between the contribution of national factors and external factors to the price rise (Archanskaia et al, 2011), for the large open economies especially.

In the case of a demand shock, one needs to identify the role of domestic demands in the rise in global aggregate demand, for example by looking at the correlations between the oil price and global GDP, and between domestic and global GDP. When domestic activity contributes to the demand shock, monetary tightening ought to curb inflationary pressures and rein-in activity, thereby helping to bring down the global price of oil. Conversely, if domestic activity is weak, monetary policy needs to make a trade off between supporting activity on the one hand, and on the other hand the desire to limit second round effects of the global demand shock on domestic inflation.

In the face of a global oil price shock, national policy needs to make a trade off between stabilising prices and supporting activity. This trade off depends on the respective importance national authorities place on stabilising activity around growth potential and stabilising prices around the inflation target. It is especially hard for the ECB to make this trade off, given the wide variety of national situations.

Violaine FAUBERT,

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Publication manager:
Claire Waysand

Editor in chief:
Jean-Philippe Vincent
+33 (0)1 44 87 18 51
tresor-eco@dgtresor.gouv.fr

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