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It ain't over till it's over: A global perspective on the Great Moderation-Great Recession interconnection*

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Abstract

A large-scale Factor-Augmented Vector Autoregressive (FAVAR) model of the global economy is used to investigate the determinants of the Great Moderation and the transition to the Great Recession (1986-2010). Beside the global economy perspective, the model presents the novel feature of a broad range of included financial variables and risk factor measures. The results point to various mechanisms related to the global monetary policy stance (Great Deviation), financial institutions' risk taking behavior (Great Leveraging) and global imbalances (savings glut), determining aggregate fluctuations. Finally, an out-of-sample forecasting exercise provides evidence against the "end of the Great Moderation" view, showing that the timing, though not the dimension of the Great Recession episode (2008-2010), was predictable on the basis of the same macroeconomic mechanisms at work over the two previous decades.

Keywords: Great Moderation, Great Recession, Euro area sovereign debt crisis, risk factors, early warning system, macro-financial instability; FAVAR models; PC-VAR estimation.

JEL *classification*: E32, E44, G15, C22.

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1 Introduction

A generalized dampening in macroeconomic fluctuations has been observed since the mid-1980s in the US and major industrialized countries. This "Great Moderation" phenomenon (Stock and Watson 2003; 2005) persisted for more than two decades despite various episodes of economic, financial and political distress, until the eruption of the subprime financial crisis in 2007, the oil price shock in 2008, and the ensuing global Great Recession. The causes of the Great Moderation have been debated in depth in the literature. One prominent view attributes the greater macroeconomic stability to "good luck" in the form of smaller shocks hitting the economy (Stock and Watson, 2003; Ahmed et al., 2004; Arias et al., 2007; Kim et al., 2008; Canova, 2009). Other contributions focus on the role of better monetary policy in reducing aggregate volatility (Clarida et al., 2000), shifting the economy away from indeterminacy and leading to an environment of price stability (Lubik and Schorfeide, 2004; Coibion and Gorodnichenko, 2011). Finally, several sources of structural change, potentially responsible for declining output volatility, have been explored, such as *i*) improved inventory management through the intensive adoption of information technology (McConnell and Pérez-Quiros, 2000; Davis and Kahn, 2008); *ii*) the expansion of the tertiary sector and contraction of energy-related and heavy industry sectors (Carvalho and Gabaix, 2013); *iii*) the decline in aggregate consumption and investment volatility due to the dominance of permanent technological shocks (Blanchard and Simon, 2001); *iv*) changes in the correlation between productivity and hours (Galì and Gambetti, 2009); *v*) lower sensitivity of aggregate expenditure to current income and interest rates due to financial innovation (Dynan et al., 2006).

More recently, the remarkable widening in macroeconomic fluctuations due to the onset of the Great Recession raised the issue of the end of the Great Moderation. While some contributions argue in favor of a shift to a new regime of higher macroeconomic uncertainty following the financial crisis (Barnett and Chauvet, 2008; Cannarella et al., 2010; Bean, 2010; Taylor, 2011; Keating and Valcarcel, 2012; Ng and Tambalotti, 2012; Ng and Wright, 2013), other evidence suggests that the Great Moderation might not be over. Stock and Watson (2012) and Gadea et al. (2014) do not detect any structural change in the volatility and in other properties of the US business cycle in the aftermath of the Great Recession. Chen (2011) points to a reversion toward a low volatility regime in the G7 countries already occurring about the end of 2009. International evidence of a purely temporary change in the GDP growth rate is also detected by Charles et al. (2014). Larger oil price and financial disturbances ("bad luck") would then be at the root of the rise in macroeconomic uncertainty caused by the financial crisis, driving the transition from the Great Moderation to the Great Recession (Clark, 2009). Also the most recent data, though not yet thoroughly researched, seem to suggest a return to a reduced volatility macroeconomic regime (Furman, 2014).

In light of the above evidence, this paper takes the perspective that the Great Moderation and Great Recession share an important global dimension and are tightly interrelated phenomena, with the purpose of getting a clear understanding of their main underlying driving forces and the features of the transition from a period of relatively subdued fluctuations to an episode of remarkably higher macroeconomic volatility.

To this aim, we employ an econometric approach with two novel features. First, rather than carrying out a country-by-country analysis, as in most previous studies, we adopt a global-economy framework. A large-scale, Factor-Augmented Vector Autoregressive (FAVAR) econometric model, covering 50 OECD and emerging economies, is used to investigate global energy, goods, labor, monetary and financial asset market conditions. In addition to providing a global perspective, the large-scale framework also grants the benefits of more accurate estimation of structural disturbances, overcoming the potential drawbacks of model misspecification and inconsistent estimation of shocks affecting small-scale VAR models (Giannone et al., 2008). Second, we include in the model a large set of financial variables, allowing for identification of a broad range of structural disturbances related to financial markets, and a comprehensive array of risk factor indicators, meant to capture investors' expectations and sentiments about the state of the business cycle.

Our findings point to several structural supply-side, demand-side and financial shocks as the main driving forces of macro-financial fluctuations over the Great Moderation and the transition to the financial crisis and the Great Recession, related to various mechanisms already documented in the literature. For example, the early 2000s might have witnessed the setting in of a new international monetary regime based on a "Great Deviation" (Taylor, 2010, 2013; Hofmann and Bogdanova, 2012), as the monetary policy stance turned (over-)accommodative in many industrialized and emerging countries, following the sequence of interest rate cuts implemented by the US Fed to contrast the recessionary effects of the dot-com bubble, the ensuing jobless recovery and deflationary expectations. The narrative tells that the Great Deviation originated in the US, spilled over internationally through the attempt of foreign central banks to resist unwanted fluctuations in exchange rates and capital flows, by keeping interest rates low in the face of the US Fed's expansionary policy. Moreover, the destabilizing effects of buoyant liquidity were amplified by excessive risk taking of financial intermediaries, giving rise to the "Great Leveraging" phenomenon (Taylor, 2012), boosted by financial deregulation and innovation (Taylor, 2010; Kahn, 2010; Bernanke, 2010; Dagher and Fu, 2011) and misled risk perceptions (Lettau et al., 2008). An alternative explanation, the "savings glut" hypothesis (Bernanke, 2005), points to foreign factors, rather than Fed's policy, as the main forces driving downward US real interest rates and deteriorating the US current account deficit. Financial crises in emerging (especially East Asian) countries during the 1990s led their central banks to build up foreign exchange reserves and to convey national savings to international capital markets. As the Great Deviation hypothesis, also the savings glut view highlights the fact that the transition to the Great Recession occurred in an environment of too low real interest rates, originating a sequence of asset price misalignments involving initially bonds, stocks and house prices, and then oil and non-energy commodity prices (Caballero et al., 2008a; Caballero and Fahri, 2014). As the bust phase of the financial cycle set in, deteriorating balance sheets forced financial institutions into deleveraging and fire sales of assets, triggering a contraction in domestic and external demand through a credit crunch and worsening expectations about future credit supply and higher precautionary savings due to mounting uncertainty about the resilience of the international financial system (Adrian and Shin, 2010; Bean, 2010; Bagliano and Morana, 2012; Morana, 2013).

Our results provide insights on the relevance of those mechanisms for the global economy in the period leading to the Great Recession. To preview, global macro-financial dynamics over the 1986-2010 period are due to a composite set of structural disturbances coming from all (supply-side, demand-side and financial) sources. Some of those shocks displayed increased volatility well before the onset of the Great Recession, which is better interpreted as the final outcome of an ongoing process, in accord with the account provided by Caballero et al. (2008b). The savings glut, Great Deviation and Great Leveraging hypotheses are then complementary explanations of the transition dynamics leading to the Great Recession.

Peculiar to the Great Recession was then the much larger magnitude of shocks rather than their source, and the size of the global real activity contraction, which was (on average per quarter) four times larger than during the previous three episodes. Demand-side and financial shocks account for about two-thirds of the global output contraction during the Great Recession, consistent with the narrative pointing to the real effects of the subprime financial crisis working mainly through aggregate demand shortages, due to a credit crunch, an increased level of uncertainty and larger precautionary savings. Coherently, by means of an out of sample forecasting exercise, we provide evidence of predictability of the timing of the Great Recession, yet not of its depth.

Our results finally cast some doubts on a purely structural explanation of the "jobless recovery" phenomenon. In fact, demand-side and financial shocks, in addition to accounting for as much as cyclical employment variance than supply-side disturbances over the whole sample, had an even larger slowing down effect in the year following the end of the Great Recession.

The rest of the paper is organized as follows. In Section 2 the econometric methodology is outlined, and details on the identification and economic interpretation of structural shocks are provided. Section 3 presents and discusses results concerning the structural sources of macro-financial fluctuations over the Great Moderation and the transition to the Great Recession. The predictability of the timing and depth of the Great Recession is investigated in Section 4, and conclusions are drawn in Section 5.[1]

2 Econometric methodology

The empirical analysis is cast in terms of a Factor-Augmented Vactor Autoregressive (FAVAR) econometric model composed of two blocks of equations. The former, the *global-economy* model, describes the dynamics of a broad range of macroeconomic, financial, and oil market global factors. The second block, the *local-economies* model, captures the dynamics of the main macroeconomic and financial variables for a large set of developed and emerging economies, and is used to estimate the unobserved global macro-financial factors.

2.1 The econometric model

The *global-economy* model contains *unobserved* ($\mathbf{F}_{1,t}$) and *observed* ($\mathbf{F}_{2,t}$) global macro-financial factors and oil market demand and supply side variables ($\mathbf{O}_t$), collected in a $R \times 1$ vector $\mathbf{F}_t = \left[\mathbf{F}'_{1,t}\ \mathbf{F}'_{2,t}\ \mathbf{O}'_t\right]'$. The *local-economies* model refers to Q macro-financial variables for M countries, collected in a $N \times 1$ vector $\mathbf{Z}_t$ (with $N = M \times Q$). The joint dynamics of the *global* and *local* macro-financial blocks are then modelled by means of the following stationary reduced form dynamic factor model

$$
\begin{aligned}
(\mathbf{I} - \mathbf{P}(L))(\mathbf{F}_t - \boldsymbol{\kappa}) &= \boldsymbol{\eta}_t & (1)\\
(\mathbf{I} - \mathbf{C}(L))\left((\mathbf{Z}_t - \boldsymbol{\mu}) - \boldsymbol{\Lambda}\,(\mathbf{F}_t - \boldsymbol{\kappa})\right) &= \mathbf{v}_t & (2)
\end{aligned}
$$

where $(\mathbf{F}_t - \boldsymbol{\kappa}), (\mathbf{Z}_t - \boldsymbol{\mu}) \sim I(0)$, $\boldsymbol{\mu}$ and $\boldsymbol{\kappa}$ are vectors of intercept components of dimension $N \times 1$ and $R \times 1$ respectively, with $R \leq N$, and the contemporaneous effects of the global

[1] A Supplementary Appendix, available online with the working paper version of this article at http://www.carloalberto.org/assets/working-papers/no.424.pdf, provides additional information on the dataset, the estimation methods, the identification of structural disturbances and further results.

factors in $\mathbf{F}_t$ on each country's variables in $\mathbf{Z}_t$ are measured by the loading coefficients collected in the $N \times R$ matrix $\mathbf{\Lambda} = \left[\mathbf{\Lambda}'_{F_1}\ \mathbf{\Lambda}'_{F_2}\ \mathbf{\Lambda}'_{O}\right]'$.

Global factor dynamics are described by the stationary finite-order polynomial matrix $\mathbf{P}(L) \equiv \mathbf{P}_1 L + \mathbf{P}_2 L^2 + ... + \mathbf{P}_p L^p$, where $\mathbf{P}_j$ $(j = 1, ...p)$ is a square matrix of coefficients of order R, whereas dynamics in the local-economies variables are captured by $\mathbf{C}(L) \equiv \mathbf{C}_1 L + \mathbf{C}_2 L^2 + ... + \mathbf{C}_c L^c$, where $\mathbf{C}_j$ $(j = 0, ..c)$ is a square block (own-country) diagonal matrix of coefficients of order N. Finally, $\boldsymbol{\eta}_t \sim$i.i.d.$(\mathbf{0}, \mathbf{\Sigma}_\eta)$ is a $R \times 1$ vector of reduced form global shocks driving the $\mathbf{F}_t$ factors, and $\mathbf{v}_t \sim$i.i.d.$(\mathbf{0}, \mathbf{\Sigma}_v)$ is the $N \times 1$ vector of reduced form country-specific disturbances, with $E\left[\eta_{jt} v_{is}\right] = 0$ for all i, j, t, s.

The chosen specification of (1) and (2) embeds important assumptions on the structure of global and local linkages: (i) global shocks $(\boldsymbol{\eta}_t)$ affect both the global and local economies through $\mathbf{P}(L)$ and the factor loading matrix $\mathbf{\Lambda}$, respectively; (ii) country-specific disturbances $(\mathbf{v}_t)$ do not affect the global economy, limiting their impact only to the country of origin, due to the assumed block (own-country) diagonal structure for $\mathbf{C}(L)$.

Consistent and asymptotically normal estimates of the coefficients in (1) and (2) are obtained by means of the procedures proposed in Morana (2012, 2014), yielding accurate estimation also in small samples (see the Monte Carlo evidence reported therein). Such procedures involve the iterative estimation of the unobserved factors and the local-economies model, followed by the estimation of the global-economy model conditional on the estimated unobserved factors.

Given the specification of (1) and (2), the disturbances of the global-economy model in $\boldsymbol{\eta}_t$ have the nature of reduced-form innovations. In order to investigate the role of underlying structural shocks in shaping global factor dynamics it is then necessary to adopt an identification scheme. To this aim, we impose a set of exclusion restrictions on the contemporaneous (within quarter) responses of the factors to the structural disturbances, resulting in a precise "ordering" (discussed below) for the elements of $\mathbf{F}_t$. The structural vector moving average representation for the global model (1) can then be written as

$$(\mathbf{F}_t - \boldsymbol{\kappa}) = \mathbf{H}_F(L)\mathbf{K}^{-1}\boldsymbol{\xi}_t \tag{3}$$

where $\mathbf{H}_F(L) = [\mathbf{I} - \mathbf{P}(L)]^{-1}$, and $\boldsymbol{\xi}_t = \mathbf{K}\,\boldsymbol{\eta}_t$ is the vector of the R structural shocks driving the common factors in $\mathbf{F}_t$, with $\mathbf{K}$ being a $R \times R$ invertible matrix. By assumption, the structural factor shocks are orthogonal and have unit variance, so that $E\left[\boldsymbol{\xi}_t \boldsymbol{\xi}'_t\right] = \mathbf{K}\,\mathbf{\Sigma}_\eta\,\mathbf{K}' = \mathbf{I}_R$. To achieve exact identification of the structural disturbances, additional $R(R-1)/2$ restrictions are needed. Since $\boldsymbol{\eta}_t = \mathbf{K}^{-1}\boldsymbol{\xi}_t$, imposing exclusion restrictions on the contemporaneous impact matrix amounts to imposing zero restrictions on the elements of $\mathbf{K}^{-1}$, for which a lower-triangular structure is assumed. Operationally, $\mathbf{K}^{-1}$ (with the restrictions necessary for exact identification imposed) is estimated by the Choleski decomposition of the factor innovation variance-covariance matrix $\mathbf{\Sigma}_\eta$, i.e., $\hat{\mathbf{K}}^{-1} = chol(\hat{\mathbf{\Sigma}}_\eta)$. Forecast error variance and historical decompositions are then derived using standard formulas. Following the thick modelling strategy of Granger and Jeon (2004), median estimates of the parameters of interest, impulse responses, forecast error variance and historical decompositions, as well as their confidence intervals, are obtained by means of simulation.

2.2 Specification of the global model

In the current application, the global-economy model (1) counts 33 endogenous variables, collected in vector $\mathbf{F}_t = \left[\mathbf{F}'_{1,t}\ \mathbf{F}'_{2,t}\ \mathbf{O}'_t\right]'$ over the period 1986:1 through 2010:3. $\mathbf{F}_{1,t}$ contains 12 unobserved global factors estimated by means of the local-economies block (2) using a own-country diagonal dynamic structure of the first order, as suggested by the BIC information criterion. The local block counts over 800 equations and contains macroeconomic and financial data for 50 countries.[2] Each unobserved global macro-financial factor is estimated as the first Principal Component (PC) extracted from a subset of cross-country, homogeneous variables in the local-economies model. In particular, global macroeconomic and financial conditions are captured by a *real activity growth* factor (Y) extracted from real GDP, private consumption and investment growth series; an *employment growth* factor (E) from the civilian employment growth series; an *unemployment rate change* factor (U) from changes in the unemployment rate series; a *real wage growth* factor (W) from the real wage growth variables; a *fiscal policy stance* factor (G), capturing excess public consumption growth, from changes in the ratio of public expenditures to GDP; a global *US$ exchange rate return* index (X) obtained from the bilateral exchange rates returns against the US$; a *core inflation* (nominal) factor (N) extracted from changes in the series for inflation, nominal money growth rates, short and long-term interest rates; a global *excess liquidity growth* index (L) from changes in the M3 (or M2) to GDP ratio and the private loans to GDP ratio series; a *real stock market return* factor (F) from the real stock market price index return series; a *real housing return* factor (H) from the real housing price index return series; a *real short term rate* factor (SR) obtained from changes in real short-term interest rates; and a *term spread* factor (TS) extracted from changes in the term spread series.

$\mathbf{F}_{2,t}$ contains 11 observed factors, added to capture several sources of financial disturbances and fundamental imbalances with potential international spillover effects. Nine factors are US variables, namely: changes of the *financial fragility* index (FRA) used by Bagliano and Morana (2012) and summarizing overall credit conditions, with reference to the corporate, interbank and mortgage markets; the Fama and French (1993) *size* and *value* factors (SMB, HML); the Carhart (1997) *momentum* factor (MOM); the *stock market liquidity* factor (PSL) proposed by Pastor and Stambaugh (2003); the *leverage* factor (LEV) constructed by Adrian, Etula and Muir (2014); a *risk aversion* index (FV) obtained from a measure of stock return volatility; changes in the ratio of *US fiscal deficit to GDP* (Fd) and in the ratio of *US trade deficit to GDP* (Td). The remaining two observed factors are the returns on the *real gold price* (GD) and on the *IMF non-energy commodities price index* (M). Finally, $\mathbf{O}_t$ contains 10 observed variables concerning global oil market demand and supply conditions, included in order to capture potential effects of oil market developments on global macroeconomic and financial quantities.[3]

[2] The countries are: 31 advanced economies (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States), 5 advanced emerging economies (Brazil, Hungary, Mexico, Poland, South Africa), and 14 secondary emerging economies (Argentina, Chile, China, Colombia, India, Indonesia, Malaysia, Morocco, Pakistan, Peru, Philippines, Russia, Thailand, Turkey). Main data sources are: IMF *International Financial Statistics,* FRED2 (Federal Reserve Bank of St. Louis); OECD and BIS (unofficial) house price data sets, and International Energy Agency (IEA-OECD) datasets.

