

ARTICLES

COMMODITY PRICES AND THEIR ROLE IN ASSESSING EURO AREA GROWTH AND INFLATION



Over the past decade commodity prices have witnessed stronger upward trends, greater co-movement and higher volatility. It is likely that these features have mainly reflected the increased alignment of developments in commodity markets with those in global economic activity (in particular in the case of emerging economies). The changed nature of commodity price developments has potential implications for the assessment of the euro area's economic outlook. In particular, assumptions made with respect to this outlook for the future development of commodity prices may be surrounded by more uncertainty than previously. Overall, it is always necessary to conduct a careful analysis of the underlying factors driving commodity prices in order to assess the implications for medium-term price stability and to determine the appropriate monetary policy response to changes in commodity prices.

I INTRODUCTION

Developments in international commodity prices play an important role in the assessment of both the outlook for euro area inflation and the risks to price stability in the medium term. This assessment entails the need to identify the nature of commodity price movements, the channels through which they affect the economy and their relative importance. The purpose of this article is to identify recent changes in the nature of commodity price movements and their potential implications for assessing the outlook for economic growth and inflation in the euro area if these changes were to become permanent.

To this end, the article is structured as follows. Section 2 reviews the pattern of commodity price movements and discusses factors that may explain any changes in this pattern. There is some evidence of a stronger trend increase in commodity prices since the early 2000s coupled with higher volatility and stronger co-movement across individual commodity prices. Changes in global demand for commodities, in particular the increasing role of emerging economies as importers of commodities, may account for these changes. Section 3 describes what the changed nature of commodity price movements implies for the assessment of the economic outlook for the euro area. These implications range from arriving at adequate assumptions for future commodity prices in the context of macroeconomic projections to the consideration of a wider set of channels through which commodity price developments may influence domestic activity and inflation. Changes in the nature of commodity price developments and their impact on the economy may also have implications for the conduct of monetary policy. Section 4 concludes.

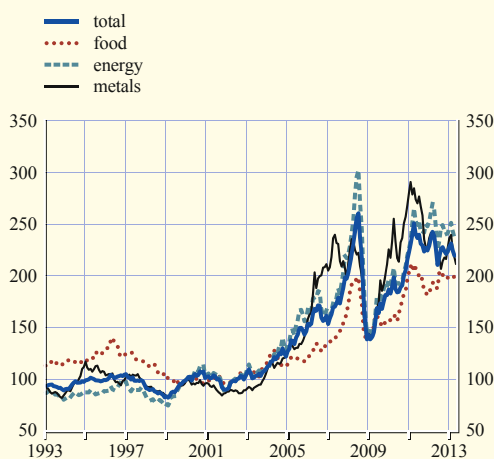
2 COMMODITY PRICES IN THE 2000S: WHAT HAS CHANGED?

After a period of relatively stable developments until the early 2000s, there was a broad-based increase in international commodity prices (see Chart 1). Taking 2003 as a dividing line between these two periods, the aggregate commodity price index – comprising energy, food and metals – increased by, on average, 0.6% in annual terms in the ten years up to 2003, while it has increased by, on average, 10% per annum in the ten years since then.¹ The change in commodity price dynamics is visible across all categories of commodities, although it has been somewhat more pronounced for energy and metals than for food. The same pattern prevails when looking at commodity prices relative to global output price or consumer price developments. Obviously, changes in real or

¹ The year 2003 is often chosen in the literature as the point after which oil prices started to follow an upward path, driven by unexpected strong growth in oil demand (see, for example, Kilian, L. and Hicks, B., “Did Unexpectedly Strong Economic Growth Cause the Oil Price Shock of 2003-2008?”, *Journal of Forecasting*, Vol. 32, Issue No 5, August 2013, pp. 385-394).

Chart 1 Evolution of commodity price indices

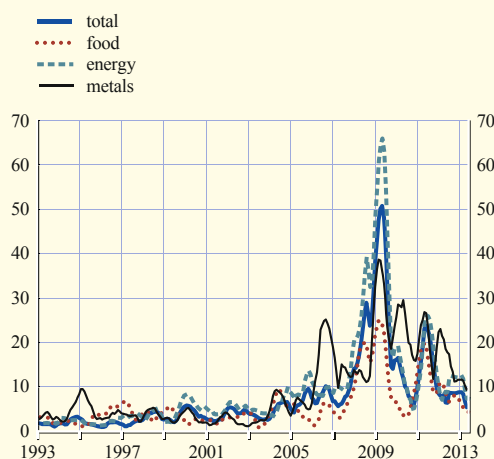
(index: 2000 = 100; monthly data)



Source: IMF.
Note: The last observation is that for May 2013.

Chart 2 Volatility of commodity prices

(rolling 12-months standard deviations)



Source: IMF.
Notes: For each point in time, the rolling standard deviation is calculated using monthly data over the past year. The last observation is that for May 2013. The pattern of volatility is similar when the standard deviation is calculated over smaller or larger rolling windows.

relative commodity price trends over the period since 2003 cannot be taken as firm indications of truly secular trends. After recovering from the lows reached following the 2008 financial crisis, commodity prices broadly stabilised again amid some volatility since mid-2010.

Commodity prices have also become more volatile over the past decade (see Chart 2). Approximating volatility by rolling standard deviations, there was an upward shift in average volatility in the period after 2003. Again, this is a feature that is visible across all categories of commodities, and it prevails when looking beyond the particularly high volatility recorded in 2008. Overall, the fact that both changes in medium-term trends and more short-run volatility were discerned in the data marks a difference compared with historical commodity price behaviour.

