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Macroeconomic and financial effects of oil price shocks: Evidence for the euro area☆

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ABSTRACT

The paper investigates the macroeconomic and financial effects of oil price shocks for the euro area, with a special focus on post-2009 oil price dynamics and the recent slump. The analysis is carried out episode by episode, by means of a large-scale time-varying parameter model. We find that recessionary effects are triggered by oil price hikes and, in some cases, also by oil price slumps. In this respect, the post-2009 run-up likely contributed to sluggish growth, while uncertainty and real interest rate effects are the potential channels through which the 2014 slump has depressed aggregate demand and worsened financial conditions. Also in light of the zero interest rate policy carried out by the ECB, in so far as the Quantitative Easing policy failed to generate inflationary expectations, a more expansionary fiscal policy might be required to counteract the deflationary and recessionary threat within the expected environment of soft oil prices.

1. Introduction

Crude oil price dynamics since the mid-2000s have surely raised new interest on the oil price-macroeconomy relationship, particularly the 2008 boom-bust episode, comparable in real terms with the early 1980s shock (US$ 140 July 2008; US$ 40 December 2008). The oil price has persisted at rather high levels for about five years thereafter (90 US$), until the recent oil price slump, which has lead to a swift 50% oil price contraction since June/October 2014 (40 US$).

Despite the potentially sizable real effects for oil importing countries of recent oil price dynamics, we are unaware of any empirical assessment carried out using post-2009 data for the euro area (EA). The latter issue is particularly relevant since the EA has so far only partially recovered from the subprime financial crisis, newly falling in recession in July 2011 -through February 2013- as the sovereign debt crisis deepened. Hence, the unfavorable and long lasting oil price developments since late 2009 might have contributed to its scattered and sluggish recovery. It is also unclear whether the recent oil price slump will enhance economic growth in the EA. On the one hand, it might be expected to support economic recovery through reducing energy bills and input costs, increasing total factor productivity and through monetary policy accommodation (Mohaddes and Pesaran, 2016; see also Morana, 2013b). On the other hand, by occurring in an environment of weak economic growth, high deflation risk, and where the policy interest rate is already at the zero lower bound, the oil price slump might exercise recessionary effects through deepening deflationary dynamics, raising real interest rates and macroeconomic and financial uncertainty.[2]

In light of the above issues, in this paper we assess the macroeconomic and financial effects of oil price dynamics for the EA since its creation, with a special focus on post-2009 oil price developments and the recent oil price slump. Overall the available evidence at the EA-wide level is rather thin and, by neglecting recent economic developments, might not yield accurate guidance concerning the expected

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[2] The weak and scattered recovery from the sovereign debt crisis and the recent contraction in energy and food prices have put price stability at risk in the EA, inducing deflationary dynamics from December 2014 through March 2015, in September 2015, and then again from February through May 2016, despite the sizable depreciation of the currency and the implementation of the Quantitative Easing policy (*Q. E.*) since January 2015.

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effects of the slump. For instance, Jiménez-Rodríguez and Sánchez (2005) estimate a small-scale structural vector autoregressive model (SVAR) over the period 1972 through 2001. Consistent with the "reallocation effect" (Hamilton, 2011), they point to a non-linear impact of oil price shocks on real GDP, as oil price increases lead to stagflation, while oil price declines do not have a statistically significant impact.[3] Peersman and van Robays (2009) also estimate a small-scale constant parameter SVAR model over the period 1986 through 2008. They find that the macroeconomic effects of oil price shocks crucially depend on their source, i.e. on whether they are oil supply disturbances, shocks to flow oil demand, or precautionary oil demand shocks. In particular, all of the three types of shocks are inflationary already in the short-run, yet recessionary at different horizons: flow oil supply and demand shocks in the medium-term only; precautionary oil demand disturbances also in the short-term. Similar evidence is provided by Forni et al. (2012), who estimate a small open economy DSGE model over the period 1995-2007. On the other hand, Hahn and Mestre (2011) estimate a small-scale time-varying parameter SVAR model with stochastic volatility over the period 1970 through 2009. They point to weaker stagflationary effects of both supply and demand oil shocks since the mid-1990s than over the three previous decades (see also ECB, 2010, for similar evidence), yet an unchanged relative contribution of both shocks to the determination of oil price fluctuations.

Differently from previous work in the literature, in this paper we assess the real and financial effects of oil price developments in the EA by means of a new large-scale time-varying parameter framework, based on the semiparametric dynamic conditional correlation model (SP-DCC) of Morana (2015). Relatively to standard time-varying parameter SVAR models, i.e. Hahn and Mestre (2011), the proposed modeling strategy is not subject to the curse of dimensionality and, by allowing for a large and comprehensive information set, should yield more accurate and robust results. In particular, our information set includes, in addition to standard macroeconomic variables, a new financial conditions index for the euro area (Morana, 2017) and the European *market*, *size*, *value* and *momentum* risk factors (Fama and French, 1993; Carhart, 1997). We believe the inclusion of the latter variables is well justified in light of the progressive "financialization" of commodity markets since the early 2000s (Gkanoutas-Leventis and Nesvetailova, 2015) and the sizable contribution of oil market shocks to the determination of risk factor fluctuations themselves (Morana, 2014).

Consistent with the asymmetric response of the EA economy to positive and negative oil price shocks (Jiménez-Rodríguez and Sánchez, 2005; Cuñado and Pérez de Gracia, 2003; Cologni and Manera, 2009), we then separately assess the macroeconomic and financial effects of various episodes of persistent price changes. Due to the reduced form approach, "oil price shocks'" in our framework should be understood in terms of "shocks to the oil price equation". Hence, while we do not attempt to categorize the original source of oil price changes, by evaluating their effects episode-by-episode our analysis is however fully consistent with the view that "not all the oil price shocks are alike" (Kilian, 2009), yet with the advantage of not imposing any identification assumption.