[3] The included variables capture various dimensions of oil market dynamics: (i) global oil supply

Estimation of the global-economy model (1) is then performed by means of the PC-VAR method and involves the first 12 principal components of $\mathbf{F}_t$, jointly accounting for 80% of total variance, and three lags, as suggested by Monte Carlo results (Morana, 2012) and specification tests. Hence, 36 parameters are estimated for each of the 33 equations in the model.[4]

2.3 Identification of structural disturbances

Structural shocks are identified by means of a Choleski decomposition of the factor innovation variance-covariance matrix. The chosen recursive structure of the global factors in $\mathbf{F}_t$ is motivated by plausible assumptions on their relative speed of adjustment to shocks and theoretical reasoning. Implementation of the recursive identification strategy yields, for each equation in the global-economy model, a series of orthogonalized innovations purged from correlation with all variables placed before in the ordering and interpreted as underlying structural economic disturbances. The selected ordering of the fators in $\mathbf{F}_t$ is as reported below:

• *oil supply conditions*: reserves (R), oil production changes (Pp; Pm), refineries margins (RM);

• *macroeconomic conditions*: employment (E), unemployment (U), real activity (Y), fiscal policy stance (G), US fiscal and trade deficits (Fd, Td), core inflation (N), real wages (W);

• *flow oil demand conditions*: oil consumption (C);

• *monetary policy stance* and *interest rates*: excess liquidity (L), real short term rate (SR) and term spread (TS);

• *financial conditions I*: real housing prices (H), US$ exchange rate index (X), stock return volatility (FV), Fama-French size and value factors (SMB, HML), Carhart momentum factor (MOM), Pastor-Stambaugh stock market liquidity factor (PSL), Adrian-Etula-Muir leverage factor (LEV);

• *oil futures and spot market conditions*: Working-T index (WT), futures market basis (FB), oil inventories (INV), oil price (OP), oil price volatility (OV);

• *financial conditions II*: non-energy commodities price index return (M), stock market return (F), gold price return (GD), US financial fragility index (FRA).

Structural innovations are then grouped into two broad classes, "supply-side" and "demand-side and financial" disturbances, each including shocks coming from various sources. The main identified sources of supply-side shocks are oil and (non-energy) commodities markets (OIL), the labor market (LM) and productivity dynamics (PR). The identified disturbances coming from the demand-side and the financial sector of the economy concern an aggregate demand (AD) shock to the goods market, a saving rate (SAV) disturbance, a monetary policy stance (MP) shock, a US terms of trade (TT) shock, a portfolio allocation (PA) disturbance and some risk factor (RF) disturbances.

Tables 1 lists the various categories of shocks and the corresponding global factor equations from which orthogonalized innovations are obtained. As a general caveat, it

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conditions: *world oil reserves growth* (R), positive (Pp) and negative (Pm) *net world oil production changes*, and *OECD oil refineries margins growth* (RM); (ii) flow oil demand conditions: *world oil consumption growth* (C); and (iii) oil futures and spot market conditions: *OECD oil inventories growth* (INV), *real WTI oil price return* (OP), changes in *nominal WTI oil price volatility* (OV), the 12-month *futures basis* (FB), and the rate of change of the oil futures market *"T" speculation index* (WT).

[4]Given the sample size available, the estimation of an unrestricted VAR(3) model would have been unfeasible, counting 99 parameters for each equation.

should be recalled that the interpretation of the results of the forecast error variance and historical decompositions and the impulse response analysis in terms of structural economic and financial shocks may be sensitive to the chosen ordering of the variables. Since the structural model implied by the recursive identification scheme is exactly identified, the assumed contemporaneous restrictions cannot be tested. However, the reliability of the identifying assumptions is suggested by the results of a joint weak exogeneity test, which, though not providing validation of the set of restrictions at the system level, strongly supports the implied pairwise recursive structure.[5]

3 Evolving macro-financial dynamics since the mid-1980s

On the basis of the adopted identification scheme, the transition from the Great Moderation to the Great Recession is assessed by looking at historical decompositions of several variables in the global-economy model, that allow to disentangle the contributions of the various structural disturbances to the dynamics of global macro-financial factors on a quarter by quarter basis. Cumulative historical decompositions (net of base predictions) are depicted in Figures 1-3 for selected global variables. In all plots, dashed lines portray the behavior of a global factor over the whole 1986-2010 sample, and solid lines show the contribution of each structural shock of interest to global factor dynamics. Shaded areas in the figures correspond to four global recessionary episodes that we identify with protracted declines in the real activity global factor (Y, see Figure 1): (i) a recession in the early 1990s (from 1990:2 to 1993:2), following the collapse of the high-yield market (1989-1990) and the peak of the Savings & Loans crisis (1986-1989) in the US, the burst of the real estate bubble in Japan (1989-1991), the economic crisis in India (1991), the banking crisis in Finland and Sweden (1991-1993), and the first Persian Gulf War and the ensuing oil price shock (1990); (ii) a relatively short downturn in the late 1990s (1997:3-1998:3), associated with the financial crisis in East-Asia and Russia (1997-1998); (iii) a recessionary period in the early 2000s (2000:4-2003:2), following the burst of the dot-com financial bubble, accounting scandals (2000) and the September 11th terrorist attack (2001) in the US, the economic crisis in Argentina (1999-2002) and the second Persian Gulf War (started in 2003) and the related oil price shock; and finally (iv) the Great Recession (2008:2-2009:3) ignited by the US subprime financial crisis (2007-2009) and the third oil price shock (2007-2008). Tables 2 and 3 focus on those four episodes, presenting the contributions of various categories of structural disturbances to the overall change of selected global variables in the detected recessionary periods, as well as in the four quarters following recessions.

3.1 Real activity and employment

As shown in Figures 1 and 2, the dynamics of global real activity (Y) and employment (E) are shaped by shocks from all (supply-side, demand-side and financial) sources over the 1986-2010 sample as a whole. Yet, two sub-periods can be broadly distinguished

[5] The joint weak exogeneity test is based on the Bonferroni bounds principle, and is computed using the 528 possible bivariate tests implied by the recursive structure involving the 33 variables in the global-economy model. The test does not reject, even at the 20% significance level, the weak exogeneity null hypothesis (the value of the test is 0.005 to be compared with a 20% critical value equal to 0.0004).

with somewhat different macro-financial features: the first decade of the sample up to the mid-1990s and the latter part of the period starting thereof.

Wider fluctuations in the contribution of several structural disturbances to global output are detected from the mid-1990s onwards, particularly for productivity (PR), goods' aggregate demand (AD), global saving rate (SAV) shocks (Figure 1, first row) and, to a smaller extent, for shocks to portfolio allocation (PA) and to the US terms of trade (TT) (Figure 1, second row). On the other hand, a similar contribution to global output dynamics across subsamples is provided by other structural disturbances, such as those originated in the labor market (LM, first row) and the risk factor shocks (RF, second row). Due to sign compensations, the increased variability of some important sources of shocks did not affect the actual volatility of global output until the recent Great Recession episode and went unnoticed in the literature. In fact, many empirical studies relate the widening in real activity fluctuations to the 2008-2009 recession only (Clark, 2009; Canarella et al., 2010; Chen, 2011; Stock and Watson, 2012; Charles et al., 2014; Gadea et al., 2014), whereas our findings point to an increase in volatility of various important sources of disturbances preceding the onset of the Great Recession. Moreover, at a more general level, they also raise the issue of the potential contribution of financial innovation and liberalization to macroeconomic instability, as the widening in real activity fluctuations associated with productivity, portfolio allocation, and aggregate demand disturbances might be related to changes in the financial structure of the global economy.[6] They also question somewhat the "good luck" explanation of the Great Moderation, due to the changing contribution of productivity shocks to output volatility, as well as oil market shocks contributing more to trend than cyclical output dynamics. Global employment fluctuations show a broadly similar, though less clear-cut, pattern across sub-periods (Figure 2), with saving rate shocks and (to a lesser extent) productivity disturbances displaying a larger variability since the mid-1990s, in contrast to risk factor and labor market shocks.

3.1.1 Global recessionary episodes

Focusing on global recessionary periods, several additional features of real activity and employment fluctuations can be noted in Panel A and B of Table 2. Overall, demand-side and financial shocks account for the bulk of output declines during all recessions from the mid-1980s. In the 2000-2003 recession, they determine a drop of -5.3% out of an overall decrease in output of -6.9% (last column of Panel A), and explain -9.3% of the -15.4% output decline during the 2008-2009 Great Recession. A similar observation applies to global employment, for which demand-side and financial shocks account for -14% out of an overall -18% decline in the early-1990s contraction and -7.3% out of -10.6% in the Great Recession period. However, supply-side disturbances become more relevant for global output fluctuations since the late-1990s, explaining -1.5% and -6% of real activity drops in the early 2000s and Great Recession periods, respectively. This result is mostly attributable to a different role played by productivity shocks across recessions, partially dampening the contractionary effects of demand-side disturbances in the two recessions of the 1990s and sizably contributing to deepen the output drop in the 2000s episodes. Oil

[6] Gorton and Ordonez (2014) present a model where a credit cycle is initially sustained by a productivity growth revival, subsequently dampened as productivity advances fade away. Indeed, the timing of the 1996-2004 US productivity growth revival (2.9% yearly on average; Gordon, 2012) is consistent with a link between productivity dynamics and the ensuing financial crisis.

market shocks provided a relatively limited contribution to all recessions (e.g. explaining only -0.5% of the -15% drop in global output in 2008-2009), but imparted a persistent downward trend in real activity from the mid-1990s (Figure 1, first row).

The identification strategy adopted here allows also to uncover similarities between the recent Great Recession and some of the previous contractionary episodes in terms of their main structural driving forces. In both the 2008-2009 and the early 1990s recessions, shocks originated in the financial sector of the economy played a remarkable role in determining output and employment drops. Portfolio allocation shocks (PA) sizably contributed to both recessions, accounting for around -2%/-3% of actual declines in output and employment, whereas disturbances related to the monetary policy stance (MP) had a larger impact in the 1990-1993 contraction, when they can explain some -3.8% and -4.2% drops in output and employment, respectively. Conversely, innovations to risk factors (RF), signalling changes in investors' expectations and risk attitudes, gave a more substantial contribution in the Great Recession, accounting for -2% of the output and -2.5% of the employment fall. Within the latter category of disturbances, size (SZ) and leverage (LV) shocks were the most relevant determinants. Overall, those results can be understood by noting that the early-1990s and the 2008-2009 recessions share a broadly similar boom-bust credit cycle origin, rooted in the Savings & Loans and in the subprime mortgage market crisis respectively, as well as deep contractions in asset prices (see below). They are also consistent with Stock and Watson (2012), pointing to a more sizable contribution to the depth of the Great Recession by financial disturbances rather than oil market shocks. Our global perspective, however, provides evidence of the relevance of disturbances from a broader range of sources, including productivity, the labor market, portfolio allocation choices, and risk factor measures.

3.1.2 Global jobless recoveries

Table 2 also shows the contribution of various structural shocks to global output and employment fluctuations in the first four quarters of the recoveries following each recession. Several features are worth mentioning. Concerning real activity (Panel A), all recoveries, with the only partial exception of the 1997-1998 episode, are mainly driven by supply-side forces, with demand-side and financial shocks having an offsetting effect in the two most recent recessions, providing a -0.3%/-0.4% contribution to relatively mild output expansions of around 0.5%. Global employment (Panel B) displays reductions not only in the year following the Great Recession (-1.5%), but also during the recoveries occurred after the early-1990s and the early-2000s contractions (amounting to -1.4% and -0.5%, respectively).[7] The latter results are notable since they document that the "jobless recovery" phenomenon, so far detected for the US economy only (Groshen and Potter, 2003; Camacho et al., 2011; Kolesnikova and Liu, 2011), has an important global dimension, and extends back to (at least) the early 1990s. According to our structural historical decomposition, both supply-side and demand-side/financial driving forces account for the jobless recovery episodes, the latter disturbances showing the larger contribution. In the aftermath of the Great Recession, portfolio allocation shocks and, within the risk factor category, innovations to the leverage factor were the most relevant financial structural

[7] The exception to this pattern is the recovery after the 1997-1998 recession, during which employment rose by 3.8%. However, from the perspective of global employment, the whole late-1990s episode displays peculiar features, since even during the recession period employment actually rose by 4.6% in the face of a contraction of global output of 2.8%.

determinants, whereas among supply-side influences, productivity disturbances (-0.4%) and labor market shocks (-0.7%), sizably contributed to the jobless recovery. Relative to Stock and Watson (2012), who argue that the jobless recovery from the Great Recession in the US was caused mostly by a slowing down in trend labor force growth, our results, based on a finer identification of structural shocks, describe a more composite picture, pointing also to productivity and financial shocks (-1.3%) as significant determinants of the jobless recovery phenomenon.

3.2 Global imbalances, liquidity and financial markets

We now turn to a discussion of the main determinants of fluctuations in additional important US and global macroeconomic and financial variables and to the analysis of the developments leading to the onset of the recent financial crisis and Great Recession. Our results point to tight relationships between the buildup of global imbalances, the global monetary policy stance and liquidity conditions, and fluctuations in risk factors and asset prices. The overall picture is broadly consistent with the explanation of the deep origins and main mechanisms underlying the recent crisis and ensuing recession provided by Caballero et al. (2008a, 2008b), that we adopt as an organizing framework to discuss our evidence. According to this account, three phases can be distinguished in macro-financial dynamics since the late 1990s. The pre-crisis period is characterized by the building up of global external imbalances and a "savings glut" phenomenon, with a global excess demand for safe assets, directing capital flows from emerging markets to the US. This reallocation of capital flows contributed to maintain low US and world real interest rates, reinforcing the expansionary effects of the Federal Reserve's monetary policy, and fuelled a boom in the US housing and related credit markets, putting pressure on the securitization mechanism, that eventually broke down in early 2007 in the face of falling house prices. The first stage of the crisis, from mid-2007 through mid-2008, is then marked by the freezing of the entire securitization industry, vanishing confidence and pervasive flights to quality, creating even more pressure on the provision of safe financial assets. The ensuing deterioration of balance sheets forced financial institutions into deleveraging and fire sales of assets, transmitting the negative house price shock to the US and world stock markets, that experienced a sharp contraction through early 2009. At the same time, driven by fast growth in emerging economies and portfolio allocation effects, oil as well as other commodity prices rose considerably, even accelerating their pace from mid-2007 to mid-2008. Finally, the second phase of the crisis, from mid-2008 to mid-2009, is characterized by the real effects of the financial turmoil, the bursting of the oil and non-energy commodity price bubbles, and the ensuing decline in global real activity. A sequence of asset price misalignments, migrating over time from bond to housing, credit, stock and oil and non-energy commodity markets, is then a distinguishing feature of the 2000s. In what follows, we will focus first on global imbalances and monetary policy conditions, and then on the dynamics of asset prices.

3.2.1 The "savings glut", the Great Deviation and the Great Leveraging

Several results broadly consistent with the proposed account of the main macro-financial developments leading to the recent financial and economic crisis are delivered by the historical decomposition of key variables, namely the US trade deficit to GDP ratio (Td), global excess liquidity (L), the leverage factor (LEV), and the US exchange rate return index (X). The pre-crisis period is indeed characterized by the building up of global external imbalances, as the deterioration in the US current account deficit (shown as the dashed line in Figure 3, first row), while ongoing since 1991, rapidly worsened in 1998 in the aftermath of the East Asia financial crisis, and again in 2000 following the burst of the dot-com bubble. Consistent with the "savings glut" hypothesis and the pre-crisis scenario envisaged by Caballero et al. (2008b), the worsening in the US trade balance since the late-1990s is largely explained by global non-US saving rate shocks (GTI), as well as oil market disturbances (OIL), due to the potential impact of oil price dynamics on the US trade balance. Yet, while OIL negatively affected trade balance conditions over the whole time span considered, since 2006 saving rate disturbances actually contributed to its improvement, reflecting a shift away from US housing market-related securities by international investors. Moreover, both innovations in the global monetary policy stance (MP) and risk factor disturbances (RF) deepened the US trade imbalance since the early 2000s, while portfolio allocation shifts (PA) and terms of trade shocks (TT) had a partially offsetting effect. The worsening of Td determined by monetary policy shocks accords with the basic mechanism of the international risk-taking channel of monetary policy (Borio and Zhu, 2012; Bruno and Shin, 2015): over-expansionary US monetary policy caused a contraction in perceived risk and funding costs, fuelling asset prices and the net worth of financial institutions, as well as their leverage and risk-taking attitude, resulting in capital inflows into the US and depreciation of the US$.

The increase in global excess liquidity (L) occurred since the mid-1990s (Figure 3, second row, dashed line) is accounted for by shocks originated in the oil and labor markets (LM), reflecting the countercyclical use of monetary policy in OECD countries since the 1980s (Sutherland, 2010) and in some emerging economies following the subprime financial crisis (McGettigan et al., 2013), while shocks to risk factors (RF), productivity (PR) and goods' aggregate demand (AD, shown together in the second row, last plot) have moderated global excess liquidity creation. Feedback effects from asset prices to excess liquidity generation are detected through the contributions of portfolio allocation shocks (mostly due to housing and stock preferences) to global liquidity dynamics, as well as the relevance of leverage-credit spirals unrelated to fundamentals through the contribution of the (own) leverage shock to financial leverage fluctuations. Moreover, the existence of a linkage between global excess demand for safe assets and excess risk taking by US financial institutions, and the relevance of a risk-taking channel of monetary policy, are supported by the sizable contribution of global saving rate and monetary policy disturbances to leverage fluctuations. Overall, the above features are consistent with the Great Deviation and Great Leveraging hypotheses, pointing to an empirically relevant relationship between global excess liquidity creation, excessive risk taking and boom-bust asset price cycles over the time span investigated.

Additional supporting evidence is provided by behavior of Td and L during and after recessionary episodes, shown in Table 3. The "savings glut" hypothesis can explain the worsening of the US trade deficit (Panel A) in the late 1990s and early 2000s recessions (by 0.9% and 0.6% respectively), with a considerable contribution of global savings shocks (SAV) during the former episode (1%). Such disturbances also played a significant role in the Great Recession, contributing by -0.7% to the -2.3% improvement in the US trade deficit, along with other financial shocks, mainly related to the global monetary policy stance and portfolio allocation shifts. Excess liquidity (L, Panel B) remarkably increased during the Great Recession (10.6%), largely driven by demand-side (6.8%), and especially global monetary policy disturbances (MP, 2.3%), due to widespread generous countercyclical policies. Similarly, L increased, though by smaller amounts, in the late 1990s (3.8%) and early 2000s (0.8%) recessions, but in those episodes mostly driven by supply-side shocks. Finally, the deep contraction in the financial leverage factor LEV during the Great Recession (-60.4%) is a clear-cut distinguishing feature from previous recessionary episodes, mostly accounted for by financial shocks, particularly risk factor and uncertainty disturbances.

3.2.2 Asset price dynamics

Shocks to global saving rates are also responsible for the downward shift in global real short-term rates from the mid-1990s, as predicted by the "savings glut" hypothesis, while global monetary policy disturbances contributed to maintain a low interest rate environment. From the early 2000s, also risk factor shocks, related to investors' misperceptions of actual macro-financial risk, contributed importantly to the short-rate downward path. According to the "migrating bubble" narrative, the excess demand for safe assets, directed to the US bond market since the late 1990s, partially shifted over time to the housing and stock markets and eventually moved to commodity markets. The historical decomposition of global real house (H) and stock price (F) factors portrayed in Figure 3 (third and last rows) broadly accords with this reading. The house price cycle started in the late 1990s is mostly driven by disturbances to portfolio allocation preferences (PA), especially housing preference shocks (PH), consistent with shifts in investors' preferences in favor of the housing market and with a growing fad component in house prices as well. Some of the main driving forces of movements in short rates also sizably affected house prices over both the boom and bust cyclical phases. Shocks to global monetary policy contributed to the surge in H up to 2003, as well as to its stabilization until 2008, and decline thereafter. Disturbances to global savings rates and risk factors drove house prices upward since 2003 and then downward since 2007. Moreover, consistent with shifts in investors' preferences in favor of stocks taking place as profit opportunities in the housing market were fading away, PA sizably accounts for the rise in stock prices over the 2003-2007 period.