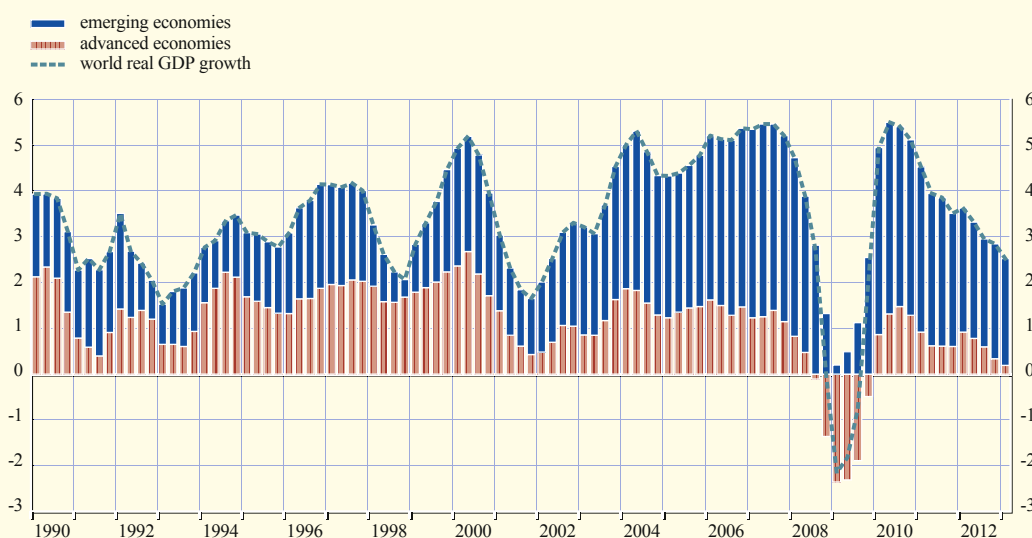
Explaining such changes in trends and volatility is arduous as – by nature – international commodity prices are driven by a large range of supply and demand-related factors in the global economy. At the same time, some of these factors may have a greater bearing on trends than on volatilities, or vice versa. Similarly, some factors may be more relevant for price movements of specific commodities, while others tend to influence prices of all commodities alike. Such distinctions can help in identifying relevant factors.

With regard to the common trend across prices of different commodities in the 2000s, this is likely to reflect demand factors that stem from broad macroeconomic conditions in the world economy. In particular, as the demand for commodities tends to be closely related to global production and income developments, the strong economic growth in emerging economies such as China and India gave rise to more persistent upward pressures on commodity prices.² Industrialisation tends to go

² On the relevance of demand from emerging economies in explaining the development of oil prices between 2003 and 2008, see, for example, Kilian, L. and Hicks, B., loc. cit.

Chart 3 World real GDP growth, and contributions from advanced and emerging economies

(annual growth rates and percentage point contributions; quarterly data)



Source: ECB.

Notes: Data are weighted by purchasing power parity. The last observation is that for the first quarter of 2013.

hand in hand with a higher commodity intensity in production, and improvements in income levels tend to coincide with commodity-impacting changes in consumption patterns, such as preferences related to transportation, housing or diet.

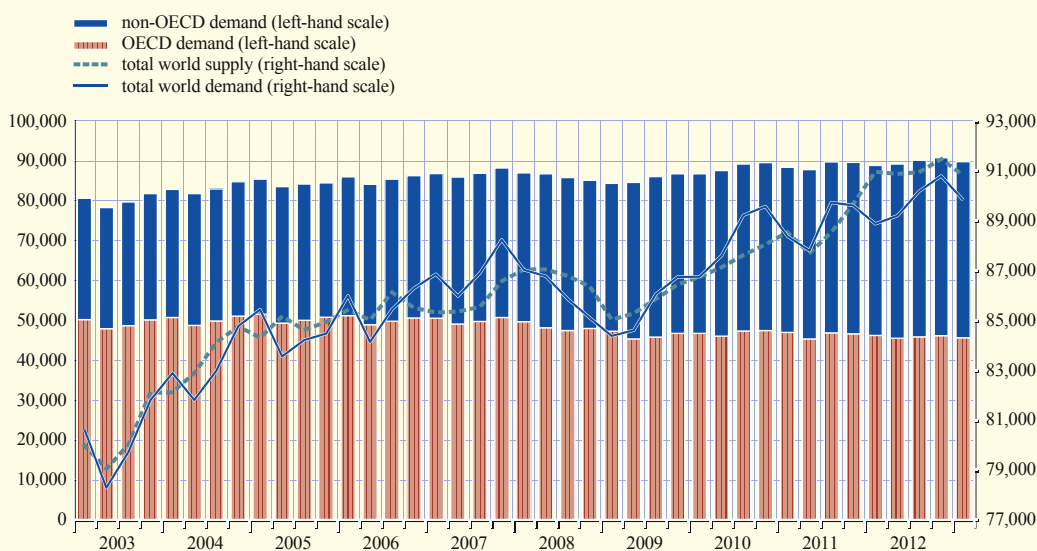
In the ten years up to 2003 emerging economies accounted for, on average, around half of global real GDP growth, while their share in the period since then has risen to four-fifths (see Chart 3). The relationship with commodity consumption can be exemplified by the case of oil. In 2003 non-OECD countries accounted for somewhat less than 40% of total oil consumption, while ten years later, this figure already stood at almost 50% (see Chart 4). In addition, energy intensity is higher in emerging markets than in the euro area. For example, total primary energy use per unit of GDP was 12% in the euro area in 2010, compared with 14% in Brazil, 18% in India and 26% in China.

In combination with a somewhat lagging supply, the significant increases in emerging economies' demand for commodities caused the prices of energy, food and metals to increase in parallel between 2003 and 2008. In the case of oil, these sharp and unexpectedly strong increases in demand reduced the spare capacity of OPEC countries as the supply of oil accommodated that higher demand. A decline in global growth and the subsequent drop in commodity demand after the financial crisis also explain why commodity prices plunged in 2008. Given the relatively swift recovery in demand for commodities from emerging economies, commodity prices recovered relatively quickly from early 2009.

In addition to the aforementioned demand factors, supply-side factors also had an impact on the trend in commodity prices. In the case of energy commodities such as oil or gas, these supply-side

Chart 4 Development of oil supply and demand over the period from 2003 to 2013

(thousand barrels per day; quarterly averages)



Source: International Energy Agency.
Note: The last observation is that for the first quarter of 2013.

factors relate mainly to technological advances, for example “fracking”,³ that allow a greater degree of substitution between energy sources and effectively provide a backstop to scarcity-related trends in prices of individual energy commodities.

As regards the higher volatility of commodity prices in the period since 2003, one explanation is the impact of the global recession, but other factors could also be at play. For instance, many supply-side factors have a commodity-specific nature and tend to account for volatility and one-off movements in prices, rather than for medium-term trend developments. Where energy commodities are concerned, such supply-side factors can be changes in, and disruptions to, production as a result of, for example, political instability in energy-exporting countries or decisions by OPEC countries with regard to the management of spare capacity. In the case of food commodities, supply-side factors are frequently related to abrupt changes in weather conditions and their possible consequences in the form of droughts or floods. Finally, in the case of metal commodities, supplies depend on, among other factors, technological progress and events such as strikes in the relevant mining sector. Examples of such supply-side factors can be found throughout the 2000s, but there is no clear evidence that their impact on the respective commodity prices was any different from that in earlier periods.

