Box I.3: Drivers of the euro area recovery - evidence from an estimated model

GDP growth is expected to continue in 2018 at a similar pace to the one observed last year. This box uses an estimated, general equilibrium, multi-region, structural macroeconomic model [(1)] to provide a model-based decomposition of the euro area recovery in recent years from the double-dip recession and the subsequent expansion. The model features two regions, the euro area and the rest of the world (RoW), and it has been estimated on historical quarterly data for the period from 1999-Q1 to 2017-Q4. The historical time series are extended with forecast data from the European Commission's Spring 2018 forecast for the set of available variables to also cover the forecast period.

Model-based analysis allows disentangling and quantifying key drivers of macroeconomic dynamics

The estimation of a structural model allows to identify the shocks, i.e. the exogenous factors, that drive the short- and medium-term deviation of endogenous variables, including real GDP growth and inflation, from their long-run trends, and to provide an interpretation of the dynamics from the perspective of economic theory.

The advantage of using a detailed structural model to decompose economic dynamics derives from its ability to use the rich information in the data during estimation. In particular, a detailed model allows identifying the driving forces and transmission mechanisms on the basis of restrictions across variables and over time. In particular, the size of the various domestic and foreign demand and supply shocks - including financial market, saving, commodity price, and productivity shocks - is determined by the ability of these shocks to fit not only GDP or inflation, but also other observed variables that are included in the model (e.g. consumption, investment, international trade, employment, the exchange rate) and the co-movement between them, including the observed co-movement of GDP and inflation, GDP and net exports, or employment and wages.

This box focusses on real GDP growth and inflation in the euro area since 2013 as the variables of interest (on inflation, see also the dedicated Box 1.1 in this document). The year 2013 is chosen as a starting point, because it covers the turning point of the latest recession with the trough of euro area real GDP in the first quarter of 2013. [(2)] The results are shown for annual real GDP growth and percent changes in the consumer price index (CPI), while the drivers are merged into main groups for compact presentation.

Seven groups of drivers are separated: (1) shocks to euro area productivity; (2) goods market adjustment as reflected by price mark-up shocks; (3) labour market adjustment as captured by wage mark-up shocks; (4) oil price shocks; (5) monetary and exchange rate shocks, which include deviations of short-term interest rates from the estimated monetary policy rule and foreign exchange market shocks that move the euro exchange rate independently of the monetary policy stance; (6) domestic demand shocks, i.e. changes in domestic consumption and investment demand that are not explained by model fundamentals such as household income, return expectations, and the monetary policy stance; and (7) changes to world demand and international trade, which contains foreign demand and supply shocks and deviations of trade volumes and prices from the estimated export and import demand and pricing equations. The remaining factors are bundled together in the "others" group. Factors (1)-(4) act mainly on the supply side of the economy, whereas the factors (5)-(7) predominantly affect demand for euro area output in the short and medium term.

The model-based interpretation of the recovery that started in 2013 [(3)] is displayed in Graph 1, which shows the decomposition of annual growth rates of euro area real GDP. More precisely, Graph 1 shows the decomposition for the fluctuation of annual real GDP growth around its long-term trend rate (around 1.3%). The solid black line represents the data, including the ECFIN forecast for 2018. The bars depict the contribution of the driving factors

(1) These results are based on the Global Multi-Country (GM) DSGE model developed by DG ECFIN and the Joint Research Centre of the European Commission. A detailed description of the GM model can be found in: Albonico, A., L. Calès, R. Cardani, O. Croitorov, F. Ferroni, M. Giovannini, S. Hohberger, B. Pataracchia, F. Pericoli, R. Raciborski, M. Ratto, W. Roeger, L. Vogel (2017). 'The Global Multi-Country Model (GM): an Estimated DSGE Model for the Euro Area Countries', European Commission, *JRC Working Papers in Economics and Finance* 2017-10.

(2) For a characterisation of the drivers of the double-dip recession in the euro area during 2008-13 in a very similar model to the one used here, see: Kollmann, R., B. Pataracchia, R. Raciborski, M. Ratto, W. Roeger, L. Vogel (2016). 'The post-crisis slump in the Euro Area and the US: Evidence from an estimated three-region DSGE model', *European Economic Review* 88(C), pp. 21-41.

(3) Time series for 38 variables were included in this model.

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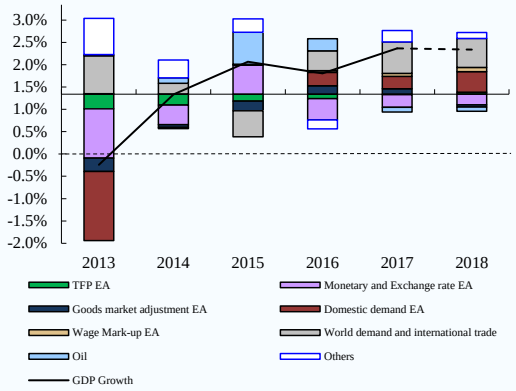
Box (continued)

(1)-(7) and "others" to the deviation of growth from its long-run trend. The components above the horizontal axis indicate positive contributions to GDP growth, whereas those below represent negative contributions. The sum of all positive and negative contributions equals the actual outcome for each year, i.e. the data displayed by the black solid line up to 2017 and dashed for the forecast year.