In addition to portfolio allocation shifts, other factors played a role in shaping the stock price cycle. In accordance with the "savings glut" hypothesis and the evidence for house prices, global saving rate shocks drove F upward since the early 2000s, and then downward during the Great Recession; on the other hand, productivity disturbances (PR) imparted a downward trend to stock prices over the entire time span. The latter effect, occurred in a period of growing productivity, is broadly consistent with a Shumpeterian view of innovation as a process of creative destruction, as suggested by Kogan et al. (2012), and with the outcome of efficiency gains in production.

Focusing on the Great Recession episode, the contraction in housing prices started in early 2007 led to the break down of the securitization industry. The deterioration of US financial institutions' balance sheets then forced them into deleveraging and sharp asset sales, transmitting the negative house price shock first to stock markets, and then to commodity markets. A sizable contraction in stock prices occurred from 2007:4 to 2009:1, while non-energy commodity prices declined only over the period 2008:3-2009:1. As the financial crisis turned into an economic crisis, the downturn in global real activity (2008:1-2009:2) drove down the demand for oil and commodities, amplifying the negative financial shock and eventually bursting the oil and commodity price bubbles. Table 3 confirms that the decline in asset prices during the Great Recession was generalized, yet particularly sizable for house (-12.7%, Panel D) and commodity prices (-27.6%, Panel E), and driven by a wide array of macroeconomic (supply-side and demand-side) and financial shocks. Some similarities between the Great Recession and the early 1990s episode can be noted, consistent with their analogous boom-bust credit cycle origin, while asset prices behavior during the late 1990s and early 2000s episodes are more heterogeneous. The effects of shocks during the Great Recession were however larger than in the early 1990s contraction in the case of house prices (-7.6% in 1990-1993) and commodity prices (-16%), whereas the overall drop in stock prices was more pronounced in the early 1990s recession. Among individual sources of disturbances for asset prices, a significant contribution of global monetary policy and portfolio allocation disturbances to house and commodity price fluctuations is observed in all recessionary episodes.

4 The end of the Great Moderation?

An important conclusion that can be drawn from our study is that the Great Moderation and the Great Recession were not two unrelated events. In this section we provide further evidence against the “end of the Great Moderation” view by means of an out-of-sample forecasting exercise. In particular, we show that the Great Recession would have been predictable along the timing, though not the size dimension by conditioning on information already available over the Great Moderation period. This finding is then consistent with the view that the same macroeconomic mechanisms prevailing during the Great Moderation also persisted through the Great Recession, yet with much larger shocks hitting the macroeconomy.

Our forecasting exercise is implemented by recursive estimation of the econometric model in (1)-(2) and the associated structural innovations. The latter are then employed in various forecasting models, in order to assess the incremental gain in predicting power yielded by their inclusion, relative to past information, on real activity measures for the global economy, the US and the Euro area.

Indeed, the results presented in the previous section point to a remarkable contribution of shocks to a large set of risk factors in shaping fluctuations of global macroeconomic and financial variables over the whole sample. Due to our identification strategy, those disturbances are all orthogonal to past and current changes in global macroeconomic factors, oil supply, the global monetary policy stance and interest rate movements. Therefore, they are able to capture changes in investors’ expectations and risk attitudes in a more complete fashion and are also likely to show “early warning” or “forward looking” properties for mounting macro-financial imbalances.

Forecasting models are specified by means of a general-to-specific econometric approach and estimated over the sample 1986:1-2008:1. Out of sample 1-step (quarter)-ahead predictions are then generated over the period 2008:2 through 2010:3 *without* updating the model’s parameter estimates, which makes our forecasting exercise more challenging. The analysis is carried out in two steps, focusing first on the predictability of the *timing* of the real downturn and the following recovery, and then on the *magnitude* of real activity fluctuations. In the first step, the variable to be predicted is the probability of a recession to occur, simply measured by a dummy variable taking an unitary value during recessions and zero elsewhere. For robustness, predictability is assessed with reference not only to the global output factor (Y), but also to the US and the Euro area output growth rates.[8] Results are presented in Table 4 and Figure 4 (left column). The Table shows, for each real activity measure (Y, $GDPUS$ and $GDPEA$), a benchmark autoregressive model (OD) and the best performing dynamic models augmented with lagged structural shocks to various risk factors ($OD-X$, $OD-X1$ and $OD-X2$) estimated on 1986:4-2008:1. The 1-quarter-ahead out-of-sample predictions are then generated over the period 2008:2-2010:3 and the forecasting performance of the models is assessed. The gain in forecasting power obtained by the augmented models is remarkable irrespective of the metric employed ($RMSE$, $MAFE$ and TIC), showing reductions ranging from 50% to 90% of the corresponding forecast error measure for the benchmark autoregressive specification. Indeed, as shown in Figure 4**,** the improvement in forecasting performance yielded by risk factor innovations stems from their ability to accurately signal the beginning (2008:2 for global output and Euro area GDP growth, and 2008:3 for US GDP growth) and the end of the economic downturn (especially 2009:4 for global output), as well as the further decline in global real activity occurred at the end of the sample in 2010:3. In contrast, standard dynamic models fail to accurately predict both events.

In the second step we specify forecasting models augmented with structural risk factor innovations directly for the actual rates of change of the global output factor and US and Euro area GDP. This allows to assess the predictability of the magnitude of real activity fluctuations over the 2008:2-2010:3 period, and of the depth of the Great Recession in particular. As shown in Table 5 and Figure 4 (right column), a 30% to 60% improvement in forecasting accuracy, depending on metric and target variable, is obtained by means of (asymmetric) augmented models, conditioned on censored (according to sign) risk factor innovations. In particular, a 40% to 60% contraction in $RMSFE$, $MAFE$ and TIC figures is obtained for US and Euro area GDP growth models, while for global real activity growth the improvement is about 30%.

Overall, two main conclusions can be drawn. First, the timing of economic downturn and recovery following the financial crisis cannot be accurately predicted by standard dynamic models, conditioned on own relevant information only. Predictions are greatly improved when models are augmented with information contained in past risk factor structural innovations. Second, the magnitude of output fluctuations and the depth of the Great Recession cannot be accurately predicted even by the factor innovations-augmented autoregressive models. Both findings are consistent with the in-sample results, showing that the Great Recession was peculiar for its depth, rather than for its mechanics, and therefore predictable along the timing, but not the size dimension. We interpret the latter results as evidence against the "end of the Great Moderation" view.

5 Conclusions

This paper contributes to the literature on the sizable dampening of global macroeconomic fluctuations occurred since the mid-1980s, dubbed the Great Moderation, yielding new insights on its structural features, as well as on the process leading to the Great Recession. Grounded on the view that those phenomena share an important global dimension and are tightly related, we employ a large-scale, global-economy econometric model to identify structural macroeconomic and financial global factors as driving forces

[8] We consider the US economy to be in recession in the 2008:3-2009:2 period. In 2008:2 US output actually increased by an annual rate of 2% over the previous quarter.

of observed fluctuations. A second distinctive feature of our approach is the introduction of a comprehensive array of risk factor indicators in the estimated model. Structural innovations in the latter variables are interpreted as complementary signals of revisions in investors' expectations and risk attitudes, with a potential role as early warning indicators of upcoming real activity downturns.

Our results show that observed macro-financial dynamics over the 1986-2010 period were the outcome of a composite set of disturbances coming from all (demand-side, supply-side and financial) sources, and cannot be associated only with subdued productivity and oil shocks and improved monetary policy management. Moreover, macroeconomic fluctuations do not show the same features over the whole Great Moderation, as heterogeneity in terms of amplitude and determinants are detected, in contrast to the existing literature, well before the onset of the Great Recession. In fact, much wider real fluctuations are detected from the mid-1990s, determined by productivity, goods' aggregate demand and global saving rate shocks, as well as portfolio allocation and US terms of trade disturbances. In this perspective, the late-2000s financial crisis and economic contraction were the eventual outcome of an already ongoing process, determined by both macroeconomic and financial disturbances, broadly consistent with the account provided by Caballero et al. (2008b).

Our findings also point to the "savings glut" view of the buildup of global imbalances (Bernanke, 2005), the "Great Deviation" hypothesis on the global monetary policy stance (Taylor, 2013), and the "Great Leveraging" view about financial intermediaries' risk-taking behavior (Taylor, 2012) as complementary explanations of the transition dynamics leading to the Great Recession. Misalignments in asset prices also appear to have migrated from bond to housing and credit markets since the early 2000s, and then to stock and commodity markets following the contraction in house prices since 2007.

Peculiar to the Great Recession was the much larger magnitude of shocks rather than their source, and the size of the global real activity contraction, which was (on average per quarter) four times larger than during the previous three episodes. Demand-side and financial shocks account for about two-thirds of the -15% drop in global output over the 2008:2-2009:3 period, with disturbances to portfolio allocation and innovations to risk factors playing a substantial role. The overall evidence is then consistent with the narrative pointing to the real effects of the subprime financial crisis working mainly through aggregate demand shortages, due to a credit crunch, an increased level of uncertainty and larger precautionary savings.

Our results also points to similarities between recoveries following recessionary episodes. In particular, we find that the "jobless recovery" phenomenon is not limited to the aftermath of the Great Recession but extends back to at least the early-1990s recession and displays an important global dimension, previously unnoticed in the literature. In this respect, our findings cast some doubts on a purely structural explanation of this phenomenon. In fact, demand-side and financial shocks (particularly portfolio allocation, terms of trade and risk factor), in addition to accounting for as much as cyclical employment variance than supply-side (productivity and labor market) disturbances over the whole sample, had an even larger slowing down effect in the year following the end of the Great Recession.

Finally, by means of an out-of-sample forecasting exercise we provide evidence against the "end of the Great Moderation" view. In fact, we find that dynamic models augmented with lagged risk factor innovations could have accurately predicted the timing of the cyclical downturn and upturn in the global economy output factor and in the US and

Euro area GDP growth. Yet, the magnitude of output fluctuations and the depth of the Great Recession cannot be accurately predicted even by the factor innovations-augmented autoregressive models. Both findings are consistent with the in-sample results, showing that the Great Recession was peculiar for its depth, due to the size of the shocks, but featured the same macroeconomic mechanisms at work also during the Great Moderation period.

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Table 1: Identified structural shocks

Supply-side disturbances		
Category of shocks (collective label)	**Structural interpretation**	**Corresponding global factor(s)**
Oil market (OIL)	Oil supply shocks (OS) Other oil market shocks (OO)	R, Pp, Pm, RM, INV C, WT, FB, OP, OV
Labor market (LM)	Labor supply (LS) Labor demand (LD) Unit labor costs (core inflation, CI)	E U N
Productivity	Productivity shock (PR)	W
Commodities market	Non-energy commodity price shock (PM)	M
Demand-side and financial disturbances		
Category of shocks (collective label)	**Structural interpretation**	**Corresponding global factor(s)**
Goods market	Aggregate demand (AD)	Y
Saving rates (SAV)	Global and US saving rate shocks (GFI, GDI, GTI)	G, Fd, Td
Monetary policy and interest rates (MP)	Excess liquidity, short-term rate and term structure slope shocks (EL, TL, TS)	L, SR, TS
Foreign exchange market	US$ exchange rate shock (terms of trade, TT)	X
Portfolio allocation (PA)	Preference shocks to housing (PH), stocks (PF), gold (PG)	H, F, GD
Risk factors (RF)	Size (SZ), value (VL), momentum (MM), stock market liquidity (SL), leverage (LV), uncertainty (RAV), risk appetite (RAP) shocks	SMB, HML, MOM, PSL, LEV, FV, FRA

In the table details about the identified structural shocks (central column) and their originating reduced form equations of the global model (right hand side column) are reported.

Table 2: Historical Decomposition (selected periods): contribution of various categories of shocks to real activity and employment fluctuations.

Panel A: Real activity																			
	Supply-side shocks				**Demand-side and financial shocks**							**Risk factor shocks**							**Actual**
	Total	**OIL**	**PR**	**LM**	**Total**	**AD**	**SAV**	**MP**	**PA**	**TT**	**RF**	**RAV**	**SZ**	**VL**	**MM**	**SL**	**LV**	**RAP**	**Y**
90(2)-93(3)	**0.19**	**-0.40**	**1.86**	**-1.26**	**-8.64**	**0.64**	**-1.27**	**-3.83**	**-2.87**	**-0.51**	**-0.79**	**-0.80**	**0.41**	**-0.47**	**-0.14**	**-0.30**	**0.28**	**0.24**	**-8.45**
93(4)-94(3)	1.36	1.79	-0.40	-0.03	1.58	-0.73	1.70	-0.06	1.77	0.30	-1.41	-0.71	-0.11	0.27	-0.04	0.21	-0.93	-0.10	2.95
97(3)-98(3)	**0.96**	**-0.77**	**2.50**	**-0.77**	**-3.72**	**-6.00**	**2.34**	**-1.21**	**-0.85**	**0.99**	**1.01**	**0.01**	**0.67**	**0.07**	**-0.03**	**-0.14**	**0.55**	**-0.12**	**-2.76**
98(4)-99(3)	0.55	-0.06	1.18	-0.57	1.82	2.96	0.43	-1.42	0.23	0.99	-1.38	0.53	-1.07	-0.10	-0.06	-0.38	-0.28	-0.02	2.38
00(4)-03(2)	**-1.53**	**-0.49**	**-3.85**	**2.82**	**-5.35**	**-1.44**	**-3.82**	**0.43**	**1.65**	**0.24**	**-2.42**	**-0.51**	**-0.77**	**0.01**	**-0.44**	**0.03**	**-0.51**	**-0.22**	**-6.88**
03(3)-04(2)	0.87	0.07	-0.32	1.12	-0.36	0.15	-0.50	-0.25	0.33	0.21	-0.28	-0.05	-0.74	0.17	0.07	0.09	0.22	-0.04	0.51
08(2)-09(3)	**-6.04**	**-0.55**	**-3.51**	**-1.98**	**-9.32**	**-1.15**	**-0.33**	**-1.58**	**-2.71**	**-1.56**	**-1.99**	**-0.06**	**-0.71**	**0.43**	**0.02**	**-0.22**	**-1.24**	**-0.20**	**-15.36**
09(4)-10(3)	0.77	0.62	-0.04	0.19	-0.29	-0.29	0.66	0.05	-0.09	-0.19	-0.44	0.47	-0.56	-0.12	0.13	0.13	-0.40	-0.09	0.48
Panel B: Employment																			
	Supply-side shocks				**Demand-side and financial shocks**							**Risk factor shocks**							**Actual**
	Total	**OIL**	**PR**	**LM**	**Total**	**AD**	**SAV**	**MP**	**PA**	**TT**	**RF**	**RAV**	**SZ**	**VL**	**MM**	**SL**	**LV**	**RAP**	**E**
90(2)-93(3)	**-4.03**	**-3.23**	**-0.21**	**-0.60**	**-14.03**	**0.54**	**-3.52**	**-4.19**	**-2.27**	**-0.58**	**-4.01**	**-1.98**	**-1.03**	**-0.34**	**-0.18**	**-0.28**	**-0.44**	**0.25**	**-18.07**
93(4)-94(3)	-1.18	0.40	0.89	-2.48	-0.24	-0.35	1.16	-1.16	1.03	0.05	-0.98	-0.87	0.72	0.06	-0.26	-0.03	-0.58	-0.01	-1.42
97(3)-98(3)	**6.01**	**2.57**	**0.76**	**2.68**	**-1.36**	**-2.02**	**-0.26**	**-0.56**	**-1.76**	**0.93**	**2.32**	**0.52**	**0.38**	**0.11**	**0.20**	**0.15**	**1.24**	**-0.29**	**4.65**
98(4)-99(3)	3.13	1.92	0.40	0.82	0.67	-0.70	1.67	-1.24	-0.28	1.05	0.18	0.79	-0.14	0.20	-0.12	-0.52	0.02	-0.05	3.81
00(4)-03(2)	**5.84**	**3.89**	**-2.41**	**4.36**	**-6.68**	**-0.24**	**-3.36**	**-0.32**	**2.45**	**0.55**	**-5.74**	**-1.26**	**-0.88**	**-0.95**	**-0.48**	**0.24**	**-2.10**	**-0.31**	**-0.84**
03(3)-04(2)	0.79	0.26	-0.41	0.95	-1.28	-0.69	-0.52	0.02	0.01	0.26	-0.36	-0.18	-0.32	0.03	-0.09	0.20	0.04	-0.05	-0.48
08(2)-09(3)	**-3.30**	**0.46**	**-0.99**	**-2.77**	**-7.33**	**-0.64**	**-0.38**	**-0.98**	**-1.82**	**-1.06**	**-2.46**	**-1.09**	**0.09**	**0.31**	**0.09**	**-0.47**	**-1.16**	**-0.24**	**-10.63**
09(4)-10(3)	-0.32	0.85	-0.73	-0.44	-1.20	-0.03	0.12	0.05	-0.69	-0.33	-0.33	0.59	-0.32	-0.01	0.26	0.11	-0.82	-0.14	-1.52

In the table the contributions of various categories of structural disturbances to fluctuations in the global real activity factor Y (Panel A) and the global employment factor E (Panel B) are reported for the four global recessionary episodes occurred in the 1986-2010 period (in bold): the early 1990s recession (1990:2-1993:2); the late 1990s recession (1997:3-1998:3); the early 2000s recession (2000:4-2003:2), and the Great Recession (2008:2-2009:3). The contributions of structural shocks in the four quarters following recessions are also shown. For each period, the overall actual changes in Y and E are displayed in the last column "Actual". The categories of structural disturbances (see Notes to Table 1) are: oil market shocks (OIL), productivity shocks (PR), labor market shocks (LM); goods' aggregate demand shocks (AD); saving rate shocks (SAV); monetary policy stance shocks (MP); portfolio allocation shocks (PA); US terms of trade shocks (TT); overall risk factor shocks (RF). For the latter category of disturbances the Table shows also the specific contributions of uncertainty shocks (RAV), size factor shocks (SZ), value factor shocks (VL), momentum shocks (MM), stock market liquidity shocks (SL), leverage shocks (LV), and risk appetite shocks (RAP).

Table 3: Historical Decomposition (selected periods): contribution of various categories of shocks to fluctuations in the US trade deficit to GDP ratio, excess liquidity, and asset prices.