Yet another factor that might increase the volatility of commodity prices relates to changes in the price elasticity of commodity supply or demand, although its importance in explaining commodity price volatility in general is still unclear. In the case of oil, however, there is empirical evidence that variations in the price elasticities of oil demand and supply create periods of elevated oil price

3 Fracking or hydraulic fracturing is a technique for oil and gas extraction whereby a mixture of water, sand and chemicals is pumped into shale or tight formations at ultra-high pressure, creating small fractures that free up oil and gas. This technique has led to a boom in the production of shale gas and oil, primarily in the United States. This shale gas and oil production revolution, in contrast to many other supply-side developments, has mainly had an impact on the medium-term trend development of oil prices.

volatility. This, in turn, can reflect the structure of production, possible recourse to alternative sources or spare capacity, the management of commodity stocks and inventories and, more generally, the impact of macroeconomic uncertainty.⁴

Finally, increases in the very short-term volatility of commodity prices may be related to what is known as “financialisation”. This refers to the increased use of commodities as financial assets and to the active management of these assets in futures markets, which might affect, for example, oil price fluctuations at very short horizons.⁵ Investment in commodities has increased over the 2000s. The empirical verdict is still out on the relevance of financialisation in explaining commodity price volatility and on the direction in which it works. However, there seems to be some evidence that financialisation has caused a stronger correlation between the short-term movements in prices of different types of commodities.⁶

Overall, over the past ten years commodity prices have exhibited some changes in behaviour. In particular, strong demand for commodities from emerging market economies appears to have resulted in the prices of different types of commodity moving in a more synchronised fashion – both with regard to higher shorter-term volatility and the overall rate of increase.⁷ If shocks to commodity prices tend to occur more simultaneously, the consequences for inflation and economic growth in commodity-importing countries such as the euro area may be amplified.

3 THE CHANGED NATURE OF COMMODITY PRICE MOVEMENTS: WHAT IMPLICATIONS DOES THIS HAVE FOR THE ASSESSMENT OF THE EURO AREA'S ECONOMIC OUTLOOK?

Movements in commodity prices play an important role in the assessment of the economic outlook for the euro area. This relates, first, to the technical assumptions on future commodity price developments, as they are typically used as so-called exogenous variables in forecasts and projections. Second, it relates to the direct and indirect effects that movements in commodity prices have in the underlying analytical frameworks and, third, to the conduct of monetary policy. Changes in the nature of commodity price movements, as witnessed over the past ten years, may have implications for the reliability of the assumptions, the analytical frameworks used for gauging future developments and the conduct of monetary policy.

4 See Van Robays I., “Macroeconomic uncertainty and the impact of oil shocks”, *Working Paper Series*, No 1479, ECB, Frankfurt am Main, October 2012 for an empirical analysis where declines in the price elasticity of oil supply and demand caused by greater macroeconomic uncertainty, as measured by volatility in GDP growth, leads to higher oil price volatility. Everything else being equal, a lower price elasticity in the supply of commodities implies a more marked effect on prices in the event of a commodity demand shock. These two factors, i.e. larger shocks and a changed price elasticity of supply and demand, might explain volatility in commodity prices over the economic growth cycle.

5 See, for example, “Report of the G20 Study Group on Commodities”, November 2011.

6 For an overview, see Kilian, L., Fattouh, B. and Mahadeva, L., “The Role of Speculation in Oil Markets: What Have We Learned So Far?”, *The Energy Journal*, Vol. 34, No 3, July 2013, pp. 7-33. Stronger commodity price co-movement can, for example, be explained by the increased popularity of commodity index funds, which simultaneously track movements in prices of different types of commodity. In this respect, it has been shown that prices of non-energy commodities, in particular those included in commodity index funds, have become increasingly correlated with oil prices since the early 2000s (see Tang, K. and Xiong, W., “Index Investment and the Financialization of Commodities”, *Financial Analysts Journal*, Vol. 68, No 6, November/December 2012, pp.54-74).

7 This stronger general co-movement can be captured in markedly higher pair-wise correlations of commodity prices. In the period from 1992 to 2003 the correlation was negative (-0.37) between energy and food, marginally positive (0.08) between energy and metal and somewhat more positive (0.56) between food and metal. By contrast, in the period from 2003 to 2013 the correlations between the different pairs of commodity prices were all between 0.85 and 0.93. A caveat to these calculations is that the second period includes the recession of 2008 and 2009, when there was a strong demand-driven decline in all commodity prices which dominates the rest of the sample.

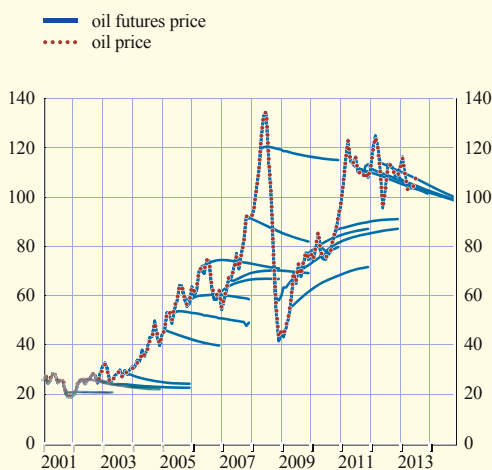
3.1 IMPLICATIONS FOR THE TECHNICAL ASSUMPTIONS MADE IN PROJECTIONS

The Eurosystem staff projections assume that commodity prices evolve in line with the prices set in futures markets. In the case of oil, the h -period forecast of the price of oil is derived from the price of the oil futures contract at maturity h , based on the assumption that the futures price is equal to the expected spot price of oil. However, the futures prices of risky assets such as oil can deviate from the expected spot price as a result of a risk premium component. Moreover, unlike classic financial assets, storable commodities carry additional costs, such as storage costs, and benefits, such as holding physical inventories for consumption, normally referred to as the convenience yield. Typically, the risk premium and the convenience yield components are larger than the cost component, which causes oil futures prices to be lower than current oil prices and to follow a slightly downward sloping path (see Chart 5).⁸