Graph 1: **Euro area real GDP growth**



Dynamics of a long recovery phase

The model-based decomposition of the euro area real GDP growth suggests that the recession in 2013 has been driven mainly by components of domestic demand, in particular by low private investment and consumption demand. The negative investment demand shock is identified in the model as wedge between the return to capital that is required by investors and the short-term policy rate augmented by a long-term average of the equity premium. Hence, investment demand shocks capture factors like financing constraints and the perception of elevated investment risk that can be behind the temporary rise in the required profitability. The negative consumption demand shock is identified in the model by saving rates that are higher than suggested by fundamentals, such as real interest rates, income and wealth, and the household consumption smoothing behaviour. The negative consumption demand shocks in the model relate to factors such as uncertainty, i.e. low confidence and heightened income risk, and the legacy of high private debt (deleveraging), which is left out from the structural equations for the purpose of model simplicity. [4]

The problem of subdued domestic demand in 2013 has been aggravated by the appreciation of the euro in nominal effective terms and by "contractionary monetary policy shocks" according to the model. Contractionary monetary shocks correspond to the observation that the monetary policy stance, as measured by short-term policy rates, had been tighter than suggested by the estimated Taylor rule coefficients due to the zero lower bound on nominal interest rates. [5]

In comparison with the dominant role of domestic demand shocks, the contribution of supply-side factors to low growth in 2013 is less important. Graph 1 points to some negative contribution by total factor productivity (TFP) growth below trend and by goods market adjustment, where the latter captures the limited downward adjustment of prices in response to the slack in demand.

Contrary to the weakness in domestic demand and negative supply-side factors, the recovery of world output growth and trade after the 2008-09 global recession strengthened euro area activity in 2013.

In line with negative growth in 2013 being driven mainly by weak domestic demand, the recovery of GDP growth over 2014-17 is associated in the first place with a recovery in consumption and, in particular, investment demand. Negative growth effects from domestic demand shocks disappeared in 2014-15, and the recovery of domestic demand has supported the growth of the euro area economic activity since 2016. [6] The European Commission's Spring forecast for GDP growth in 2018 contains a further positive contribution from domestic demand according to the model-based decomposition.

(4) For an estimated structural model with household debt and debt deleveraging see, e.g., in 't Veld, J., R. Kollmann, B. Pataracchia, M. Ratto, W. Roeger, Werner (2014): International capital flows and the boom-bust cycle in Spain, *Journal of International Money and Finance* 48(PB), 314-335.

(5) The monetary policy shock does not capture the impact of unconventional monetary policy measures which rather contribute to the private demand (savings and investment risk premium shocks) and foreign exchange shocks in the model.

(6) The impact of negative domestic demand shocks on the *level* of euro area real GDP is more persistent. Indeed the model estimation suggests a negative contribution of domestic demand shocks to level of GDP and the output gap for all years including the forecast for 2018.

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Box (continued)

Tight monetary conditions played an important role in the 2013 recession according to Graph 1, due to the appreciation of the euro in effective terms and the binding constraint on monetary policy. The growth contribution turned positive in 2015 in the context of strong euro depreciation. The contribution over 2016-17 is slightly negative, in line with a moderate recovery in the effective exchange rate.

The impact of world demand and trade on post-2013 euro area growth has remained positive overall, except for 2015, which has been marked by a deceleration of growth in international trade. The positive growth contribution of external demand and trade has strengthened in 2017 compared to 2016. The forecast for 2018 embodies a positive contribution of foreign demand and trade to euro area GDP growth that is very similar in size to 2017.

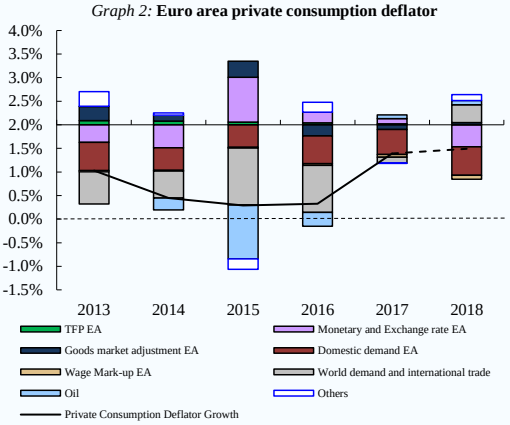
The decline in the oil price between mid-2014 and early 2016 added a positive supply-side impulse to euro area growth, in particular in 2015. [7] The following renewed increase in oil prices has dampened euro area growth moderately in 2017 and continues to slow growth in 2018 based on the forecast's underlying oil price assumption. Concerning the other supply-side factors, TFP growth has normalised after 2013, and its negative contribution to euro area GDP growth gradually disappeared.