Panel A: US Trade deficit																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	Td
90(2)-93(3)	**-0.32**	**-0.09**	**-0.01**	**-0.21**	**-0.31**	**0.03**	**-0.28**	**0.06**	**-0.37**	**-0.12**	**0.37**	**0.00**	**0.30**	**-0.04**	**-0.01**	**-0.04**	**0.15**	**0.02**	**-0.63**
93(4)-94(3)	0.65	0.29	0.01	0.34	-0.34	-0.09	-0.35	0.08	0.24	0.08	-0.29	-0.06	-0.20	0.05	0.04	0.01	-0.13	-0.01	0.32
97(3)-98(3)	**-0.01**	**0.53**	**-0.01**	**-0.53**	**0.92**	**-0.62**	**0.99**	**-0.14**	**0.39**	**0.22**	**0.08**	**-0.08**	**0.11**	**0.00**	**-0.02**	**0.05**	**0.00**	**0.02**	**0.91**
98(4)-99(3)	-0.08	0.37	-0.31	-0.14	1.10	0.49	0.78	-0.17	0.22	0.18	-0.41	0.03	-0.30	0.06	-0.02	-0.08	-0.10	-0.01	1.02
00(4)-03(2)	**0.73**	**0.27**	**0.03**	**0.43**	**-0.17**	**-0.11**	**-0.23**	**0.33**	**-0.18**	**-0.01**	**0.03**	**0.06**	**-0.07**	**0.03**	**-0.08**	**-0.05**	**0.16**	**-0.01**	**0.56**
03(3)-04(2)	0.17	-0.06	-0.01	0.24	-0.75	-0.15	-0.44	-0.08	0.07	0.06	-0.21	-0.05	-0.26	0.00	0.00	0.08	0.02	0.00	-0.58
08(2)-09(3)	**-0.24**	**0.24**	**-0.17**	**-0.31**	**-2.05**	**-0.15**	**-0.72**	**-0.37**	**-0.36**	**-0.31**	**-0.14**	**0.15**	**-0.17**	**0.03**	**-0.03**	**0.03**	**-0.15**	**-0.01**	**-2.29**
09(4)-10(3)	0.56	0.20	0.22	0.14	0.23	0.03	0.03	0.07	0.10	-0.01	0.01	0.11	-0.08	-0.08	0.03	0.02	0.01	0.00	0.79
Panel B: Excess liquidity																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	L
90(2)-93(3)	**-4.96**	**-5.60**	**-1.10**	**1.74**	**-4.53**	**-0.41**	**-1.96**	**-0.29**	**0.87**	**0.23**	**-2.96**	**-0.44**	**-2.03**	**0.13**	**0.04**	**0.23**	**-0.73**	**-0.17**	**-9.49**
93(4)-94(3)	-4.55	-1.73	0.16	-2.98	-0.27	0.51	-0.36	-0.87	-0.46	-0.43	1.34	-0.06	1.38	0.01	-0.35	-0.17	0.32	0.20	-4.82
97(3)-98(3)	**3.51**	**0.64**	**-1.16**	**4.03**	**0.29**	**3.74**	**-3.37**	**1.65**	**-1.91**	**-0.77**	**0.94**	**0.56**	**-0.46**	**-0.03**	**0.33**	**0.01**	**0.58**	**-0.05**	**3.80**
98(4)-99(3)	2.30	1.10	-0.08	1.29	-1.54	-2.76	0.23	-0.55	-0.66	-0.52	2.71	-0.08	1.59	0.54	0.03	0.20	0.49	-0.07	0.76
00(4)-03(2)	**1.93**	**1.64**	**0.76**	**-0.47**	**-1.11**	**1.34**	**1.22**	**-3.51**	**1.57**	**0.34**	**-2.07**	**-0.56**	**0.18**	**-0.93**	**0.41**	**0.20**	**-1.49**	**0.12**	**0.82**
03(3)-04(2)	-0.59	-0.04	0.23	-0.78	-0.09	-0.06	0.06	-0.06	-0.39	0.02	0.33	-0.13	1.07	-0.20	-0.12	-0.05	-0.24	0.01	-0.68
08(2)-09(3)	**3.77**	**1.04**	**1.94**	**0.79**	**6.78**	**0.52**	**0.98**	**2.31**	**1.28**	**1.14**	**0.56**	**-1.19**	**1.13**	**0.05**	**0.31**	**-0.08**	**0.25**	**0.08**	**10.55**
09(4)-10(3)	-2.57	-0.19	-0.77	-1.61	-1.59	0.04	-0.24	0.04	-0.64	-0.16	-0.64	-0.37	0.39	-0.01	-0.14	-0.08	-0.42	-0.02	-4.16
Panel C: House prices																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	H
90(2)-93(3)	**3.17**	**2.95**	**1.67**	**-1.45**	**-10.79**	**-0.22**	**-2.48**	**-2.69**	**-2.51**	**-0.12**	**-2.77**	**-3.12**	**0.13**	**-0.26**	**-0.17**	**0.35**	**0.10**	**0.21**	**-7.62**
93(4)-94(3)	-0.80	-0.16	-0.81	0.16	1.85	0.43	2.16	-0.37	1.95	0.17	-2.49	-1.47	0.24	-0.12	-0.22	-0.01	-0.88	-0.03	1.04
97(3)-98(3)	**0.44**	**-2.05**	**2.05**	**0.44**	**-0.02**	**0.13**	**-0.51**	**-2.11**	**-0.96**	**1.00**	**2.42**	**1.07**	**0.55**	**0.13**	**0.29**	**-0.53**	**0.99**	**-0.08**	**0.42**
98(4)-99(3)	0.33	-0.62	1.71	-0.76	-0.23	-0.83	0.24	-0.63	-0.13	0.96	0.17	1.02	-0.60	-0.37	-0.21	0.38	-0.08	0.03	0.10
00(4)-03(2)	**1.72**	**2.41**	**-2.83**	**2.14**	**2.79**	**0.76**	**-2.53**	**3.15**	**3.91**	**0.83**	**-3.33**	**-1.41**	**-0.64**	**0.44**	**-0.28**	**-0.18**	**-1.18**	**-0.08**	**4.51**
03(3)-04(2)	0.02	-0.34	0.02	0.34	0.12	0.16	-0.31	0.30	-0.18	0.10	0.05	0.11	0.01	0.11	-0.01	-0.25	0.13	-0.06	0.15
08(2)-09(3)	**-2.83**	**0.81**	**-2.08**	**-1.57**	**-9.83**	**-0.38**	**-0.34**	**-2.08**	**-3.52**	**-0.62**	**-2.90**	**-0.80**	**-0.88**	**0.23**	**-0.02**	**0.07**	**-1.27**	**-0.24**	**-12.66**
09(4)-10(3)	-0.97	-0.09	-1.02	0.14	-3.26	-0.10	-0.76	-0.83	-0.84	-0.46	-0.27	0.99	-0.59	0.05	0.03	0.07	-0.68	-0.14	-4.24

Table 3 (ctd).

Panel D: Stock prices																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	F
90(2)-93(3)	**-5.49**	**-4.89**	**0.49**	**-1.09**	**-3.57**	**-0.24**	**-0.24**	**-2.19**	**-1.60**	**-0.22**	**0.92**	**0.29**	**0.76**	**0.08**	**-0.47**	**-0.19**	**0.30**	**0.13**	**-9.06**
93(4)-94(3)	0.15	0.45	-0.96	0.66	-1.27	0.04	0.28	0.74	-0.12	0.29	-2.50	-0.72	-0.56	0.01	0.29	0.08	-1.53	-0.08	-1.12
97(3)-98(3)	**1.38**	**2.50**	**-0.34**	**-0.78**	**-2.24**	**-2.24**	**1.30**	**-0.94**	**-0.02**	**0.16**	**-0.51**	**-0.01**	**0.74**	**0.00**	**-0.36**	**-0.60**	**-0.15**	**-0.12**	**-0.86**
98(4)-99(3)	-0.08	0.38	-0.73	0.28	2.87	1.88	-0.09	-0.30	0.01	0.05	1.33	1.11	-0.55	0.73	0.00	0.06	-0.12	0.10	2.80
00(4)-03(2)	**1.76**	**0.44**	**-0.35**	**1.68**	**-4.73**	**-0.23**	**-2.01**	**0.26**	**2.06**	**-0.97**	**-3.84**	**-0.45**	**-1.92**	**-0.88**	**-0.29**	**-0.10**	**0.09**	**-0.31**	**-2.97**
03(3)-04(2)	0.05	-0.08	-0.04	0.18	1.06	0.56	0.05	0.02	1.37	-0.17	-0.75	0.00	-0.79	-0.22	0.16	0.04	0.13	-0.07	1.11
08(2)-09(3)	**-0.60**	**0.85**	**-0.52**	**-0.93**	**-2.23**	**-0.43**	**-0.35**	**0.04**	**-1.61**	**0.14**	**-0.03**	**0.00**	**0.05**	**0.41**	**0.26**	**0.21**	**-0.95**	**-0.02**	**-2.83**
09(4)-10(3)	2.10	0.56	1.02	0.52	-1.05	-0.14	-0.47	-0.01	0.42	0.18	-1.02	0.46	-0.82	-0.47	0.02	-0.13	-0.01	-0.06	1.05

Panel E: Non-energy commodity price index																			
	Supply-side shocks				Demand-side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	M
90(2)-93(3)	**0.37**	**8.73**	**-8.36**	**-10.63**	**-16.40**	**1.49**	**-2.63**	**-8.46**	**-7.10**	**-2.20**	**2.51**	**1.48**	**4.31**	**-3.39**	**-1.37**	**0.35**	**1.18**	**-0.05**	**-16.03**
93(4)-94(3)	0.76	-3.29	4.05	6.25	7.97	-2.67	4.60	3.10	6.56	0.75	-4.37	-0.33	-3.96	2.08	0.83	0.86	-3.44	-0.41	8.73
97(3)-98(3)	**-12.92**	**-7.27**	**-5.65**	**-6.45**	**-9.86**	**-20.83**	**12.95**	**0.79**	**0.49**	**-4.28**	**1.02**	**-0.17**	**3.20**	**0.23**	**-1.07**	**-0.01**	**-1.43**	**0.26**	**-22.78**
98(4)-99(3)	-0.92	1.90	-2.82	-1.18	-8.70	15.37	-6.03	-4.83	0.37	-3.60	-9.99	0.51	-5.95	-4.44	-0.59	1.42	-0.90	-0.05	-9.63
00(4)-03(2)	**-3.16**	**-15.56**	**12.40**	**13.36**	**-3.95**	**-5.90**	**-4.94**	**-7.73**	**3.98**	**5.32**	**5.32**	**2.54**	**-5.54**	**9.51**	**-2.55**	**-0.85**	**2.23**	**-0.02**	**-7.11**
03(3)-04(2)	0.57	-3.08	3.66	4.36	-2.04	1.70	-1.94	-1.75	0.11	3.70	-3.88	-0.21	-4.23	0.38	0.61	-1.05	1.02	-0.40	-1.47
08(2)-09(3)	**-9.78**	**3.09**	**-12.87**	**-7.52**	**-17.81**	**-3.33**	**0.05**	**-2.27**	**-3.73**	**-3.16**	**-5.37**	**1.65**	**-1.56**	**-2.09**	**-0.49**	**0.72**	**-3.36**	**-0.24**	**-27.59**
09(4)-10(3)	8.90	2.41	6.49	1.98	1.62	-1.91	0.12	1.67	2.92	-1.07	-0.12	0.21	-1.89	0.45	0.73	0.14	0.24	0.01	10.51

In the table the contributions of various categories of structural disturbances to fluctuations in the US trade deficit to GDP ratio (Td, Panel A), in the global excess liquidity factor (L, Panel B), house price factor (H, Panel C), stock price factor (F, Panel D), and in the non-energy commodity price index (M, Panel E) are reported for the four global recessionary episodes occurred in the 1986-2010 period (in bold): the early 1990s recession (1990:2-1993:2); the late 1990s recession (1997:3-1998:3); the early 2000s recession (2000:4-2003:2), and the Great Recession (2008:2-2009:3). The contributions of structural shocks in the four quarters following recessions are also shown. For each period, the overall actual changes in Td, L, H, F, and M are displayed in the last column “Actual”. The categories of structural disturbances are: oil market shocks (OIL), productivity shocks (PR), labor market shocks (LM); goods’ aggregate demand shocks (AD); saving rate shocks (SAV); monetary policy stance shocks (MP); portfolio allocation shocks (PA); US terms of trade shocks (TT); overall risk factor shocks (RF). For the latter category of disturbances the Table shows also the specific contributions of uncertainty shocks (RAV), size factor shocks (SZ), value factor shocks (VL), momentum shocks (MM), stock market liquidity shocks (SL), leverage shocks (LV), and risk appetite shocks (RAP).

Table 4: Out of sample forecasting exercise I, 2008:2-2010:3: predicting recession probabilities.

Y	GLOBAL		GDPUS	US			GDPEA	EA		
	OD	**OD-X**		**OD**	**OD-X1**	**OD-X2**		**OD**	**OD-X1**	**OD-X2**
CONST	-0.408 (0.189)	-0.891 (0.304)	**CONST**	-0.800 (0.283)	-1.534 (0.223)	-2.212 (0.466)	**CONST**	-1.320 (0.318)	-1.905 (0.360)	-5.095 (1.176)
Y(-1)	-1.974 (0.483)	-7.006 (1.509)	**GDPUS(-1)**	-1.277 (0.365)		-3.864 (1.088)	**GDPEA(-1)**	-0.835 (0.790)		
SZ(-7)		-2.135 (0.564)	**Y(-1)**		-0.608 (0.291)	-0.677 (0.273)	**Y(-1)**		-0.920 (0.360)	-2.854 (0.908)
PH(-2)		-1.200 (0.395)	**RAV(-1)**			1.418 (0.354)	**RAV(-6)**			-1.355 (0.517)
SL(-4)		1.252 (0.486)	**RAP(-4)**			-1.573 (0.416)	**PM(-8)**			1.980 (0.750)
PF(-2)		1.288 (0.428)	**PF(-3)**			1.486 (0.411)				
TS(-3)		-0.978 (0.379)	**MM(-8)**			1.168 (0.344)				
AIC	0.743	**0.470**	**AIC**	0.465	0.511	**0.408**	**AIC**	0.409	0.389	**0.276**
BIC	0.801	**0.680**	**BIC**	**0.522**	0.569	0.619	**BIC**	0.469	0.449	**0.397**
HQ	0.766	**0.554**	**HQ**	**0.488**	0.535	0.492	**HQ**	0.433	0.413	**0.324**
RMSE	0.396	**0.151**	**RMSE**	0.326	0.260	**0.154**	**RMSE**	0.490	0.382	**0.061**
MAFE	0.260	**0.061**	**MAE**	0.222	0.179	**0.086**	**MAE**	0.344	0.227	**0.019**
TIC	0.247	**0.092**	**TIC**	0.300	0.228	**0.125**	**TIC**	0.466	0.300	**0.044**

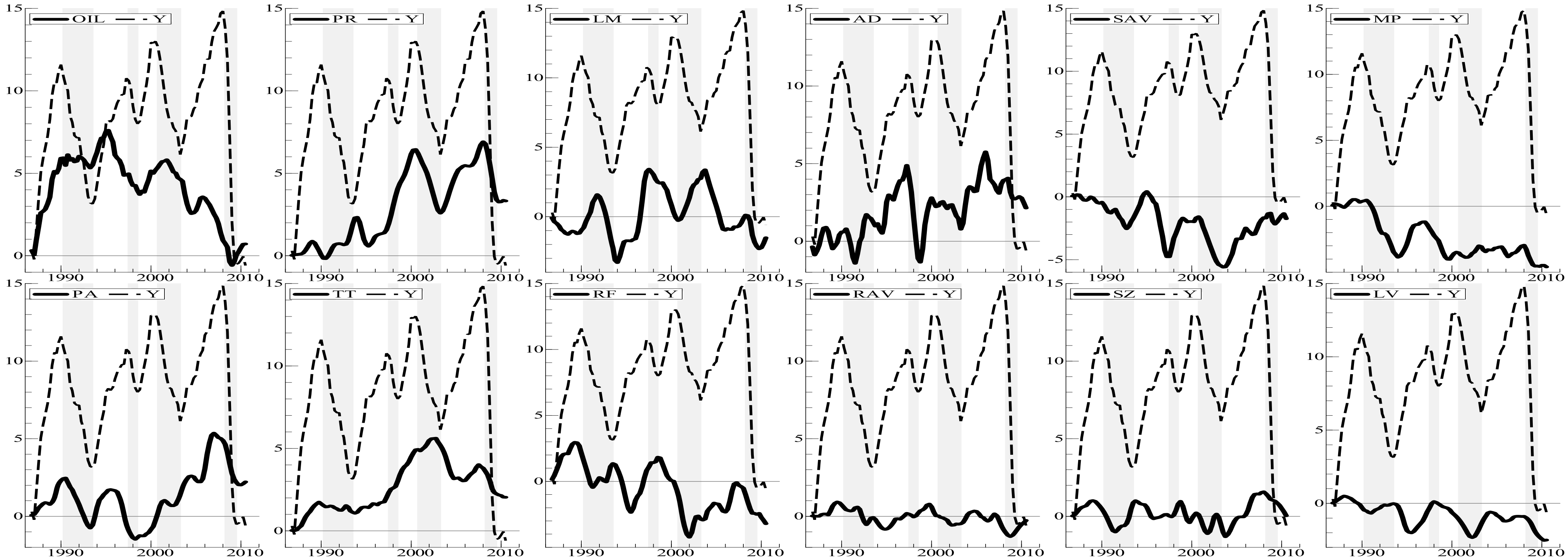
The table reports models for recession probabilities relative to global real activity (Y), the US GDP growth rate (GDPUS), and the Euro area GDP growth rate (GDPEA). The forecasting models are the benchmark own-dynamic autoregressive (OD) and the best performing augmented models (OD-X for global output, OD-X1 and OD-X2 for US and Euro area GDP growth rates), estimated over the period 1986:4-2008:1, with robust coefficient standard errors in brackets. AIC, BIC and HQ are the Akaike, Bayes-Schwarz and Hannan-Quinn information criteria, respectively. 1-step ahead out-of-sample forecasts are generated over the period 2008:2-2010:3 and assessed by means of the root mean square forecast error (RMSFE), the mean absolute forecast error (MAFE) and the Theil inequality coefficient (TIC). The structural shocks included in the augmented models are the size (SZ), stock market liquidity (SL) and momentum (MM) factor disturbances; the uncertainty (RAV), appetite (RAP) and term structure slope (TS) shocks; the stock (PF) and housing (PH) preference shocks; the non-energy commodities price index (PM) disturbance.

Table 5: Out of sample forecasting exercise II, 2008:2-2010:3: predicting global real activity and US and Euro area GDP growth.