As long as movements in oil prices tend to be very short-lived and fluctuate around some recent, relatively stable level, the assumption based on futures prices tends to imply relatively small errors. By contrast, when oil price developments are characterised by (piecewise) trends and volatility that includes swings that, despite extending over several quarters, are unexpected, the assumption based on the futures prices observed in recent history can quickly become outdated.⁹ In this respect, the

Chart 5 Futures prices for Brent crude oil

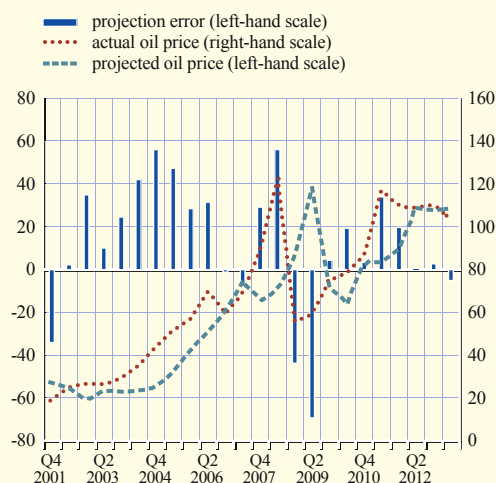
(US dollars per barrel)



Source: ECB staff calculations.
Note: The futures curves reflect the assumptions in the biannual Eurosystem staff projections made at the time.

Chart 6 Forecasting error in the one-year-ahead assumptions for oil prices in Eurosystem staff projections and actual oil price developments

(percentages; US dollars per barrel)



Source: ECB calculations.
Notes: The forecasting error is the percentage deviation of the actual oil price from the one-year-ahead projection made for the second and fourth quarter of each calendar year. A positive error thus denotes an underestimation of the actual oil price. See also the article "An assessment of Eurosystem staff macroeconomic projections", *Monthly Bulletin*, ECB, May 2013.

8 This situation, whereby the futures contract of oil is traded at a lower price than the spot contract in the oil market, is referred to as "backwardation". If the reverse occurs, when spot prices are higher than futures prices because of, for example, high storage costs, the oil market is in "contango".

9 Alquist and Kilian show that the inaccuracy of the futures-based prediction is driven by the variability of the spread between the futures and the spot price, see Alquist, R. and Kilian, L., "What do we learn from the price of crude oil futures", *Journal of Applied Econometrics*, Vol. 25(4), February 2010, pp. 539-573.

pronounced movements in oil prices in response to the global growth cycle in the period between 2007 and 2011 were not anticipated by oil futures. These errors in projecting oil prices (see Chart 6) contributed significantly to the overall error in projections of HICP inflation. Overall, since 1999 oil price assumptions implied a marked downward bias, resulting in a downside bias also in inflation projection errors by Eurosystem staff.¹⁰

Futures prices are also used by Eurosystem staff as assumptions for the projection of both food commodity prices and prices of non-energy hard commodities such as metals. In the case of the latter, however, this assumption only applies to the first part of the projection horizon, while prices of non-energy hard commodities further out are assumed to evolve in line with global economic activity. This switch reflects the lack of depth in the futures markets for these commodities at longer horizons and the risk that prices are determined by only a few contracts and trades. At the same time, given the stronger co-movement that commodity prices in general have had with global economic activity and, in particular, with the contribution from emerging economies, a stronger link of assumptions regarding future commodity prices with those relating to global economic activity might reflect the changed nature of commodity price movements also in the case of oil and food. Where energy commodities are concerned, the substitution of different types of energy can also lead to relative price changes. For example, fracking technologies can increase the demand for gas relative to that for oil, thereby putting downward pressure on oil prices. While such factors could be reflected by making commodity prices endogenous to the system and thereby including demand-side factors, it is not straightforward to find a model that significantly improves the out-of-sample forecast performance compared to futures prices.

In the case of food commodity prices, developments in international prices are used by Eurosystem staff to derive predictions of so-called EU farm-gate prices, which are in turn used as the assumptions for food commodity prices that are relevant in the context of the EU's Common Agricultural Policy. EU farm-gate prices tend to move closely in line with international commodity prices when prices are above the intervention level determined in the context of this policy (see Box 1). The general upward trend in commodity prices since 2003 has led to levels of international food commodity prices that are well above the intervention levels, and has thus strengthened the impact of global food commodity-related assumptions on the economic outlook for the euro area.

¹⁰ For more details, see the article "An assessment of Eurosystem staff macroeconomic projections", *Monthly Bulletin*, ECB, Frankfurt am Main, May 2013.

Box 1

FOOD COMMODITIES AND THE COMMON AGRICULTURAL POLICY

In 2007-08 global food commodity prices rose sharply. Consumer prices of food in Europe were visibly affected. The magnitude of this effect came as a surprise. In the past, consumer prices of food within Europe had generally moved modestly in response to movements in international food commodity prices. The Common Agricultural Policy (CAP) had largely shielded them from world market developments. This box looks at the design of the CAP, and at the effects that changes to it can have on the pass-through of international food commodity prices.

Designed around 1960 to secure food supplies and the income of farmers, the CAP relies, among other measures, on “intervention prices”. If the price of a product falls below the intervention price, the product is bought into publicly-funded inventories at the intervention price. This system therefore has the potential to ensure relatively high prices within the European Union when compared with market-determined prices, but it can also depress world market prices if excess supplies are exported, possibly with the help of subsidies.

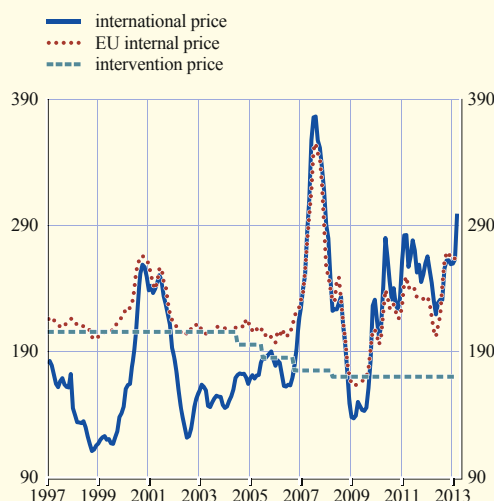
European farm-gate prices, which follow the intervention prices, were generally higher than international food commodity prices and also more stable than the latter until 2007 (see the example of skimmed milk powder in the chart). They have been found to better explain developments in consumer prices of food both in the euro area and in individual euro area countries than international commodity quotations.¹

Over time, adaptations to the CAP measures meant that world market prices had greater influence. Among other things, intervention prices were reduced, while world prices rose. This caused European farm-gate prices to be somewhat lower than in the past, although they remained higher than world market prices. Thus, when world market prices started to increase sharply at the end of 2006, intervention prices provided no effective limit and European farm-gate prices moved more or less in parallel with international commodity prices.² A similar picture has been observed since the end of 2009. As can be expected when markets become more open, prices along the European food supply chain have also become less stable.³ At the same time, publicly-funded inventories have been reduced.