With respect to product and goods market adjustment, the decomposition in Graph 1 finally points to a small positive contribution of declining price mark-ups to the euro area recovery during 2016-17. The fall in price mark-ups implies a reduction in the profit margin of firms, which strengthens the purchasing power of wage earners and economic activity in the model in the short and medium term. [8] Similarly, the model suggests a small positive contribution of weak euro area wage growth for 2017 and the 2018 forecast. The estimated fall in the wage mark-up indicates that euro area wages have grown less than suggested by GDP and labour demand in recent years. Wage mark-up reduction strengthens the recovery in the model, where the positive supply-side effect of wage moderation (employment growth) dominates the short-term decline in consumption demand (linked to lower hourly wages) in the medium term.

Inflation remains below trend in 2018

Turning to inflation dynamics, Graph 2 plots the annual percent change in the euro area private consumption deflator as the bold line and the model-based decomposition of deviations from trend inflation (2%) into groups of drivers as in Graph 1.

Graph 2: **Euro area private consumption deflator**



Inflation measured by the growth rate of the private consumption deflator has been below the trend of 2% during 2013-17, and it is expected to remain around 0.5 pps. below trend also in 2018. The decomposition of inflation in Graph 2 mirrors the findings for GDP growth in Graph 1 by attributing an important part of low inflation to the slack in domestic demand. While the impact on GDP *growth* has vanished, the 2012-13 recession has continued to weigh on the *level* of economic activity, translating into low inflation pressure.

Foreign and trade developments have reduced price pressure over 2013-17 according to the model. The negative contribution of this group of drivers is dominated by negative shocks to import prices. The negative shocks account for slower growth of euro area import prices compared to general price inflation in the RoW. Besides the direct dampening impact of cheaper imports on consumer prices, competition from importers implies downward pressure also on euro area output prices. The negative import price shock becomes very small in 2018, implying that import prices are forecast to develop in line with foreign inflation. It is more than offset by a positive contribution from strengthening export demand, which translates into

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(7) The size of the oil price effect, notably the positive growth contribution of ca. 0.7 pps. in 2015, is in line with magnitudes in previous DG ECFIN analysis in Raciborski, R., A. Theofilakou, L. Vogel (2015). 'Revisiting the macroeconomic effects of oil price changes', European Commission, *Quarterly Report on the Euro Area* 14:2, pp. 19-27.

(8) The estimated profile of the price-mark up shock, i.e. an elevated mark-up during the recession and a declining mark-up in the recovery, is required by the model to fit inflation data as explained below.

Box (continued)

a positive aggregate contribution by world demand and international trade shocks to consumer price inflation in 2018. Monetary and exchange rate shocks played a negative role for inflation during 2013-14, in line with the effective nominal appreciation of the euro and constrained monetary policy, and a positive role especially in 2015 but also during 2015-16, which is attributable to the estimated depreciation pressure on the euro.

On the supply side, low wage growth, i.e. the weak response of wage inflation to the recovery, as reflected in the negative shock to the wage mark-up has had a dampening, but quantitatively only very moderate impact on inflation. Falling oil prices in 2014-16 have dampened consumer price growth especially in 2015 (-1.1 pps.), i.e. the year for which the oil price decline has been strongest in annual terms. The effect has been reversed to some extent with the partly recovery of oil prices since.

The inflation-reducing effects of falling non-oil and oil import prices and the legacy of weak domestic demand explain the weakness of inflation during 2013-17 to a large extent according to the model-based decomposition, but they do not fully account for the persistence of low euro area inflation in a context of domestic and global recovery in most recent years. The gap between prices and domestic costs is filled in the estimation by a price mark-up shock. According to the estimated shock, sluggish price adjustment has upheld inflation in 2013-15, in line with the shock's dampening impact on GDP growth (Graph 1), and has lowered inflation in 2016-17, consistent with a positive supply-side contribution to GDP growth.

Despite the fact that the euro area estimated output gap moves to positive territory in 2018, inflation remains below trend. Three factors keep inflation down in 2018. First, the appreciation of the euro reduces import prices. Second, despite positive growth contributions of domestic demand, investment and consumption levels are still below their long run trend and still contribute negatively to the output gap and inflation. The output gap is positive because of both positive demand and supply shocks from the rest of the world. The latter still exert negative pressure on import prices and therefore keep inflation down. Ongoing wage moderation also contributes positively to the output gap but also reduces inflation pressures.

Taken together, the estimated model attributes the post-2013 euro area GDP growth recovery mainly to the sustained recovery in domestic demand, supported by persistently strong growth in the rest of the world, and by the temporary boost from falling commodity prices in 2014-15. Inflation below trend mainly reflects the legacy of the demand slump and foreign factors, namely appreciation pressure on the euro in 2013-14, low prices for manufactured imports, and the decline in the oil price during 2014-16.