Y	GLOBAL				GDPUS	US			GDPEA	EA		
	AR	AR-X1	AR-X2	AR-X3		AR	AR-X1	AR-X2		AR	AR-X1	AR-X2
Y(-1)	0.645 (0.084)	0.561 (0.088)	0.524 (0.078)	0.517 (0.073)	**CONST**	0.394 (0.113)	0.567 (0.095)	0.706 (0.103)	**CONST**	0.365 (0.102)	0.542 (0.048)	0.284 (0.098)
GDPEA(-4)		-0.229 (0.104)			**GDPUS(-1)**	0.173 (0.108)		0.239 (0.080)	**GDPEA(-1)**	0.371 (0.155)		
GDPUS(-1)		0.268 (0.087)	0.353 (0.088)	0.385 (0.090)	**GDPUS(-2)**	0.285 (0.108)	0.222 (0.110)		**GDPEA(-3)**			0.340 (0.076)
SL(p,-4)			-0.208 (0.085)		**Y(-1)**		0.162 (0.087)	0.214 (0.064)	**Y(-1)**		0.264 (0.053)	0.292 (0.045)
SL(p,-5)				0.220 (0.083)	**Y(-4)**		-0.255 (0.100)	-0.255 (0.072)	**MM(p,-1)**			-0.087 (0.047)
PF(p,-8)			0.186 (0.080)	0.125 (0.075)	**Y(-5)**		0.201 (0.098)	0.207 (0.074)	**MM(p,-2)**			-0.132 (0.050)
MM(p,-1)			-0.202 (0.077)	-0.164 (0.072)	**RA(-7)**		-0.232 (0.077)	-0.140 (0.057)	**MM(p,-3)**			-0.126 (0.050)
RAV(p,-1)			-0.246 (0.097)	-0.251 (0.088)	**SL(n,-7)**			-0.133 (0.060)	**RAP(n,-4)**			-0.114 (0.047)
RAV(p,-2)			-0.242 (0.092)	-0.226 (0.086)	**LV(n,-5)**			-0.109 (0.065)	**RAP(p,-6)**			-0.133 (0.053)
EL(n,-8)			0.219 (0.082)	0.152 (0.078)	**RAV(n,-8)**			0.166 (0.067)	**VL(n,-4)**			-0.103 (0.049)
TL(n,-6)			-0.151 (0.083)	-0.182 (0.077)	**PG(p,-3)**			-0.199 (0.068)	**SL(p,-5)**			0.211 (0.054)
GFI(n,-1)			-0.219 (0.078)	-0.160 (0.079)	**PG(p,-7)**			-0.353 (0.068)	**RAV(n,-6)**			0.207 (0.051)
ORP(n,-2)				-0.202 (0.078)	**TL(p,-2)**			-0.204 (0.077)	**RAV(p,-1)**			-0.229 (0.058)
ORP(p,-1)				-0.179 (0.088)	**PM(n,-3)**			0.174 (0.063)	**TL(n,-6)**			-0.104 (0.052)
ORP(p,-5)				-0.244 (0.083)	**GDI(n,-7)**			-0.122 (0.063)	**TL(n,-7)**			-0.242 (0.057)
ORP(p,-6)				-0.247 (0.088)	**TT(n,-3)**			-0.252 (0.070)	**PH(n,-8)**			-0.114 (0.065)
									GFI(n,-1)			-0.203 (0.051)
R2	0.376	0.479	0.660	**0.741**	**R2**	0.130	0.278	**0.701**	**R2**	0.138	0.188	**0.719**
R2c	0.376	0.466	0.615	**0.688**	**R2c**	0.109	0.230	**0.635**	**R2c**	0.138	0.178	**0.652**
AIC	1.781	1.547	1.264	**1.096**	**AIC**	1.428	1.325	**0.688**	**AIC**	1.134	1.074	**0.222**
BIC	1.810	1.635	1.566	**1.519**	**BIC**	1.514	1.505	**1.141**	**BIC**	1.191	1.132	**0.705**
HQ	1.793	1.582	1.385	**1.265**	**HQ**	1.462	1.397	**0.870**	**HQ**	1.157	1.097	**0.415**
RMSE	1.152	1.093	0.877	**0.788**	**RMSE**	0.931	0.824	**0.508**	**RMSE**	1.055	0.815	**0.508**
MAFE	0.892	0.838	0.564	**0.528**	**MAE**	0.682	0.663	**0.407**	**MAE**	0.774	0.659	**0.410**
TIC	0.274	0.259	0.206	**0.185**	**TIC**	0.632	0.434	**0.278**	**TIC**	0.683	0.501	**0.285**

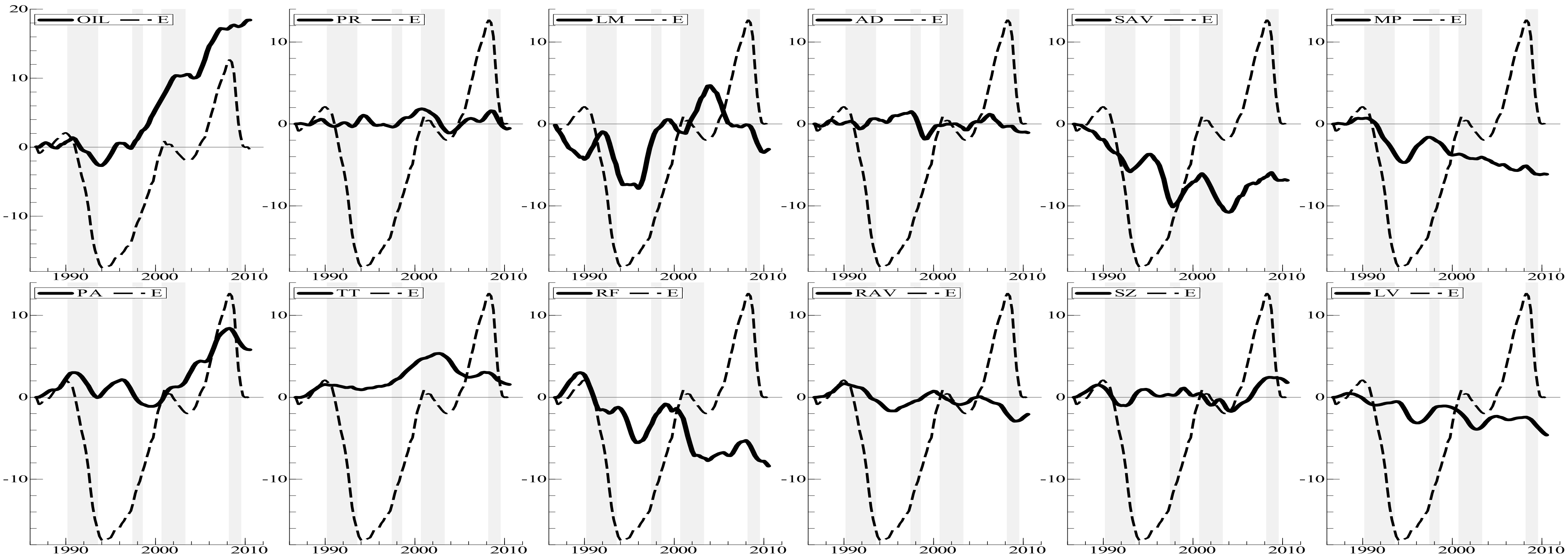
The table reports the autoregressive (AR) and the best performing augmented autoregressive (AR-X1, AR-X2, and AR-X3) models, estimated over the period 1986:4-2008:1, with robust coefficient standard errors in brackets. AIC, BIC and HQ are the Akaike, Bayes-Schwarz and Hannan-Quinn information criteria, respectively. 1-step ahead out of sample forecasts are generated over the period 2008:2-2010:3 and assessed by means of the root mean square forecast error (RMSFE), mean absolute forecast error (MAFE) and the Theil inequality coefficient (TIC). The predicted variables are global real output growth (Y) and US and EA real GDP growth (GDPUS and GDPEA). The lagged censored (positive (p), negative (n)) structural shocks included in the augmented models are the size (SZ), value (VL), stock market liquidity (SL), momentum (MM) and leverage (LV) factor disturbances; the uncertainty (RAV) and appetite (RAP) shocks; the excess liquidity (EL) and term structure level (TL) disturbances; the global (GFI) and US (GDI) saving rate shocks; the stock (PF), housing (PH) and gold (PG) preference shocks; the other oil price (ORP) and non-energy commodities price (PM) disturbances.

Figure 1: Historical Decomposition: real activity; contributions of structural shocks.



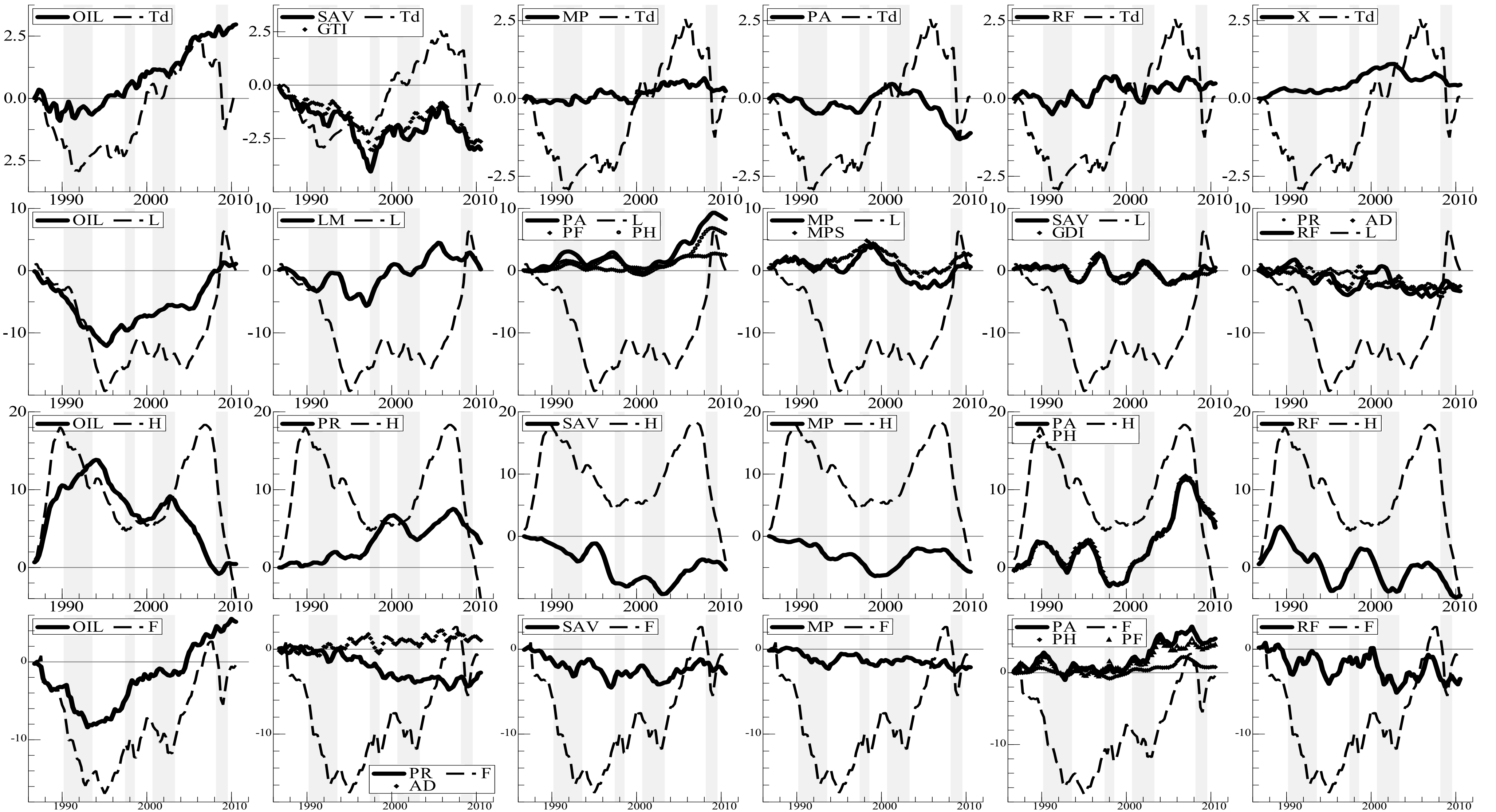
The Figure plots the historical decomposition of real activity (Y) relative to the various identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labor market (LM: labor supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate, US saving rate, global ex-US saving rate), monetary policy (MP: excess liquidity, term structure level and slope); US terms of trade (TT); portfolio allocation (PA: stocks, housing and gold preferences); risk factor (RF: size (SZ), value (VL), momentum (MM), stocks' liquidity (SL), leverage (LV), risk aversion (RAV), risk appetite (RAP)).

Figure 2: Historical Decomposition: employment; contributions of structural shocks.



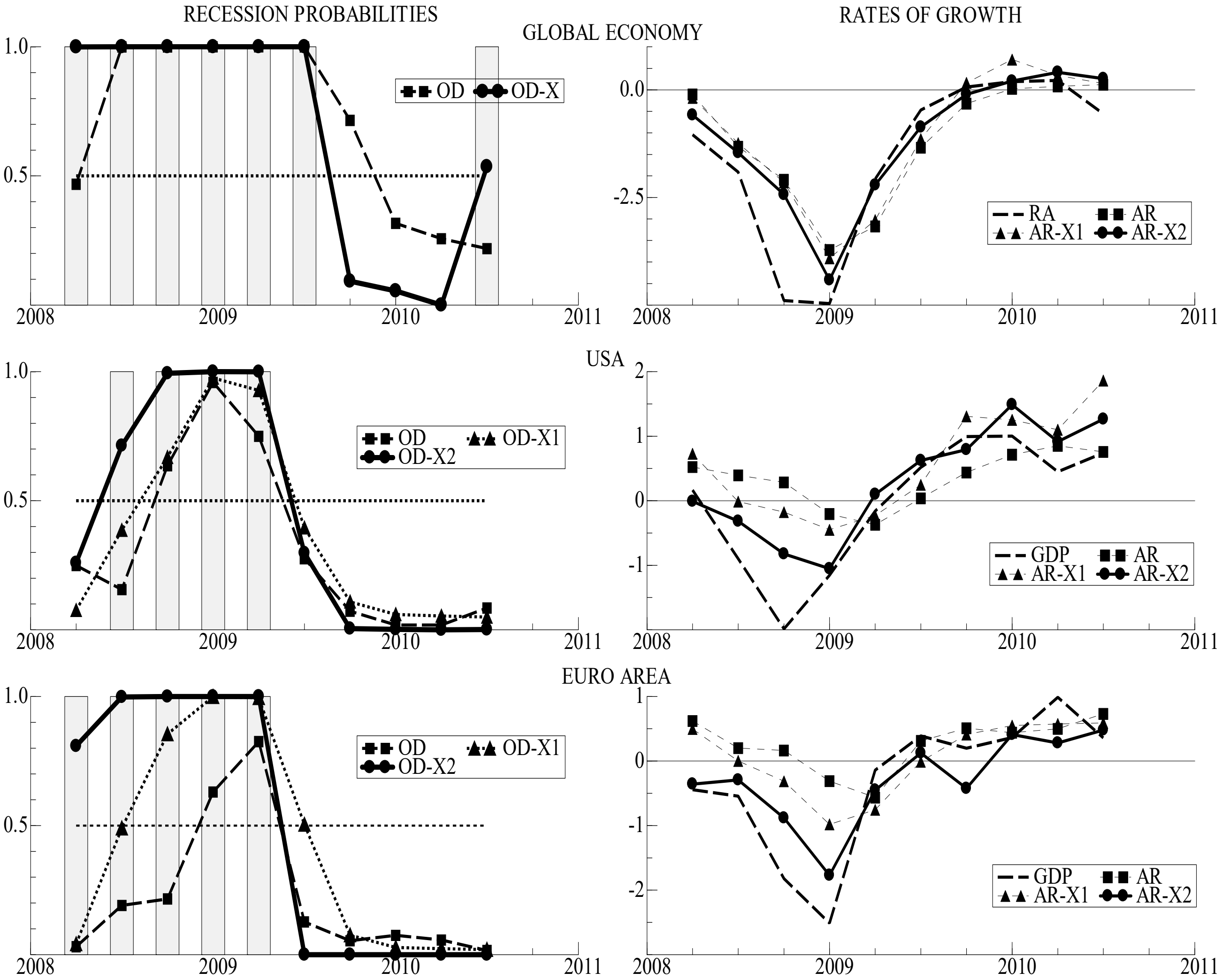
The Figure plots the historical decomposition of employment (E) relative to the various identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labor market (LM: labor supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate, US saving rate, global ex-US saving rate), monetary policy (MP: excess liquidity, term structure level and slope); US terms of trade (TT); portfolio allocation (PA: stocks, housing and gold preferences); risk factor (RF: size (SZ), value (VL), momentum (MM), stocks' liquidity (SL), leverage (LV), risk aversion (RAV), risk appetite (RAP)).

Figure 3: Historical Decomposition: US Trade deficit to GDP ratio, excess liquidity, real house price and real stock price factors; contributions of structural shocks.



The Figure plots the historical decomposition of the US Trade deficit to GDP ratio (Td) and the global excess liquidity (L), real house prices (H) and real stock prices (F) factors, relative to selected identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labor market (LM: labor supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate GFI, US saving rate, global ex-US saving rate GTI), monetary policy (MP: excess liquidity EL, term structure level and slope); US terms of trade (X); portfolio allocation (PA: stock PF, housing PH and gold preferences); risk factor (RF: size, value, momentum, stocks' liquidity, leverage, uncertainty, risk appetite).

Figure 4: Actual and predicted recession probabilities and real activity/GDP growth.



In the Figure actual and forecast values for recession probabilities (left-hand side plots) and global real activity (Y) and GDP growth rates (right-hand side plots) are plotted over the period 2008:2-2010:3. Top panels report results for the global economy, center panels for the US, bottom panels for the Euro area. In the left-hand side plots, actual recession periods are highlighted by shaded bars: 2008:2-2009:3 (and 2010:3) for the global economy output; 2008:3-2009:2 for the US; 2008:2-2009:2 for the Euro area. The 0.5 probability demarcation value is denoted by the horizontal dotted line. Forecasts generated by the own-dynamics autoregressive model (OD), the own-dynamic autoregressive model augmented by lagged global real activity growth (OD-X1, for the US and the Euro area) and lagged structural innovations (OD-X for global activity, and OD-X2 for the US and the Euro area) are reported using dashed, dotted and solid lines, respectively. Forecasting models are specified as in Table 7. In the right-hand side plots the actual figures are denoted by dashed lines; forecasts generated by the autoregressive model (AR), the autoregressive model augmented by lagged global real activity (AR-X1) and by lagged structural innovations (AR-X2) are denoted by dotted and solid lines. Forecasting models are specified as in Tables 4-5.

Supplementary Online Appendix to: "It ain't over till it's over: A global perspective on the Great Moderation-Great Recession interconnection"

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This Appendix presents details on the dataset used (Section A1), the adopted econometric methodology (Section A2), the identification strategy implemented to obtain economically interpretable structural shocks (Section A3), and a full account of the impulse response functions (Section A4) and forecast error variance decomposition results (Section A5). Finally, further results from the historical decomposition analysis discussed in the main text are shown in Section A6.

A1. The data

Countries. The dataset contains macroeconomic and financial data for 50 countries: 31 advanced economies (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States), 5 advanced emerging economies (Brazil, Hungary, Mexico, Poland, South Africa), and 14 secondary emerging economies (Argentina, Chile, China, Colombia, India, Indonesia, Malaysia, Morocco, Pakistan, Peru, Philippines, Russia, Thailand, Turkey).

Variables in the local-economies model. For each country, with few exceptions due to data availability, 17 quarterly macroeconomic variables are employed: the growth rates of *real GDP*, *private consumption* and *private investment*, the change of the *public expenditure to GDP ratio*, *nominal bilateral US$ exchange rate* (value of 1 US$ in units of domestic currency) returns, the *CPI inflation rate*, the change of the *M2* (or *M3) to GDP ratio*, the *nominal M2* (or *M3)* growth rate, the *civilian employment* growth rate, the change in the *unemployment rate*, the *real wages* growth rate, the rates of change of *real stock prices* and *real housing prices*, the *real short* and *long term interest rates*, the *real effective exchange rate* returns, the change of the *bank loans to the private sector to GDP ratio.* Macroeconomic data are seasonally adjusted. A total of over 800 equations is then considered in the local-economies block (equation (1) in the text).

Sample. The macro-financial sample extends from 1980:1 through 2010:3 for OECD economies, and from 1995:1 through 2010:3 for non-OECD countries (the latter being: Hong Kong, Singapore, Taiwan, Brazil, South Africa, and the secondary emerging economies listed above with the exceptions of Chile and Turkey). The unobserved global factors in $\mathbf{F}_{1,t}$, estimated from the local-economies block, therefore reflect commonalities occurring across OECD countries only over the period 1980-1994. Due to the limited sample available for the oil market variables (1986-2010), vector $\mathbf{F}_t$ in the global-economy model collects factors over the period 1986:1 to 2010:3.

Sources. The main data sources are: IMF *International Financial Statistics,* FRED2 (Federal Reserve Bank of St. Louis); OECD and BIS (unofficial) house price data sets, and International Energy Agency (IEA-OECD) data sets. Additional sources for specific variables are listed below.