In the light of the changed situation, some supply-restricting measures under the CAP were suspended. Moreover, it was announced that others would be phased out over the longer term. Intervention prices are still in place, but they stand at rather low levels. Thus, even though there are still some differences, European farm-gate prices have been more closely synchronised with international commodity quotations since the end of 2006, with European consumer prices of food consequently also moving more in line with international food commodity prices since then.

Developments in international and EU internal market prices of skimmed milk powder

(euro per 100kg)



Sources: Understanding Dairy Markets, European Commission and ECB calculations.

Notes: The latest observation is for May 2013. International price refers to Oceania 1.25% butterfat skim milk powder (average of mid-point of price ranges reported bi-weekly). EU internal price refers to the monthly average of milk powder prices (from 2003 to 2012 in intervention quality) in the EU 27.

1 See Annex D in “Processed food: inflation and price levels”, *Economic Review – Special Edition*, National Bank of Belgium, April 2008, pp. 53-72, and Jiménez-Rodríguez, R., Ferrucci, G. and Onorante L., “Food price pass-through in the euro area: the role of asymmetries and non-linearities”, *Working Paper Series*, No 1168, ECB, Frankfurt am Main, April 2010.

2 For a discussion of the causes of the increase in world food prices, see the box entitled “What accounts for the global surge in food prices”, *Monthly Bulletin*, ECB, Frankfurt am Main, June 2008.

3 In its evaluation of CAP measures in the dairy sector, the European Commission came to the conclusion that there was greater volatility in EU milk producer prices after the reduction of intervention prices than previously (see “Evaluation of CAP measures applied to the dairy sector, final report”, European Commission – Directorate-General for Agriculture and Rural Development, November 2011). In the study undertaken by the National Bank of Belgium (see footnote 1), it was also found that the frequency of adjustments to Belgian consumer prices of certain food products had increased significantly since mid-2007.

3.2 IMPLICATIONS FOR THE ANALYTICAL FRAMEWORKS

When assessing the impact of shocks to commodity prices on the economic outlook, it should be borne in mind that macroeconomic models tend to imply a clear-cut and differential reaction of output growth and inflation to changes in international commodity prices: an upward shock leads to higher inflation and lower output. For instance, Eurosystem macroeconomic models imply that a permanent increase of 10% in oil prices (denominated in US dollars) has a cumulative upward impact of about $\frac{1}{2}$ percentage point on euro area HICP inflation over a three-year horizon (with the oil price level also playing a role), and a cumulative downward impact of around $\frac{1}{4}$ percentage point on euro area real GDP growth.¹¹

It should be noted that such a countermovement of inflation and economic growth is not always observed in practice. The actual movement of the various variables will depend, inter alia, on the extent to which the commodity price movements intrinsically come together with movements in global growth. If oil prices are driven by stronger global growth, their movement may be associated with increases in euro area growth, even if the rise in oil prices, all other things being equal, has a dampening effect on euro area growth.

Commodity price shocks can influence euro area economic growth and inflation via a number of different channels. These channels are often intertwined, as the impact on economic activity, for instance, tends to materialise predominantly through real incomes and thus through the impact of commodity prices on inflation (see Chart 7).

Direct effects on inflation occur, for instance, when commodity prices have an immediate bearing on consumer prices. This is most obvious in the case of energy commodities, where changes in oil and gas prices are transmitted more or less directly to consumer prices for fuel or heating. However, it also holds true for some food commodity prices, such as meat prices, that may directly affect consumer prices for unprocessed food. Indirect effects occur when commodity prices have an impact on consumer prices essentially via the production and distribution chain. Examples are the influence of energy commodity prices on consumer prices for transportation services via fuel prices or on consumer prices for non-energy industrial goods via producer prices for energy-intensive products such as chemicals. Similar considerations hold for the impact that food commodity prices have on consumer prices for processed food. So-called second-round effects capture the reactions of wage and price-setters to the direct and indirect effects of a commodity price shock, for instance, if they attempt to keep their real wages and profits unchanged. Such dynamics could cause higher inflation expectations and could thus transform temporary commodity price shocks into more persistent inflationary pressures.

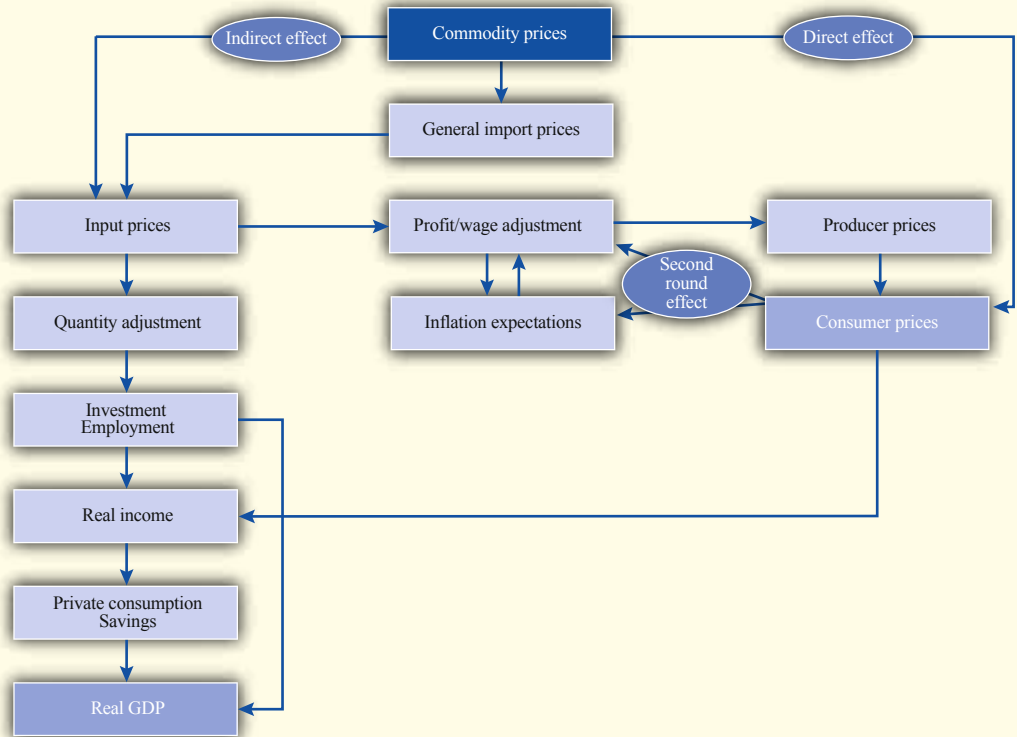
The changed nature of commodity price movements in terms of stronger growth trends, greater comovement and higher volatility could alter these channels in several ways.