Overall, our findings yield new insights on the macro-financial impact of oil price dynamics for the euro area. For instance, we find strong evidence of asymmetric real effects of oil price changes, as net oil price increases determined a contraction in industrial production over the whole sample investigated, while net price decreases were expansionary only in the early and mid-2000s. Moreover, real effects appear to increase with the magnitude of the shock and the level achieved by the oil price itself: the 2008 oil price shock was surely peculiar for both the size of its real effects and inflationary impact, as deflationary dynamics can be in general observed following both oil price hikes and slumps. The post-2009 oil price run-up also likely contributed to sluggish growth, while real interest rate and uncertainty effects are the potential channels through which the current slump has depressed aggregated demand and worsened financial conditions. Also in light of the zero interest rate policy carried out by the ECB, our findings have then a clear-cut policy implication: In so far as the Quantitative Easing ($Q.E.$) policy failed to generate inflationary expectations, a more expansionary fiscal policy might be required to counteract the deflationary and recessionary threat within the expected environment of soft oil prices.

The rest of the paper is organized as follows. In Section 2 we introduce the econometric methodology and in Section 3 we present the data. In Sections 4 and 5 we discuss the empirical results. Finally, Section 6 concludes.

2. Econometric methodology

The semiparametric dynamic conditional correlation model (SP-DCC; Morana, 2015) is defined by the following equations

$$\mathbf{y}_t = \boldsymbol{\mu}_t(\boldsymbol{\delta}) + \boldsymbol{\varepsilon}_t \tag{1}$$

$$\boldsymbol{\varepsilon}_t = \mathbf{H}_t^{1/2}(\boldsymbol{\delta})\mathbf{z}_t \tag{2}$$

where $\mathbf{y}_t$ is the $N \times 1$ column vector of the variables of interest, $\boldsymbol{\mu}_t(\boldsymbol{\delta})$ is the $N \times 1$ conditional mean vector $E(\mathbf{y}_t|I_{t-1})$, $\boldsymbol{\delta}$ is a vector of parameters, $\boldsymbol{I_{t-1}}$ is the sigma field; $\mathbf{H}_t(\boldsymbol{\delta})$ is the $N{\times}N$ conditional variance-covariance matrix $Var(\mathbf{y}_t|I_{t-1})$. Moreover, the random vector $\mathbf{z}_t$ is of dimension $N \times 1$ and assumed to be $\boldsymbol{i.i.d.}$ with first two moments $E(\mathbf{z}_t) = \mathbf{0}$ and $Var(\mathbf{z}_t) = \mathbf{I}_N$. Concerning the specification of the conditional variance-covariance matrix $\mathbf{H}_t(\boldsymbol{\delta})$, we assume that the elements along its main diagonal, i.e., the conditional variances $Var(y_{i,t}|I_{t-1}) \equiv h_{i,t}$ follow a GARCH(1,1) process

$$h_{i,t} = \omega_i + \alpha_i \varepsilon_{i,t-1}^2 + \beta_i h_{i,t-1} \quad i = 1, \ldots, N \tag{3}$$

subject to the usual restrictions to ensure that the conditional variances are positive almost surely at any point in time.

Concerning the definition of the conditional covariances, a non-parametric specification is posited, grounded on the *polarization* identity

$$Cov(A, B) \equiv \frac{1}{4}[Var(A+B) - Var(A-B)] \tag{4}$$

given that $Var(A \pm B) = Var(A) + Var(B) \pm 2Cov(A, B)$, for any two random variables A and B.

Accordingly, the off-diagonal elements of $\mathbf{H}_t$, $Cov(y_{i,t}, y_{j,t}|I_{t-1}) \equiv h_{ij,t}$, are

$$h_{ij,t} = \frac{1}{4}[Var_{t-1}(y_{i,t} + y_{j,t}) - Var_{t-1}(y_{i,t} - y_{j,t})] \quad i, j = 1, \ldots, N \quad i \neq j. \tag{5}$$

By defining the aggregate variables $y_{ij,t}^{+} \equiv y_{i,t} + y_{j,t}$ and $y_{ij,t}^{-} \equiv y_{i,t} - y_{j,t}$, and assuming a GARCH(1,1) specification for their conditional variance processes $Var_{t-1}(y_{ij,t}^{+}|I_{t-1}) \equiv h_{ij,t}^{+}$ and $Var_{t-1}(y_{ij,t}^{-}|I_{t-1}) \equiv h_{ij,t}^{-}$ as well, we then have

$$h_{ij,t}^{+} = \omega_{ij}^{+} + \alpha_{ij}^{+}\varepsilon_{ij,t-1}^{+2} + \beta_{ij}^{+}h_{ij,t-1}^{+} \quad i, j = 1, \ldots, N \quad i \neq j \tag{6}$$

$$h_{ij,t}^{-} = \omega_{ij}^{-} + \alpha_{ij}^{-}\varepsilon_{ij,t-1}^{-2} + \beta_{ij}^{-}h_{ij,t-1}^{-} \quad i, j = 1, \ldots, N \quad i \neq j \tag{7}$$

where $\varepsilon_{ij,t}^{+} = \varepsilon_{i,t} + \varepsilon_{j,t}$ and $\varepsilon_{ij,t-1}^{-} = \varepsilon_{i,t} - \varepsilon_{j,t}$.

The implied parametric structure for the generic conditional covariance can be worked out by substituting (6) and (7) into (5); one then has

[3] See also Cuñado and Pérez de Gracia (2003) and Cologni and Manera (2009) for evidence on the asymmetric effects of oil price shocks for European economies, yet at the single-country level.