Observed global factors ($\mathbf{F}_{2,t}$). 11 observed factors are included in the vector $\mathbf{F}_{2,t}$. Nine are US variables, namely:

- a *US financial fragility index* (FRA) obtained as the common component in the TED, *corporate* and *agency* spreads (Bagliano and Morana, 2012). The TED spread (between the 3-month LIBOR, Euro-dollar deposit rate and the yield on 3-month Treasury bills), being the difference between an unsecured deposit rate and a risk-free rate, yields a measure of credit and liquidity risk; the spread between BAA-rated and AAA-rated corporate bonds ($BAA - AAA$) yields a measure of corporate default risk, as well as a measure of investors' risk-taking attitude, a contraction in the spread signalling an increase in the demand for riskier bonds relative to safer ones; finally, the agency spread between the 30-year Fannie Mae/Freddie Mac bonds yield and the 30-year Treasury bonds yield is meant to measure the stress in the mortgage market. This index therefore summarizes overall credit conditions, with reference to corporate, interbank and mortgage markets;

- a *size* factor (SMB, the return differential between small and big sized portfolios) and a *value* factor (HML, the return differential between high and low book-to-market-ratio portfolios) from Fama and French (1993), and the Carhart (1997) *momentum* factor (MOM, the difference between the returns on the high and low past performance portfolios, measured over the previous four quarters);[1]

- a *stock market liquidity* factor (PSL), computed by Pastor and Stambaugh (2003, equation (8)) as the cross-sectional weighted average of individual-stock liquidity measures, the latter being the effect of the transaction volume in one month on the next-month individual return;[2]

- changes in the S&P 500 *stock return volatility* (FV), estimated from an asymmetric GARCH(1,1) model of monthly stock returns;

- a *leverage* factor (LEV) constructed by Adrian, Etula and Muir (2014) as the ratio of total financial assets over the difference between total financial assets and total financial liabilities of security brokers-delears, as reported in Table L.129 of the US Federal Reserve Flow of Funds. It may be considered as a proxy for financial instability (i.e., the higher the ratio, the higher the fragility of the financial sector);[3]

- changes in the *ratio of fiscal deficit to GDP* (Fd) and in the *ratio of trade deficit to GDP* (Td).

The remaining two observed factors are: returns on the real *gold price* (GD) and on the IMF *non-energy commodity price index* (M).

Observed oil market factors ($\mathbf{O}_t$). 10 variables are included in the global-economy model to capture various dimensions of oil market dynamics: (i) global oil supply conditions: *world oil reserves growth* (R), positive (Pp) and negative (Pm) *net world oil production changes* (see Hamilton, 1996 for details on the construction of the net change variables), and *OECD oil refineries margins growth* (RM); (ii) flow oil demand conditions: *world oil consumption growth* (C); and (iii) oil futures and spot market conditions: *OECD oil inventories growth* (INV), *real WTI oil price return* (OP), changes in *nominal WTI oil price volatility* (OV) computed from a GARCH model, the 12-month *futures basis* (FB), being the ratio of the nominal 12-month futures-spot spread over the nominal spot oil price computed using Crude Oil (Light-Sweet, Cushing, Oklahoma) 12th Contract settle futures prices, and the rate of change of the oil futures market Working (1960) *"T" speculation index* (WT), computed using US Commodity Futures Trading Commission (CFTC) Commitment of Trades (COT) data.[4]

[1] SMB, HML and MOM data are available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Developed .

[2] Data for the PSL factor are available at http://faculty.chicagobooth.edu/lubos.pastor/research/liq_data_1962_2011.txt.

[3] The authors are grateful to T. Muir for providing the data.

[4] The Working's T index is calculated as the ratio of speculative open interest to total open interest resulting from hedging activity, i.e., as 1+SS/(HS+HL) if HS≥HL and 1+SL/(HS+HL) if HS<HL, where open interest held by speculators (non-commercials) and hedgers (commercials) is denoted as follows: SS = Speculation, Short; HL = Hedging, Long; SL = Speculation, Long; HS = Hedging, Short.

A2. Estimation of the econometric model

The model is estimated by means of a two-stage approach. First, quasi-maximum likelihood (QML) estimation of the local-economies block is performed by means of the iterative procedure proposed in Morana (2014), delivering consistent and asymptotically normal estimates of the coefficients in equation (2) in the text, and the unobserved global factors. Then, conditional on the estimated unobserved factors, consistent and asymptotically normal estimation of the global-economy model in equation (1) is obtained using the PC-VAR method (Morana 2012).

Estimation of the unobserved factors and the local-economies block

Iterative estimation of the unobserved global factors and the local-economies model in equation (2) is performed through the following steps.

Initialization. An initial estimate of the R unobserved common factors in $\mathbf{F}_{1,t}$ is obtained by applying Principal Components (PC) analysis to subsets of homogeneous cross-country data in the vector $\mathbf{Z}_t$ of macro-financial variables in the local-economies model; for instance, a GDP growth global factor is estimated by means of the first PC extracted from cross-country GDP growth data, a stock return global factor by means of the first PC extracted from cross-country stock return series, and so on. Then, conditional on the estimated unobserved factors, preliminary estimates of the polynomial matrix $\mathbf{C}(L)$ and the factor loading matrix $\mathbf{\Lambda}$ are obtained by means of OLS estimation of the local-economies equations in (2). This step can be performed by first regressing $\mathbf{Z}_t$ on $\boldsymbol{\mu}$ and the demeaned factors $\left(\hat{\mathbf{F}}_t - \hat{\boldsymbol{\kappa}}\right)$ to get $\hat{\boldsymbol{\mu}}$ and $\hat{\mathbf{\Lambda}}$; then, the gap variables $\mathbf{Z}_t - \hat{\boldsymbol{\mu}} - \hat{\mathbf{\Lambda}}\left(\hat{\mathbf{F}}_t - \hat{\boldsymbol{\kappa}}\right)$ can be constructed and $\hat{\mathbf{C}}(L)$ obtained by means of OLS estimation of the VAR model in (2).

The iterative procedure. Next, a new estimate of the unobserved common factors in $\mathbf{F}_{1,t}$ can be obtained by means of PC analysis applied to the filtered variables $\mathbf{Z}_t^* = \mathbf{Z}_t - \hat{\mathbf{\Lambda}}_*\left(\hat{\mathbf{F}}_{*,t} - \hat{\boldsymbol{\kappa}}_*\right) - \hat{\mathbf{C}}(L)\left[\mathbf{Z}_t - \hat{\mathbf{\Lambda}}_*\left(\hat{\mathbf{F}}_{*,t} - \hat{\boldsymbol{\kappa}}_*\right)\right]$, where $\hat{\mathbf{F}}_{*,t} = \left[\mathbf{F}'_{2,t}\ \mathbf{O}'_t\right]'$, $\hat{\mathbf{\Lambda}}_* = \left[\hat{\mathbf{\Lambda}}'_{F_2}\ \hat{\mathbf{\Lambda}}'_O\right]'$ and $\hat{\boldsymbol{\kappa}}_* = \left[\hat{\boldsymbol{\kappa}}'_{F_2}\ \hat{\boldsymbol{\kappa}}'_O\right]'$, filtering out the effects on $\mathbf{Z}_t$ of the observed global factors in $\mathbf{F}_{2,t}$ and the oil market variables in $\mathbf{O}_t$. Then, conditional on the new unobserved common factors, an updated estimate of $\mathbf{C}(L)$ and the factor loading matrix $\mathbf{\Lambda}$ is obtained as described above. This procedure is then iterated until convergence.

Note that the proposed iterative procedure bears the interpretation of QML estimation performed by means of the EM algorithm using a Gaussian likelihood function. In the E-step the unobserved factors are estimated, given the observed data and the current estimate of model parameters, by means of PC analysis; in the M-step the likelihood function is maximized (implementing OLS estimation of the $C(L)$ matrix) under the assumption that the unobserved factors are known, conditioning on their E-step consistent estimate. Consistent and asymptotically normal estimation of unobserved I(0) factors by means of PC analysis is proved in Bai (2003) under general conditions.[5] Moreover, as shown by Bai and Ng (2006), when the unobserved factors are estimated by means of PC analysis in the E-step, the generated regressors problem is not an issue for consistent estimation in the M-step, due to faster vanishing of the estimation error, provided $\sqrt{T}/N \to 0$. The factors estimated by PC analysis can then be considered as they were actually observed, therefore not requiring Kalman smoothing at the E-step, i.e., the computation of their conditional expectation. Convergence to the one-step QML estimate is ensured, as the value of the likelihood function is increased at each step. See Morana (2014) for additional details and Monte Carlo results, validating the use of the iterative estimation procedure in small samples.

Estimation of the global model

Consistent and asymptotically normal estimates of the polynomial matrix $\mathbf{P}(L)$ in the VAR model (1), still relying on Bai and Ng (2006), can be obtained by means of PC-VAR estimation (Morana, 2012), by

[5] In particular, under some general conditions, given any invertible matrix Ξ and the vector of unobserved I(0) factors f_t, $\sqrt{N}$ consistency and asymptotic normality of PCA for Ξf_t, at each point in time, is established for $N, T \to \infty$ and $\sqrt{N}/T \to 0$ and the case of I(0) idiosyncratic components, the latter also displaying limited heteroskedasticity in both their time-series and cross-sectional dimensions (Bai, 2003). Moreover, $\sqrt{T}$ consistency and asymptotic normality of PC anaysis for $\Lambda_f \Xi^{-1}$ is established under the same conditions, as well as $min\left\{\sqrt{N}, \sqrt{T}\right\}$ consistency and asymptotic normality of PC anaysis for the unobserved common components $\Lambda_f f_t$ at each point in time, for $N, T \to \infty$.

holding the latent factors $\mathbf{F}_{1,t}$ as observed; then, by employing $\hat{\mathbf{P}}(L)$ and the final estimates of the $\mathbf{C}(L)$ and $\mathbf{\Lambda}$ matrices, the $\mathbf{\Phi}^*(L)$ polynomial matrix is estimated as $\hat{\mathbf{\Phi}}^*(L) = \left[\hat{\mathbf{\Lambda}}\hat{\mathbf{P}}(L) - \hat{\mathbf{C}}(L)\hat{\mathbf{\Lambda}}\right]$.

PC-VAR estimation of the reduced form global-economy model. Letting the $R \times 1$ vector $\mathbf{x}_t \equiv \hat{\mathbf{F}}_t - \hat{\boldsymbol{\kappa}}$, PC-VAR estimation of the VAR model in (1) exploits the following algebraic identity

$$\mathbf{x}_t \equiv \hat{\mathbf{\Xi}}\hat{\mathbf{f}}_t,$$

where $\hat{\mathbf{f}}_t = \hat{\mathbf{\Xi}}'\mathbf{x}_t$ is the $R \times 1$ vector of estimated principal components of $\mathbf{x}_t$, and $\hat{\mathbf{\Xi}}$ is the $R \times R$ matrix of orthogonal eigenvectors associated with the R (ordered) eigenvalues of $\hat{\mathbf{\Sigma}}$ (where $\mathbf{\Sigma} = E[\mathbf{x}_t\mathbf{x}_t']$). This follows from the eigenvalue-eigenvector decomposition of $\hat{\mathbf{\Sigma}}$, i.e. $\hat{\mathbf{\Xi}}^{-1}\hat{\mathbf{\Sigma}}\hat{\mathbf{\Xi}} = \hat{\mathbf{\Gamma}}$**,** where $\hat{\mathbf{\Gamma}} = diag(\hat{\gamma}_1, ..., \hat{\gamma}_R)$ is the $R \times R$ diagonal matrix containing the (ordered) eigenvalues of $\hat{\mathbf{\Sigma}}$. The estimation of $\mathbf{P}(L)$ is then implemented as follows:

(i) PC analysis is applied to $\mathbf{x}_t$, delivering $\hat{\mathbf{f}}_t = \hat{\mathbf{\Xi}}'\mathbf{x}_t$;

(ii) the stationary dynamic vector regression model

$$\mathbf{x}_t = \mathbf{D}(L)\hat{\mathbf{f}}_t + \boldsymbol{\varepsilon}_t$$

where $\boldsymbol{\varepsilon}_t \sim \text{iid}(\mathbf{0}, \mathbf{\Sigma}_\varepsilon)$ and $\mathbf{D}(L) \equiv \mathbf{D}_1 L + \mathbf{D}_2 L^2 + ... + \mathbf{D}_p L^p$ has all the roots outside the unit circle is estimated by OLS, yielding $\hat{\mathbf{D}}(L)$;

(iii) finally, the (implied OLS) estimates of the actual parameters of the unrestricted VAR model (1) are retrieved by solving the linear constraints

$$\hat{\mathbf{P}}(L)_{PCVAR} = \hat{\mathbf{D}}(L)\hat{\mathbf{\Xi}}'.$$

In the actual implementation only the first $R_1 < R$ ordered PCs are employed, yielding

$$\hat{\mathbf{P}}(L)_{PCVAR} = \hat{\mathbf{D}}(L)\hat{\mathbf{\Xi}}'_{R_1},$$

where $\underset{(R\times R)}{\hat{\mathbf{\Xi}}} = \begin{bmatrix} \underset{(R\times R_1)}{\hat{\mathbf{\Xi}}_{R_1}} & \underset{(R\times(R-R_1))}{\hat{\mathbf{\Xi}}_{R-R_1}} \end{bmatrix}$. Morana (2012) provides further details on PC-VAR estimation and its asymptotic properties with extensive Monte Carlo results.

A3. Identification of structural shocks

Structural shocks are identified by means of a Choleski decomposition of the factor innovation variance-covariance matrix. The chosen recursive structure of the global factors in $\mathbf{F}_t$ is detailed in the main text. Below we provide futher insights on its economic rationale.

The real and nominal side

Since *oil supply conditions* are relatively exogenous to the state of the business and financial cycle, being heavily constrained by geophysical factors, oil supply-side variables are placed first in the ordering. A set of relatively *slow-moving macroeconomic variables*, including both global and US-specific factors, is placed next, and therefore allowed to react contemporaneously to oil market supply-side conditions. The chosen ordering goes from the global employment, real activity, and fiscal policy factors (i.e., E, U, Y and G) to the US government budget and trade deficit to GDP ratios (Fd and Td), and finally to the global core inflation and real wage factors (N and W). It is then assumed that, over the business cycle, real activity is determined by labor market conditions through a short-run production function, with output growth feeding back on employment and unemployment with a (one-quarter) delay, capturing sluggish adjustment of the labor market. Then, the global fiscal policy stance factor contemporaneously adjusts to business cycle conditions, having a (one-quarter) delayed impact on real activity. Moreover, the inclusion of US fiscal and trade deficit to GDP ratios accounts for two potential sources of global imbalances; both variables are assumed to respond contemporaneously to global cyclical conditions. Finally, inflation and real wages are allowed to react within the quarter to labor market and global business cycle developments.

The financial side

A set of mainly *financial*, relatively *fast-moving variables*, comprising global and US-specific factors, is placed next, with the following ordering: excess liquidity, real short-term rate, term spread, real housing prices, and exchange rate global factors (L, SR, TS, H and X); these series are followed by a sub-set of US financial variables, namely stock market volatility (FV), size and value Fama-French factors (SMB and HML), and momentum, stocks' liquidity, and leverage factors (MOM, PSL, and LEV); finally, the remaining variables concern commodity and stock (F) markets and US financial fragility conditions (FRA). Within this set of variables, the selected ordering implies that the liquidity stance (L), set by central banks according to the state of the business cycle, contemporaneously determines the real short-term interest rate, and affects asset prices and several dimensions of financial risk (captured by the size, value, momentum, stocks' liquidity and leverage factors, and stock market volatility), the latter responding to global macroeconomic, liquidity, real estate and exchange rate market conditions and being also a proxy for market expectations about future fundamentals. Overall, asset prices respond on impact to macroeconomic and monetary policy conditions; in particular, global stock market returns are allowed to react to all contemporaneous information on macro-financial and oil market developments, and to revisions in expectations on future investment opportunities captured by movements in financial risk measures.

The structural shocks

For ease of interpretation and exposition, the structural innovations delivered by our identification strategy are grouped into two broad sets of disturbances, "supply-side" and "demand-side and financial", each including several categories of shocks, around which the discussion of the empirical results in the following sections is organized.

Supply-side shocks The main identified sources of supply-side shocks are oil and (non-energy) commodities markets, the labor market, and productivity dynamics. From the oil market variables, an *oil market* shock (OIL) is identified, that aggregates two components. The first is an oil supply disturbance, capturing current and/or future shifts in the flow oil supply coming from unanticipated changes in oil reserves, the oil production mix, and inventories' management. A positive oil supply shock drives the spot oil price downward, causing a negative correlation between oil supply and the real oil price. The second captures additional sources of disturbances originated in the oil market, mainly due to oil consumption preference shifts and futures price movements.

From the labor market, a labor supply shock, moving employment and the real wage in opposite directions, and a labor demand disturbance, leading to changes in employment and the real wage in the same direction and in the unemployment rate of opposite sign, are identified. The former can also be understood in terms of a shock to factor shares, as in Lettau and Ludvigson (2014), inducing a negative correlation between real wages and stock prices. Furthermore, a core inflation shock is identified: being by construction unrelated to innovations in employment and output, it bears the interpretation of a shock to unit labor costs capturing shifts in the short-run Phillips curve, with permanent effects on the price level but no long-run output response. Those three sources of disturbances are aggregated into a *labor market* shock (LM).

An additional source of supply-side disturbances is identified as a *productivity* (PR) shock: a positive PR realization leads to a permanent increase in output and the real wage, and a decline in real stock prices. The countercyclical impact on stock prices is consistent with both "creative destruction" (Kogan et al., 2012) and pricing kernel (Canova and De Nicolò, 1995) effects. Finally, a *non-energy commodities price* (PM) shock captures unexpected changes in commodities prices uncorrelated with global macroeconomic and financial factors, a positive PM having mild and transitory recessionary effects on global output.

Demand-side shocks The identified disturbances coming from the demand-side of the economy concern an *aggregate demand* (AD) shock to the goods market, with predictable hump-shaped effects on real activity and only a moderate impact on the price level, and various innovations to global and US saving rates, aggregated into a *saving rate* (SAV) disturbance. In the latter category, a negative global saving rate shock, signalled by a permanent increase in the common component of the public consumption to GDP ratio, leads to a long-run contraction of real activity and a decline in stock prices.

Similar effects are observed following a negative US-specific saving rate disturbance, with a long-lasting increase in the US fiscal deficit to GDP ratio and only a short-run contraction in real activity. Finally, a non-US saving rate shock is identified as the innovation to the US trade deficit to GDP ratio uncorrelated with global output movements and with changes in the US fiscal policy stance, which should capture disturbances related to the "saving glut" phenomenon associated with capital inflows from emerging countries into the US.

Financial shocks Several categories of structural financial shocks are also identified. The first category identifies innovations to the global *monetary policy* stance (MP) and includes excess liquidity shocks, i.e., changes in monetary aggregates and bank loans growth uncorrelated with current and past movements in macroeconomic conditions. A positive realization of this disturbance has a negative impact on short-term interest rates and triggers dynamic adjustments of real activity and financial variables broadly consistent with a boom-bust cycle: moderate expansionary effects in the short-run are followed by an output contraction and declining leverage and asset prices over longer horizons. Innovations in the real short-term interest rate and in the term structure slope, that are meant to capture unexpected changes in the level and slope of the term structure of interest rates possibly due to changes in expectations on future monetary policy and macroeconomic conditions, are also included in this category of shocks. Unanticipated changes in the US$ exchange rate uncorrelated with current and past global macroeconomic developments are interpreted as *US terms of trade* (TT) shocks. Changes in stock and house prices unrelated to global macro-financial and oil market conditions are interpreted as demand-driven and attributed to innovations in investors' preferences, triggering portfolio reallocation across asset classes and potentially impacting, through wealth and Tobin's "q" effects, on real activity as well: aggregate *portfolio allocation* (PA) disturbances are then identified.