First, if commodity prices are subject to a trend, they will become a systematic component of inflation. As energy prices have risen relative to other prices over the past decade, the share of energy in the overall HICP is now higher than it was, for example, in the early 2000s (11.0% in 2013 compared with 8.4% in 2000). With a relatively low price elasticity of most commodity consumption, this results in an increasing importance of commodity prices for overall HICP inflation and, consequently, in an increasing relevance for monetary policy.

11 See “Energy markets and the euro area economy”, *Occasional Paper Series*, No 113, ECB, Frankfurt am Main, June 2010.

Chart 7 Transmission channels for commodity price movements

(stylised representation assuming a net commodity-importing economy)



Source: ECB.

Second, upward trends in, and the co-movement of, commodity prices may give rise to stronger second-round effects in terms of inflation expectations and knock-on effects for wage/price dynamics. For example, energy and food are frequently and out-of-pocket purchased items, the prices of which may at times have a stronger bearing on inflation perceptions and expectations.

Third, if the level of commodity prices ultimately moves up over time, the impact for the same percentage change in the price will possibly vary. In the case of energy prices, such level-dependent impacts are associated not only with the fact that the share of energy in the HICP tends to rise with the oil price, but also with the presence of fixed excise taxes in consumer energy prices that imply a larger direct impact of oil price changes on consumer prices at higher price levels (see Box 2).

Fourth, a trend and greater co-movement of commodity prices will amplify the price shocks for industries with broad-based commodity inputs and make it more difficult for them to absorb the overall cost pressures in their profit margins. For instance, industries engaged in energy-intensive manufacturing of metal products will be more strongly affected by a joint and possibly more persistent upward movement in prices of energy and metal commodities. Depending on the interlinkages between these industries and the rest of the economy, indirect effects and their spillovers will be more likely to occur.

Finally, a higher volatility of commodity prices may increase the need for hedging instruments or inventories in importing countries, and could thus add an additional layer to commodity and material-related input costs.

Box 2

OIL PRICE EFFECTS AND TAXES

The most immediate and strongest impact of oil commodity prices on euro area inflation comes through their direct effects on energy prices. This box assesses the role that indirect taxes play in this impact. Given differences in their nature and structure, as well as in the degree of data availability, consumer prices are considered separately for oil products such as transport fuel – both petrol and diesel – and heating fuel.¹

Consumer prices of fuel are generally subject to two forms of indirect taxes: (i) ad valorem-type taxes (generally value added tax – VAT), which is levied as a percentage (e.g. 20%); and (ii) excise or other taxes that are generally levied as a fixed amount per unit consumed (e.g. 50 cent per litre). Everything else being equal, higher excise-type taxes tend to reduce elasticity, i.e. the percentage response of consumer prices to a given percentage change in commodity prices.

Table A presents a stylised decomposition of consumer prices of liquid fuel, namely petrol, diesel and heating fuel, comparing the figures for 2012 with those recorded in 1999.² In 1999 indirect taxes accounted for most of the final consumer price (for around 70% in the case of transport fuel

1 For a detailed discussion of consumer prices of energy in the euro area, see Task Force of the Monetary Policy Committee of the European System of Central Banks, “Energy markets and the euro area macroeconomy”, *Occasional Paper Series*, No 113, ECB, Frankfurt am Main, June 2010.

2 For a more detailed discussion, see the box entitled “Recent developments in consumer prices for oil products”, *Monthly Bulletin*, ECB, Frankfurt am Main, October 2012.

Table A Decomposition of average euro area consumer prices of liquid fuel

(annual averages; cent per litre unless otherwise indicated)

	Transport fuel – petrol				Transport fuel – diesel				Heating fuel – gasoil			
	1999		2012		1999		2012		1999		2012	
	cent/l	%	cent/l	%	cent/l	%	cent/l	%	cent/l	%	cent/l	%
(1) Crude oil	10.7	12	55.0	33	10.7	16	55.0	37	10.7	35	55.0	55
(2) Pre-tax consumer price incl. margins	23.6	27	73.3	45	21.5	33	77.6	53	17.6	58	73.1	73
(3) Taxes	63.5	73	91.0	55	43.5	67	69.5	47	12.8	42	26.7	27
of which:												
Excise duties	50.0	57	63.4	39	33.4	51	45.1	31	8.2	27	10.2	10
VAT rate (%)	18.2		20.2		18.3		19.9		18.2		19.7	
VAT	13.4	15	27.6	17	10.1	15	24.4	17	4.7	15	16.4	16
(4) Final consumer price	87.1	100	164.3	100	65.0	100	147.1	100	30.5	100	99.8	100

Sources: Bloomberg, Thomson Reuters, the European Commission’s weekly oil bulletin and ECB staff calculations.

and for 40% in that of heating fuel). Since then, although excise taxes per litre have increased in nominal terms (from 50.0 cent to 63.4 cent for petrol, from 33.4 cent to 45.1 cent for diesel and from 8.2 cent to 10.2 cent for heating fuel), they have remained more or less unchanged in real terms (i.e. deflated by overall HICP). As VAT is levied as a percentage, the amount of VAT levied can vary on account of a change in either the rate of VAT levied or the price. Thus, the amount of VAT levied would have increased substantially, even without a change in VAT rates, as a result of the increase in oil prices. However, over and beyond this, between 1999 and 2012 there was also an increase of 2 percentage points in the average rate of VAT applied to prices of petrol and diesel and an increase of 1 percentage point in that applied to heating fuel prices. Overall, taxes have risen for all types of fuel, but their share in the final selling price has declined.