Various determinants of changes in investors' expectations and risk attitudes on US financial markets are revealed by innovations to a large set of variables reflecting US financial conditions. By construction, the corresponding identified structural disturbances are all orthogonal to information contained in past and current changes in global macroeconomic factors, oil supply, the global monetary policy stance and global interest rate and exchange rate movements, and are aggregated into a category of *risk factor* (RF) disturbances. Within this category, positive shocks to the *size* (SZ) and *value* (VL) Fama-French factors are interpreted as signalling greater profitability of small and value stocks due to improved expected macroeconomic conditions and investment opportunities and are followed by positive and persistent responses of real activity. An innovation in stock return volatility identifies a shock to the degree of *uncertainty* (RAV) surrounding future economic fundamentals and discount rates. An upsurge in uncertainty beyond the level justified by macroeconomic and monetary policy conditions may signal worsening expectations of future economic scenarios and is followed by a short-run contraction in real activity and a somewhat looser monetary policy stance. Finally, the orthogonalized innovation to a measure of financial intermediaries' leverage allows the identification of a *leverage* (LV) shock, capturing excessive risk-taking potentially leading to financial instability and credit crunches. The observed downturn in real activity and global liquidity conditions in the aftermath of a positive leverage shock, together with a generalized decline in asset prices, broadly support this interpretation.

A4. Impulse response functions

In this section we present and discuss the main effects of each identified shock on the global-economy variables by means of impulse response analysis, shown in Tables A1-A3. In the discussion, we refer to selected time horizons: very short-term (VST; within 2 quarters), short-term (ST; between 1 and 2 years), medium-term (MT; 3 to 5 years), and long-term (LT; 10 years). Results in each Panel of the tables are the impulse responses of relevant variables to a given shock; the variable in the first column of each panel corresponds to the global factor equation from which the structural shock is obtained as orthogonalized innovation. For instance, Panel A in Table A1, reports impulse responses of oil reserves (R), future basis (FB), real oil price (OP), nominal oil price volatility (OV), real activity (Y) and the price level (N) to a unitary oil reserves shock (OR); such disturbance is obtained from the estimated innovation of the oil reserves (R) equation.

Oil and non-energy commodities market shocks

Table A1, Panel A-M, shows responses of selected variables to disturbances originated in the oil and non-energy commodities markets. The identification of oil market shocks is finer than that discussed in the text (where only two aggregate oil market disturbances were considered). Here oil market supply-side shocks include disturbances to *oil reserves* (OR), *flow oil supply* (positive, OSP; negative, OSN), the *oil production mix* (OX), and *oil inventories preference* (OI). Other oil market disturbances collect shocks to *oil consumption preferences* (OC), *oil futures market-pressure* (OFP), *residual oil futures market* (OFR), *other real oil price* (ORP) and *nominal oil price volatility* (ONV).

Oil market supply side shocks. A positive *oil reserves* (OR) shock (Panel A) signals a future downward shift in flow oil supply, and drives the futures and the spot oil prices downward. OR leads to a permanent increase in oil reserves (R), reaching 1.66% in the long-run, and to a temporary contraction in the futures (FB, -1.90% after 2 quarters) and spot real oil price (OP, -1.03%), as well as in nominal oil price volatility (OV). Along with lower oil price uncertainty, a short- to long-term positive effect on real activity (Y) is detected (up to 0.44% in the long-run), as well as a contraction in the gold price (GD, up to -3.61%). Negative (OSN) and positive (OSP) *flow oil supply* shocks (Panel B and C) capture shifts in the current flow oil supply, affecting oil production and the real oil price. OSN leads to a permanent contraction in oil production (Pm) and a short-term increase in oil price (3.26%) and volatility (0.74%), the latter effect being reversed in the medium- to long-run. Output displays a negative reaction on impact, but is positively affected in the long-run because of the decreased oil price volatility. Opposite effects occur following a OSP shock: oil price contracts in the short-run, whereas oil production (Pp) permanently increases along with oil price volatility, determining a (quantitatively small) long-term decline in output.

Positive *oil production mix* shocks (OX, Panel D) capture shifts in the mix favoring (relatively less expensive) medium and heavy sour crudes, leading to a permanent increase in refineries output (RM), a decline in the real oil price, and a long-run rise in price volatility, causing a contraction in real activity over the medium-term horizon only. A positive *oil inventories* (OI) *preference* shock (Panel F), by construction unrelated to macroeconomic fundamentals, causes a slack in supply and a contraction in the spot oil price, both effects persisting over the long-run. Global oil inventories (INV) permanently increase and oil price declines together with price volatility, gradually boosting output.

Aggregating the above disturbances, the composite oil supply shock (OS) introduced in Section 2 of the paper is obtained. A positive realization of OS signals a current and/or future downward shift in the flow oil supply schedule and drives down the spot oil price, causing a negative correlation between oil supply and the real oil price.

Other oil market shocks. In this category, additional sources of shocks coming from the oil market are considered. As shown in Panel E, a positive *oil consumption* (OC) *preference* disturbance, by construction unrelated to macroeconomic fundamentals, causes an upward shift in the flow oil demand function, determining a positive correlation between oil consumption and the real oil price. OC leads to a sizeable permanent increases in global oil consumption (C) and the real oil price, and a moderate dampening of oil price volatility, determining a (small but significant) increase in real activity. A positive *oil futures market-pressure* shock (OFP, Panel G) results in a positive correlation between the excess supply for long (speculative) traders positions and the demand for short (hedging) positions (captured by the Working's T index, WT) and the oil futures prices (FB), consistent with the Normal Backwardation and Market Pressure theories. As price discovery spills over from the futures to the spot market, a positive correlation with the spot oil price is also observed over all time horizons. A *residual oil futures market* shock (OFR, Panel H), capturing innovations in FB purged of the effect of traders positions, leads to a contemporaneous increase in the futures basis and a permanent rise in the real oil price. Also a mild decrease in oil price volatility and a small positive effect on real activity are detected in the long-run. Finally, Panels I and L show the effects of *other real oil price* (ORP) and *nominal oil price volatility* (ONV) shocks, to which we do not attribute precise economic content. Given the chosen identification strategy, both are capturing innovations unrelated to past and current macroeconomic and financial developments, as well as physical and futures oil market conditions. Empirically, both shocks determine permanent rises in the real oil price and in oil price volatility, and medium- to long-term contractions in real activity.

Non-energy commodities price index shock. A positive *non-energy commodities* (PM) *price* index shock captures an unexpected increase in non-energy commodities prices, uncorrelated with global macroeconomic as well as financial fundamentals. PM causes a permanent increase in real non-energy commodities prices (M) and a mild medium-term transitory recessionary effect on real activity, with no impact on the price level at any horizon. The shock also triggers increases in real gold and oil prices in the long-run.

Macroeconomic structural shocks

Table A2, Panel A-H, displays the responses of selected variables to various sources of macroeconomic shocks, coming from labor supply and demand, productivity dynamics, aggregate goods demand, and global saving rate changes.

Labor market shocks. A positive *labor supply* (LS) shock (Panel A) has contemporaneous impacts of opposite sign on employment (E, 0.24%) and the real wage (W,-0.16%), that build up monotonically as the horizon increases to reach 1.33% for E and -1.30% for W in the long-run. A decline in the unemployment rate (U) and a positive effect on output in the short- to medium-run are detected. This disturbance can also be rationalized as a disturbance to factor shares as in Lettau and Ludvigson (2014) boosting stock prices (F, 0.47% in the long-run) while depressing real wages. Panel B shows the effects of a negative *labor demand* (LD) shock, leading to a persistent increase of the unemployment rate, a reduction in output and a delayed negative effect on the real wage. Finally, the effects of a positive *core inflation* shock (CI) are reported in Panel E. Being unrelated by construction to innovations in employment and output, this disturbance can bear the interpretation of a shock to unit labor costs, capturing an upward shift of the short-term Phillips curve consistent with Eckstein's (1981) insight.[6] The price level (N) increases permanently, whereas real activity contracts and unemployment rises only over the medium-run, with no long-run responses.

Aggregate demand and productivity shocks. A positive goods' *aggregate demand* (AD) shock (Panel C) has a persistent, hump-shaped effect on real activity, reaching a peak within the first year and slowly declining thereafter, with only a moderate effect on the price level, and stock prices showing a positive response over all horizons. Panel D reports the effects of a positive *productivity* shock (PR) that rises the real wage gradually by 0.4% on impact to reach 1.6% over the long-run. The positive response of output builds up steadily over time up to 0.85% over the 10-year horizon. A productivity shock also determines a sizeable increase in real housing prices (Lettau and Ludvigson, 2014) and a decrease in stock prices. The latter effect is consistent with a Shumpeterian view of innovation as a process of *creative destruction* as in Kogan, Papanikolaou, Seru and Stoffman (2012): while shareholders' wealth increases at innovative firms, due to booming profits from the introduction of new technologies, wealth destruction occurs at competitor firms, which fail to fully adopt technological advances. Hence, a positive link between productivity shocks and stock prices at the firm level can be consistent with a negative relationship at the market level, as the aggregate return is a weighted average of heterogeneous and mostly negatively correlated individual firm's stock returns. The countercyclical impact of a productivity shock on stock prices may also be rationalized along the lines of Canova and De Nicolò (1995), if a sufficiently persistent PR shock has a negative effect on the stocks' pricing kernel (through consumption and working hours smoothing) which offsets the increase in expected future cashflows, determining an overall decline in stock prices.

Global saving rate shocks. The remaining Panels F-H of Table A2 show the main effects of various innovations to global and US saving rates. A negative shock to the *global saving rate* (GFI, Panel F), signalled by a permanent increase in the common component of the public consumption to GDP ratio (G), leads to a long-run contraction in real activity and a decline in stock prices. Panel G displays the effects of a negative *US-specific saving rate* (GDI) disturbance, that causes a long-lasting increase in the US fiscal deficit/GDP ratio (Fd) along with a decline in global stock prices; the contractionary effect on real activity is limited to the first year, being followed by a small expansionary response in the longer run. Finally, a *non-US saving rate* (GTI) shock is obtained from the orthogonalized innovations to the US trade deficit to GDP ratio (Td). Since this innovation is by construction uncorrelated with global output movements and with changes in the US government budget position (Fd), GTI is meant to capture disturbances related to the "savings glut" phenomenon, associated with capital inflows from

[6] According to Eckstein (1981), core inflation is measured by the weighted average of the rate of increase in unit labor costs and the user cost of capital, i.e. the rate of growth of the supply price of output along the steady-state growth path (steady-state inflation).

relatively fast-growing emerging countries (especially Asian economies) into the US over the last two decades. Consistent with Bernanke's (2005) view, a positive "savings glut" shock (Panel H) leads to a permanent increase in the US trade deficit/GDP ratio, a persistent appreciation of the US$ exchange rate (X), a downward movement in real short-term interest rates (SR), and a contraction in global output.[7]

Financial structural shocks

The large set of financial variables in the dataset allows for identification of a broad range of structural disturbances related to the stance of global monetary policy and interest rate movements, foreign exchange markets, changes in portfolio allocation in international financial markets, and movements in a comprehensive array of risk factor indicators, interpreted as complementary signals of revisions in expectations of investment opportunities. Results from the impulse response functions to structural financial innovations are reported in Table A3, Panel A-P.

Monetary policy stance and interest rate shocks. An *excess liquidity* shock (EL), capturing changes in the growth rate of monetary aggregates and bank loans uncorrelated with current and past movements in macroeconomic conditions (in particular real activity and inflation), may be interpreted as a measure of innovations to the stance of global monetary policy. As shown in Panel A, a positive EL impacts negatively on real short-term interest rates (SR) -a standard "liquidity effect"-, and also, though by a smaller amount, on real long-term rates, consistent with the expectation hypothesis of the term structure.[8] The dynamic response of real activity and asset prices broadly accords with a boom-bust cycle: EL triggers an increase in real activity (though not significant), the price level, real stock prices and financial leverage (LEV) in the very short-term, turning into an output contraction over longer horizons, accompanied by declining stock prices and leverage measures after 1-2 years; a persistent increase in stock market uncertainty (FV) is also detected. A positive *real short-term interest rate* shock (TL, Panel B) causes a permanent increase in the real short rate and a delayed reaction of long rates in the same direction. Due to the smaller magnitude of long-term interest rates changes, the term spread (TS) contracts; as the spread tends to be lower near business cycle peaks (Fama and French, 1989), its reduction may be consistent with the subsequent observed increase in real activity and in real stock (F) and housing prices (H). Finally, a positive *term structure slope* shock (TS, Panel C) tilts upward the term structure of interest rates, with a permanent increase in the long-term interest rate in the face of a substantially unchanged short rate. That innovation might signal improved expectations of future macroeconomic conditions: the observed positive dynamic effects on global output and (by a moderate amount) on the price level support this interpretation. Positive responses over time of global stock and housing prices complete the picture.

Foreign exchange market shock. A negative shock to *US terms of trade* (TT, Panel D), captured by an innovation in the US$ exchange rate (X) uncorrelated with current and past developments in real activity and other global macroeconomic conditions, causes a permanent depreciation of the US dollar and, with a one-year delay, a contraction in the US trade deficit to GDP ratio (Td). Reduced US imports have a recessionary impact on global real activity, with an associated negative effect on global house and (to a lesser extent) stock prices.

Portfolio allocation shocks. Changes in stock, house and gold prices, unrelated to global macro-financial and oil market developments, are interpreted as demand-driven and attributed to innovations in investors' preferences, triggering portfolio reallocation across asset classes and potentially impacting, through wealth and Tobin's "q" effects, on real activity as well. A positive *stocks preference* shock (PF, Panel E) leads to a permanent increase in real stock prices (F) and transitory increases in house (H) and long-term securities prices (i.e. the long-term real interest rates decreases). Similar effects follow a positive *housing preference shock* (PH, Panel F), with a permanent rise in real house prices

[7] According to this view, higher non-US global savings, servicing the growing US trade deficit, can be attributed to various causes: increased savings and reserves accumulation in emerging Asian economies following the 1997-1998 financial crisis, fostered by their export-led growth and currency undervaluation policies; aging population in industrialized countries, requiring larger savings to finance retirement; the increase in oil prices leading to trade balance surpluses in oil exporting countries. According to Caballero, Fahri and Gourinchas (2008), the savings glut view is also compatibile with the shortage of stores of values in less developed economies.

[8] The responses for the real long-term interest rate (LR) are obtained from the responses of the real term spread (TS) and short-term interest rate (SR), as $TS = LR - SR$, i.e., $LR = TS + SR$.

and transitory increases in stock and (short- and long-term) bond prices. Overall, unexpected stock and house price surges boost demand and prices of a wide range of assets through wealth effects. In addition to wealth effects, Tobin's "q" and "financial accelerator" mechanisms may be responsible for the observed expansion of global real activity (more persistent in the case of a shock to house prices).[9] Finally, Panel G shows that a shock to *preferences for gold* (PG), leading to a permanent increase in the real gold price (G) is associated with a rise in real oil (OP) and non-energy commodities (M) prices and decreases in house and (especially long-term) securities prices; no significant response of global real activity is detected.

Risk factor shocks. A rich array of variables in the global-economy model try to capture changes in investors' expectations and risk attitudes on US financial markets, grounded on the view that disturbances originated in the US financial sector had important spillovers on the global economy in the sample period considered. The remaining Panels H-P of Table A3 display the responses of selected variables to some identified sources of shocks, that are all orthogonal by construction to past and current changes in global macroeconomic factors, oil supply, the global monetary policy stance and global interest rate movements.

Positive innovations to Fama-French *size* (SZ, Panel I) and *value* (VL, Panel L) factors, determining long-run increases in the SMB and HML variables respectively, are interpreted as revealing expectations of favorable changes in the investment opportunity set. Small, poorly collateralized firms have limited access to external capital markets and are more vulnerable than large firms to adverse changes in credit conditions (Gertler and Gilchrist, 1994). Improved credit and, in general, macroeconomic prospects may then be associated with a rise in the profitability of small stocks, resulting in a higher SMB factor (Hahn and Lee, 2006; Petkova, 2006). A positive size innovation is then interpreted as signalling improved expected credit market and general macroeconomic conditions. Similarly, firms with high book-to-market ratios are likely to suffer more from a higher debt burden and be more vulnerable to adverse changes in monetary policy and interest rates. Value stocks are more exposed to news about future economic activity than growth stocks (Koijen, Lustig and Van Nieuwerburgh, 2012), are more strongly correlated with consumption growth during recessions (Lettau and Ludvigson, 2001), and do worse when the expected aggregate stock market return declines (Campbell, Giglio, Polk and Turley, 2012). Improved economic conditions may then be associated with higher profitability of value stocks, resulting in a larger HML factor. A positive value innovation may then reveal expectations of favorable changes in macroeconomic conditions and investment opportunities. Panels I and L show that size and value shocks lead to large and persistent increases in the SMB and HML factors, pointing to larger profitability of small and value stocks respectively, and are both followed by positive and persistent responses of real activity[10] and a rise in the prices of other real (house) and financial assets (long-term bonds, with a corresponding decrease in the term spread). Opposite effects are yielded by a positive shock to a *momentum* factor (MM, Panel M): a persistent innovation in MOM (the difference between returns on high and low past performance portfolios) is followed by a contraction in real activity and a temporary increase of global liquidity (L) due to an expansionary change in the global monetary policy stance. This pattern can be consistent with a momentum shock signalling unfavorable changes in expectations of future macroeconomic conditions. Indeed, if firms with stronger fundamentals outperform firms with weaker fundamentals during economic downturns and fundamentals are persistent and reflected in stock returns, positive momentum should be observed during recessions, and a positive innovation MM can reveal adverse changes in the economic outlook.[11] Consistent with this interpretation, MM triggers "flight to safety" portfolio rebalancing towards short-term securities (with a decrease in the short rate SR), and away from stocks (F), housing (H), and long-term securities, leading to declines in their prices.

A positive *stock market liquidity* shock (SL, Panel N), associated with an increase in the Pastor-Stambaugh (2003) liquidity factor (PSL), leads to a short-term expansion in real activity and a contraction in global liquidity due to a monetary policy tightening. As improving economic conditions

[9] Financial accelerator effects may be generated through firms' and households' spending decisions. Both groups of agents can borrrow posting their equities as collateral; changes in asset prices then affect net worth and eventually spending by changing their external finance premium, i.e. their cost of credit.

[10] This finding is consistent with the evidence of forecasting power of SMB and HML for US GDP growth, as well as for other industrialized countries, and with the view that investors hold large and growth stocks when the economy is in a bad state, shifting to small and value stocks when expectations of future economic growth improve (Liew and Vassalou, 2000; Lettau and Ludvigson, 2001).

[11] This effect outweighs the positive link between momentum returns and expansionary business cycle phases detected by Chordia and Shivakumar (2002) and Liu and Zhang (2008).

lead to a reduction in investors' risk aversion and to portfolio rebalancing towards riskier assets, higher stock market liquidity may signal an expected improvement in the economic outlook. Hence, a high PSL factor can be expected during expansions, and a positive liquidity shock reveals expectations of favorable changes in the investment opportunity set. Consistent with improved economic prospects, SL leads to portfolio rebalancing favoring stocks over other assets: in fact, real stock prices increase, while short-term securities and house prices decline. Panel O shows the effects of a positive innovation in the Adrian-Etula-Muir (2014) financial intermediaries' leverage measure, i.e. a *leverage* shock (LV). Being uncorrelated with current and past movements in global macroeconomic, monetary policy, and interest rates conditions, and in the US risk factors discussed so far, LV captures financial intermediaries' excessive risk-taking behavior, potentially leading to financial instability and credit crunches. As such, this disturbance determines a sizeable increase in the leverage measure (LEV) followed by a contraction in real activity and global liquidity conditions (L), and triggers a generalized decline in asset prices, particularly in the stock, housing, and long-term bond markets.