Table B Estimated elasticity of euro area consumer liquid fuel prices with respect to crude oil prices

(percentages)

	HICP Weight (2013)	1999	2012
Petrol	} 5.0	14	40
Diesel		19	45
Heating fuel	0.9	41	66

Source: ECB calculations.

In terms of their share in final consumer prices, indirect taxes still accounted for a substantial proportion of liquid fuel prices in 2012 (for, on average, approximately 50% of transport fuel prices across the euro area). Although there have been some increases in energy taxes, particularly in more recent years – reflecting fiscal pressures – they are not the main cause of the sharp increase in consumer prices of energy observed since 1999. For transport fuels, excise taxes have remained broadly unchanged in real terms since then, and owing to the marked increases in oil prices and the more modest increases in distribution costs and margins, their share in final consumer prices has declined substantially. Consequently, reflecting the fact that the elasticity of consumer prices with respect to energy commodity prices is mainly a function of the amount of non-ad valorem-type indirect taxes such as excise taxes and the response of margins, Table B illustrates that the estimated elasticity of consumers’ liquid fuel prices with respect to crude oil prices rose significantly between 1999 and 2012.³ This increase in the elasticity is due primarily to the increase in the level of oil prices.

³ A somewhat similar phenomenon has occurred in the case of consumer prices of gas and electricity, whereby the increase in the prices of commodity inputs as a percentage of the final consumer price has caused their elasticities to increase as well. For a more detailed discussion of consumer prices of gas and electricity, see the box entitled “Non-oil energy price developments”, *Monthly Bulletin*, ECB, September 2008.

The impact of commodity price movements on economic activity, as measured by real GDP, materialises mainly via real income effects.¹² If the cost increases implied by higher commodity prices are buffered by profits and/or wages, entrepreneurial and/or household incomes will decline and typically have negative repercussions on investment and consumption. If the cost increases lead to higher output prices and if these dampen demand, producers will adjust the quantity of output, and the associated investment and employment levels. This, in turn, will again have effects on real incomes and real GDP.

¹² A prominent real income effect for the economy as a whole is captured in the negative terms-of-trade effects implied by commodity price movements. However, this effect may be mitigated if the higher revenues in countries that export commodities are used for imports from countries that import commodities, an example of which would be what is known as “oil bill recycling” (see Box 3 of the article entitled “Oil prices – their determinants and impact on euro area inflation and the macroeconomy”, *Monthly Bulletin*, ECB, August 2010).

The transmission channel to economic activity can be modified in several ways owing to the changed nature of commodity prices.

First, investment in machinery may have been made in view of the marginal productivity of such investment, which may, in turn, depend on the level of energy commodity prices. If commodity prices are subject to a trend, a higher level may render energy-intensive investment unprofitable and lead to faster depreciation and scrapping, complementing income and demand-related effects on investment. In this respect, the ultimate impact of such depreciation on actual and potential output depends on the possibilities for countering high commodity prices either by reducing the intensity of energy use, by substituting one energy commodity for another or by replacing more energy-intensive investment with less energy-intensive investment.

Second, the increased co-movement of commodity prices may limit the possibilities available for replacing a given source of commodities with another. For instance, the prices of perceived backstop technologies such as biofuel or shale gas may move in the same way as established energy commodities (although possibly at a different level) and then imply responses in real income and activity to commodity price movements, also over longer horizons where substitution possibilities would normally loosen the link.

Third, the higher volatility of commodity prices may have a direct impact on firms' and households' perceptions of uncertainty regarding the general economic environment and, everything else being equal, result in a higher degree of apprehension in their decisions on investment and consumption.

Overall, given the stronger upward trend in commodity prices, it is likely that longer-term factors become more relevant for the impact on inflation and economic growth. In the case of inflation, this is due to the risk of a stronger link between commodity price developments and medium-term inflation expectations. In the case of economic growth, it is due to the possibility of reducing commodity intensity or resorting to alternative commodity inputs (see Box 3). The latter should become easier at higher prices, as the deployment of alternative sources would then be more profitable.

Box 3

ENERGY INTENSITY IN EURO AREA OUTPUT

Permanent increases in the relative price of commodities provide an incentive to reduce the intensity of use of such commodities in production and consumption. This box reviews developments in this intensity over past decades, using energy as an example.

The absolute use of oil products has decreased by 9% since 1970, while that of total energy products has increased by almost 50%. At the same time, the share of units of oil used in total output has declined by around 60%, while that of energy units has fallen by 40% (see chart).

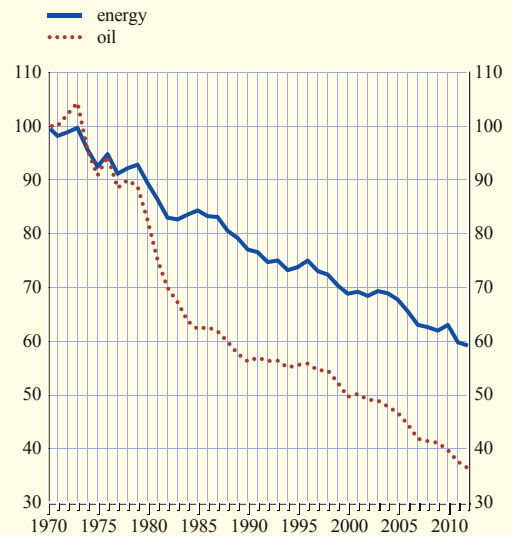
However, this secular decline in the intensity of oil use took place at different speeds across the period under consideration. After the oil price shocks of the 1970s, the intensity declined rapidly

in the course of the 1980s, but levelled off during the period of relative oil price stability in the 1990s. The 2000s saw a renewed decline in intensity as oil prices embarked on a strong upward trend from 2003. The decoupling of the intensity of use of oil products from that of total energy products in the 1980s points to substitution processes in energy commodity use. While the decoupling stalled during the 1990s, there are signs that it may have resumed again in the 2000s in response to the increase in oil prices.

Overall, the data suggest that the impact of high and upward trending oil prices on economic growth in the euro area over longer horizons may partly be contained by adjusting the intensity of use of oil commodities. However, where commodity prices follow similar trends, the incentive to substitute one type of energy commodity for another depends on the relative level of the price per unit of the different energy commodities.

Energy intensity in the euro area

(index: 1970 = 100)



Sources: ECB, IEA and ECB calculations.
 Note: Energy intensity is measured as total oil/energy supply in tons of oil equivalent divided by GDP. Total primary energy supply is defined as production plus imports minus exports adjusted for stock changes.

3.3 IMPLICATIONS FOR MONETARY POLICY

Commodity price shocks have the typical features of supply shocks, whereby output and inflation move in the opposite direction. Supply shocks thus represent a far greater challenge for monetary policy than demand shocks, which are characterised by inflation and output moving in the same direction. This implies that, while a prompt monetary policy response to demand shocks can stabilise inflation and, at the same time, reduce economic fluctuations, the policy response to supply shocks may require a more gradual response in order to avoid unnecessary volatility in real activity. However, such a gradual response is only warranted as long as inflation expectations remain well anchored.

There are several classification systems that can be helpful when thinking about the appropriate policy response to commodity price shocks. One is based on the likely features of the shock itself, i.e. whether it will be short-lived or will last for a prolonged period of time, or even contain a trend component. Assessing this requires detailed knowledge of the structural features of commodity markets and of the likely evolution of related global supply and demand conditions.

Short-lived shocks or other one-off changes in the level of commodity prices may not necessarily call for a policy response, as medium and long-term inflation expectations may be more likely to remain well-anchored, especially in the case of strong central bank credibility with respect to ensuring price stability. However, the presence of a trend component in shocks to commodity prices may require a different monetary policy response. Such longer-lasting supply shocks may have a systematic impact on inflation and could affect inflation expectations, meaning that monetary policy should respond to them.

The contribution of the energy component – which captures the unavoidable direct impact of oil price movements – to euro area HICP inflation explains roughly one-quarter of average HICP inflation recorded over the period since 2003, even though the weight of energy in that measure of inflation is only one-tenth. The implicit relative price increase curtailed the scope for price increases in the domestic economy, calling for a monetary policy stance that appropriately counterbalances the permanent effect on inflation over the medium term.

The ECB's monetary policy strategy incorporates some features that specifically help to address the challenge raised by commodity price shocks. The first feature is the quantitative definition of price stability, which provides an anchor for inflation expectations. The ECB defines price stability in terms of headline inflation, which takes movements in commodity prices into account, and hence has to explain its policy response in terms of this indicator. The second feature is its medium-term orientation, whereby the duration of the period over which price stability should be maintained is not predefined, but rather reflects the nature and persistence of the shocks that hit the euro area. In addition, the risk assessment of the outlook for price developments conducted by the Governing Council at its monetary policy meetings explicitly takes into consideration the uncertainty involved in deriving assumptions for future commodity price developments.

With its medium-term orientation, the ECB's monetary policy strategy looks through fluctuations in the HICP inflation rate caused by short-term changes in commodity prices. Medium-term inflation expectations in the euro area since 1999 have remained well anchored, notwithstanding sizeable fluctuations in HICP inflation rates (see Chart 8), reflecting the high degree of credibility of the ECB with respect to the achievement of its primary objective. This stability in inflation expectations in turn prevented short-term gyrations in commodity prices from becoming entrenched through second-round effects in wage and price setting.

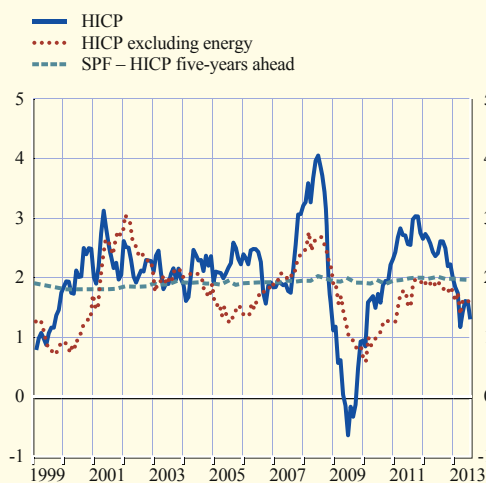
Finally, other policy areas can support the conduct of a monetary policy that is geared to maintaining price stability in the presence of commodity price shocks. Fiscal policies need to avoid having a budgetary policy stance that is too accommodative, as this could have a destabilising effect, delaying structural adjustment and prolonging inflationary pressures. Structural policy also has to play its part. Structural reforms, particularly those related to the flexibility of the labour and product markets, would facilitate the economy's adjustment in the event of commodity price shocks.

4 CONCLUSIONS

Over the past decade commodity prices have increased sharply and have become more volatile. At the same time, commodity markets have increasingly been influenced by global demand

Chart 8 Actual inflation and inflation expectations

(annual percentage changes)



Sources: ECB and Eurostat.

conditions, resulting in stronger correlations across commodity prices. This implies that shocks to commodity prices now occur in a more synchronised fashion. These changes, if they persist, may have implications for inflation and growth in commodity-importing countries such as the euro area. They also require a careful analysis in order to determine the appropriate monetary policy response.

This article reviewed the implications of the changed nature of commodity price movements for the assessment of the economic outlook in the euro area. Conventional assumptions for commodity prices that are based on futures prices may become outdated more quickly when commodity prices are subject to unexpected trends and high volatility. The marked changes in commodity prices observed over the past decade have shown that futures prices have generally under-predicted actual prices and have thereby contributed significantly to the overall error in HICP inflation projections.

The ECB's economic analysis has to take into account uncertainties in the outlook implied by the specific nature of commodity price shocks. The quantitative definition of price stability, which provides an anchor for inflation expectations, and the medium-term orientation of monetary policy, whereby the length of the period covered reflects the nature and persistence of the shocks that hit the euro area, are features in the ECB's monetary policy strategy that specifically help to address the challenges raised by the changing nature of commodity price shocks. In addition, the risk analysis to the staff projections conducted by the Governing Council has regularly pointed to risks to commodity prices as being relevant for the setting of monetary policy. Overall, benefiting from these features of its strategy, despite the upward trend in commodity prices in recent years, the ECB's Governing Council has successfully maintained inflation rates on average close to 2% in the period since 1999.