Panel H displays the effects of a positive innovation in a measure of stock return volatility, bearing the interpretation of a shock to the degree of *uncertainty* (RAV) surrounding future economic fundamentals and discount rates driving stock prices. Higher uncertainty, reflected in more volatile stock markets, can be observed during economic downturns (Schwert, 1989; Hamilton and Lin, 1996; Beltratti and Morana, 2006), together with an increase in investors' risk aversion (Cochrane, 2007). Thus, an upsurge in uncertainty beyond the level related to current and past macroeconomic and monetary policy conditions may signal worsening expectations of future economic scenarios, leading to a persistent increase in stock return volatility (FV), a short-run (and relatively mild) contraction in global real activity, and a somewhat looser monetary policy stance as global liquidity increases (L). This disturbance also causes portfolio rebalancing shifts away from stocks, as investor favor safer assets, determining price increases in the short- and long-term securities and housing markets.

Finally, the responses to an innovation in a measure of (corporate, interbank and mortgage) credit conditions, already used by Bagliano and Morana (2012), are shown in Panel P. The shock to this financial fragility index - the variable placed last in the recursive ordering - is orthogonal to past and contemporaneous changes in oil market, macroeconomic and financial conditions, and is unrelated to innovations in all other risk factors. As such, it may contain residual information on investors' willingness to bear credit risk, or *risk appetite*. Empirically, a risk appetite shock (RAP) leads to a permanent increase in the credit condition index (FRA), associated with a mild expansion in real activity in the short- and medium-run, and an increase in the credit flow to the economy (L), as well as in stock and house prices.

A5. Forecast error variance decomposition

The forecast error variance decomposition ($FEVD$) yields an average account of the sources of fluctuations over the whole sample investigated, providing insights on the structural features of the Great Moderation period. Results are presented in Table A4 for various (categories of) structural shocks and time horizons. In particular, the broad set of "supply-side" disturbances includes the contributions of oil market shocks (OIL, being the sum of oil supply and other oil market disturbances), labor market shocks (LM, including disturbances to labor supply and demand, and to unit labor costs), productivity shocks (PR) and disturbances to the non-energy commodities price index (PM). "Demand-side and financial" shocks are split into the contributions of goods' aggregate demand (AD) and saving rate shocks (SAV, being the sum of global and US-specific disturbances), US terms of trade shocks (TT), shocks related to the global monetary policy stance and interest rates (MP, including innovations in global liquidity, real short-term rates and the term structure slope), portfolio allocation shocks (PA, aggregating preference shocks for stocks, housing and gold), and innovations to risk factors (RF), a composite category of financial disturbances including mainly shocks to the size and value factors, uncertainty and leverage shocks. In the Table and the discussion below, we refer to selected time horizons: very short-term (from impact up to 2 quarters), short-term (between 1 and 2 years), medium-term (from 3 to 5 years) and long-term horizon (10 years).

Output and employment fluctuations

Panels A and B of Table A4 show that fluctuations in global real activity and employment are driven by both supply-side and demand-side/financial disturbances but with a different pattern across horizons.

The latter broad category of shocks accounts for 75% of global output variance in the very short run, decreasing to 55% at the ten-year horizon. On the other hand, employment fluctuations are mostly driven by supply-side disturbances over short horizons (74% of the two-quarter variance) with demand and financial shocks increasing their share up to 48% in the long run. Going deeper, on the demand side, goods' aggregate demand shocks (AD) account for a large fraction of output variance only in the short run (from 58% at the two-quarter horizon down to 9% after three years), whereas saving rate disturbances (SAV) gain some importance over the medium term and account for 15% of output variability at the ten-year horizon. Revisions in investors' expectations on US financial markets, captured by risk factor shocks (RF), also become a relevant source of output variability over the medium term, reaching 15% at a three-year horizon. Less significant roles are played by structural disturbances coming from monetary policy and global interest rate innovations (MP). On the supply side, shocks originated in the oil market (OIL) and disturbances to productivity (PR) gradually increase their importance as the horizon lengthens, each accounting for around 20% of output variability in the long run. Over shorter horizons, labor supply shocks (LS) give a sizeable contribution to real activity fluctuations, reaching 20% at the one-year horizon before declining to 5% in the long run. Labor supply disturbances are also dominant for global employment fluctuations, being the most important source of variability at all horizons, though declining from 57% in the very short run to 26% at the ten-year horizon. Moving from shorter to longer horizons, the contributions of other structural disturbances to employment variance increase, reaching in the long run 24% for oil market shocks, 20% for disturbances to risk factors, and 13% for global saving rate innovations.

Supply-side shocks account also for the bulk of global (core) inflation variability in the very short run and gradually lose importance over longer horizons in the face of demand-side and financial disturbances. At the business-cycle horizon, more than 70% of inflation fluctuations may be attributed to labor market, saving rate and risk factor disturbances, whereas innovations to global monetary policy play a minor role at all horizons. Finally, non-US saving rate shocks (GTI) are the main driving force of fluctuations in the US trade deficit to GDP ratio, their contribution being 60% in the very short term and more than 50% even in the long run, a finding consistent with the "saving glut" explanation of the US current account imbalance dynamics.

This initial set of results from the global-economy model suggests two considerations. First, at a business-cycle horizon (3 to 5 years) the broad picture of the main driving forces of output and employment fluctuations is composite and consistent. For both variables, a sizeable share of variability is accounted for by shocks to labor supply, global saving rates and risk factors (around 45% for real activity and more than 60% for employment). An additional non-negligible role is played by disturbances originated in the oil market and, only in the case of output, by productivity and goods' aggregate demand shocks, whereas innovations to the monetary policy stance do not appear to be an important source of variability. Second, the rich array of variables included in the model to capture changes in investors' expectations and risk attitudes on US financial markets allows identification of structural risk factor (RF) disturbances that yield a significant contribution to output and employment fluctuations (between 15 and 20% at a business-cycle horizon), a finding consistent with recently proposed news-driven business cycle theories (Beaudry and Portier, 2014). In fact, RF shocks (being orthogonal by construction to current and past changes in global macroeconomic factors, as well as oil supply and global monetary policy and interest rate changes) can signal revisions in expectations of future economic fundamentals and, affecting firms' investment and households' labor supply, might be an autonomous source of business cycle fluctuations.

Liquidity, leverage and asset price fluctuations

Panels C-E in Table A4 display variance decomposition results for two variables related to the global monetary policy stance, namely global excess liquidity and real short-term interest rate changes (capturing developments in monetary and bank loans aggregates, and in the level of the term structure of interest rates, respectively), and a (US) financial sector leverage measure.

Liquidity and real interest rate. Panel C shows that fluctuations in global liquidity are mainly demand-determined in the short and medium run, with demand-side and financial shocks accounting for around 70% of variability at the one-year horizon, declining to 40% in the long term, whereas supply-side, particularly oil market, disturbances gain importance over longer horizons. A relatively large share of fluctuations in liquidity is attributable to shocks to economic fundamentals, mainly goods' aggregate demand (AD) and global saving rate (SAV) disturbances, jointly accounting for 44% of the two-quarter and 22% of the two-year variance. This is broadly consistent with the countercyclical use of monetary policy in OECD (Sutherland, 2010) and in some emerging countries (McGettigan et al., 2013). However, changes in global liquidity uncorrelated with current and past movements in macroeconomic conditions, interpretable as innovations to the stance of global monetary policy (EL), give a sizeable contribution to liquidity fluctuations, amounting to 20-25% up to a three-year horizon, a finding consistent with the "great deviation" view of monetary policy conduct over a large part of our sample period (Taylor J.B. 2010, 2013).

Evidence of fluctuations unrelated to structural shocks to macroeconomic fundamentals is also provided by the variance decomposition of the real global short-term interest rate in Panel D. In particular, shocks to the term structure level (TL) account for 30-40% of the short-rate variability at all horizons. Less important, though significant, contributions are provided by goods' aggregate demand and global saving rate disturbances, and, from the supply side, by productivity shocks. Panel E shows the main sources of fluctuations in US financial intermediaries' leverage. A remarkable share of variability, ranging from 70% on impact to 42% from a two-year horizon onwards, is attributable to risk factor shocks. Within this category, relevant contributions are provided by shocks to the degree of uncertainty about future economic fundamentals (RAV) and, most importantly, by (own) leverage disturbances (LV). Being uncorrelated with global macroeconomic, monetary policy and interest rate conditions as well as other US risk factors, the latter shocks capture financial intermediaries' excessive risk-taking behavior potentially leading to financial instability, coherently with the "great leveraging" hypothesis (Taylor A.M., 2012).

Asset prices and financial leverage. A sizeable role for structural disturbances unrelated to macroeconomic fundamentals is also a common feature of fluctuations in several asset prices. A fraction of variability in the US$ exchange rate ranging from 50% on impact to 30% from a one-year horizon onwards is attributable to a US terms of trade shock (TT) uncorrelated with current and past developments in real activity and other global macroeconomic conditions (Panel F). Disturbances originated in the oil market account for around 25% of the exchange rate variability over horizons longer than one year, whereas shocks to global saving rates and the monetary policy stance play a negligible role. Fluctuations in real stock prices (Panel G) are mainly driven by purely financial disturbances, with portfolio allocation (PA) and risk factor shocks jointly accounting for 50% of the variance at the two-quarter and 40% at the three-year horizons. A similar pattern characterizes real house price fluctuations (Panel H), with portfolio allocation (mainly due to housing preference, PH) and risk factor shocks explaining 45% of the two-quarter and 30% of the three-year variance. Among fundamental determinants, oil market disturbances play a major role in both stock and house price fluctuations, accounting for an increasing share of the variance across horizons, reaching 33% and 41% respectively in the long run. Finally, risk factor disturbances also play a non-negligible role in determining medium to long-run fluctuations in real non-energy commodities prices, accounting for 22% of the variance at the three-year horizon.

A6. Historical decomposition: further results

Global core inflation. Table A5 (Panel A) and Figure A1 show the results from historical decomposition of global core inflation (N). Inflation dynamics are consistent with the empirical features detected for real activity and employment over the investigated sample and discussed in the main text (Section 3.1). Oil market shocks (OIL) put an upward pressure on prices only up to the mid-1990s (Figure A1, first row), having a downward influence over the second sub-period, especially since 2005. Additional negative effects over the whole sample are attributable to global monetary policy stance shocks (MP, first row), coherently with their recessionary trend impact on global output and employment. Overall, both cost-push and demand-pull factors account for inflation fluctuations over the Great Moderation. Yet, while inflation dynamics up to the mid-1990s are mostly determined by supply-side disturbances mainly originated in the oil and labor markets (LM, first row), the contribution of demand-side, especially goods' aggregate demand (AD) and global saving rate (SAV, first row), shocks is larger over the second sub-sample. A similar pattern is detected for some financial sources of disturbances, namely portfolio allocation (PA) and risk factor shocks (RF, second row). As shown in Table A5, demand-side and financial shocks also provide larger disinflationary impulses in all recessionary episodes, accounting for -0.47% of the global inflation decline occurred in the early-1990s contraction (-0.64%) and -0.22% out of a -0.36% decrease in the Great Recession. In the latter episode, a notable contribution of risk factor shocks, explaining -0.15% of the global inflation decline, is also detected.

Leverage factor, exchange rate and short-term interest rate. Panels B-D of Table A5 and Figure A2 show results from historical decomposition of the leverage factor (LEV), the US$ exchange rate index (X), and the short-term interest rate factor (SR). In the decomposition of the *leverage factor* fluctuations (Figure A2, first row) the sizable contribution of global saving rate (SAV) and monetary policy (MP) disturbances to leverage fluctuations supports the existence of a linkage between global excess demand for safe assets and excess risk taking by US financial institutions, and the relevance of a risk-taking channel of monetary policy. Panel B of Table A5 shows that the deep contraction in the financial leverage factor during the Great Recession (-60.4%) is a clear-cut distinguishing feature from previous recessions, and is mostly accounted for by financial shocks. In the latter category, the largest share is attributable to risk factor disturbances (RF, -32.7%), and to uncertainty shocks (RAV, -22.9%). In previous recessionary episodes, leverage displayed different features: a small contraction in the early 2000s (-2.1%), and an increase during the late 1990s (10.3%), both the result of conflicting effects of supply-side (positively contributing by 21% and 17.7%, respectively) and demand-side/financial disturbances (accounting for -23% and -7.4%, respectively). Even in those episodes, a sizable role of risk factor shocks (explaining -8.1% and -17% of the leverage drop, respectively) is detected, with uncertainty shocks being particularly relevant (-15% and -17.6%). The decomposition of the *US$ exchange rate index* (Figure A2, second row) shows that the remarkable depreciation of the US$ occurred from 2000 until the Great Recession (dashed line) is mostly attributable to portfolio allocation shocks (PA), particularly related to housing preferences (PH), and to disturbances to terms of trade (TT). The third row of Figure A2 shows that the downward shift in global real short-term rates from mid-1990s can be accounted for by shocks to global saving rates (SAV), as predicted by the "savings glut" hypothesis, while global monetary policy disturbances (MP) contributed to maintain a low interest rate environment. In the early 2000s risk factor shocks (RF) are an important driving force of the downward short-rate path, that can be related to investors' misperceptions of actual macro-financial risk.

Commodity prices. The last row of Figure A2 shows the historical decomposition of the *non-energy commodity price* index (M). During the Great Recession episode, commodity prices declined in the 2008:3-2009:1 period, following contractions in house and stock prices.

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Table A1: Identification of oil market structural shocks: Impulse response functions of selected variables to oil market structural shocks (up to a 40-quarter horizon)

	Panel A: Oil reserve shock (OR)									**Panel B: Negative flow oil supply shock (OSN)**							
	R	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**		**Pm**	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**
0	**0.39**	**0.65**	**-0.92**	**-0.13**	**-0.03**	**-0.01**	**0.36**	**-0.41**	**0**	**-0.21**	**0.63**	**1.59**	**0.74**	**-0.11**	0.00	0.03	**-0.18**
2	**0.79**	**-1.90**	**-1.03**	-0.03	0.01	**-0.02**	0.06	**-0.68**	**2**	**-0.17**	**-1.96**	**3.26**	0.14	0.00	**0.03**	**1.10**	0.34
4	**1.00**	**-0.59**	-0.05	**-0.39**	**0.12**	**-0.01**	-0.19	**-1.12**	**4**	**-0.15**	**-0.64**	0.73	**-0.40**	0.04	0.00	**0.74**	0.37
6	**1.20**	**-1.03**	0.73	**-0.65**	**0.22**	0.00	0.09	**-1.63**	**6**	**-0.15**	-0.09	-0.04	**-0.52**	0.04	**0.01**	**0.84**	-0.21
8	**1.29**	-0.15	-0.61	**-0.55**	**0.23**	0.00	-0.31	**-2.16**	**8**	**-0.15**	**-0.77**	0.80	**-0.65**	0.11	**0.01**	**1.06**	-0.62
12	**1.43**	**0.31**	-0.74	**-0.52**	**0.22**	0.01	-0.51	**-2.49**	**12**	**-0.13**	-0.19	0.38	**-0.79**	**0.28**	**0.02**	**0.92**	**-1.09**
20	**1.53**	-0.05	-0.91	**-0.64**	**0.29**	0.01	-0.47	**-2.88**	**20**	**-0.14**	-0.02	0.38	**-0.85**	**0.44**	**0.03**	**0.69**	**-2.09**
40	**1.66**	-0.01	-0.98	**-0.75**	**0.44**	0.01	-0.56	**-3.61**	**40**	**-0.13**	**-0.04**	-0.01	**-1.02**	**0.62**	**0.03**	0.51	**-3.26**
	Panel C: Positive flow oil supply shock (OSP)									**Panel D: Oil production mix shock (OX)**							
	Pp	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**		**RM**	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**
0	**0.40**	-0.17	**-0.96**	**0.32**	**-0.05**	0.00	0.01	**-0.32**	**0**	**0.32**	**-1.09**	**-1.44**	**0.16**	**-0.07**	**-0.01**	**0.47**	0.09
2	**0.41**	-0.14	0.34	**0.82**	0.00	0.00	-0.09	**-1.48**	**2**	**0.43**	**-0.31**	**-2.07**	**0.65**	-0.06	**-0.01**	-0.11	0.20
4	**0.42**	**1.14**	**-1.85**	**1.18**	-0.05	0.00	**-0.97**	**-1.85**	**4**	**0.40**	-0.22	-0.25	**0.48**	**-0.11**	0.00	0.15	-0.05
6	**0.41**	**0.35**	0.00	**1.05**	0.07	**0.01**	**-0.65**	**-1.97**	**6**	**0.46**	**-0.39**	-0.55	**0.51**	-0.13	0.00	-0.10	-0.26
8	**0.42**	**0.34**	0.26	**1.00**	0.10	**0.02**	**-0.56**	**-1.88**	**8**	**0.50**	0.08	**-1.25**	**0.58**	**-0.20**	0.00	-0.33	-0.33
12	**0.36**	**0.25**	-0.16	**1.24**	-0.01	0.01	**-0.83**	**-1.77**	**12**	**0.54**	0.08	**-1.39**	**0.55**	**-0.21**	0.00	-0.21	-0.31
20	**0.35**	0.08	-0.23	**1.18**	-0.13	0.00	**-0.70**	**-1.26**	**20**	**0.64**	**-0.13**	**-1.36**	**0.59**	-0.08	0.00	-0.16	**-0.65**
40	**0.36**	**0.03**	0.03	**1.26**	**-0.19**	0.00	**-0.61**	-0.72	**40**	**0.68**	-0.01	**-1.42**	**0.52**	-0.01	0.00	-0.28	**-1.13**
	Panel E: Oil consumption preference shock (OC)									**Panel F: Oil inventories preference shock (OI)**							
	C	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**		**INV**	**FB**	**OP**	**OV**	**Y**	**N**	**M**	**GD**
0	**0.54**	**1.15**	0.16	**-0.39**	-	-	**0.43**	**0.22**	**0**	**0.50**	0.00	**-1.35**	**-0.44**	-	-	**-0.20**	**0.41**
2	**0.45**	**-2.09**	**2.79**	**-0.42**	**0.14**	**0.01**	**1.41**	**0.50**	**2**	**0.58**	**1.26**	**-1.98**	**-0.61**	**0.07**	0.00	**0.48**	**0.60**
4	**0.53**	**-0.83**	**3.12**	**-0.29**	**0.25**	**0.01**	**1.54**	**0.89**	**4**	**0.51**	**0.90**	**-2.32**	**-0.46**	**0.13**	0.00	**0.63**	**0.89**
6	**0.58**	**-0.37**	**2.91**	**-0.29**	**0.24**	**0.01**	**1.24**	**0.64**	**6**	**0.45**	**0.24**	**-1.56**	**-0.42**	**0.24**	0.00	**0.85**	**1.07**
8	**0.59**	**-0.62**	**3.54**	**-0.37**	**0.27**	**0.01**	**1.31**	**0.55**	**8**	**0.39**	-0.12	**-0.66**	**-0.50**	**0.32**	**0.01**	**1.03**	**1.10**
12	**0.57**	**0.30**	**3.24**	**-0.35**	**0.25**	**0.02**	**1.01**	0.34	**12**	**0.42**	**-0.17**	**-0.71**	**-0.50**	**0.35**	**0.01**	**0.83**	**0.64**
20	**0.53**	**0.10**	**3.33**	**-0.38**	**0.16**	**0.02**	**1.10**	0.68	**20**	**0.45**	**0.08**	**-0.93**	**-0.56**	**0.28**	**0.01**	**0.72**	**0.63**
40	**0.55**	0.01	**3.27**	**-0.39**	**0.22**	**0.02**	**1.12**	0.46	**40**	**0.44**	0.00	**-0.93**	**-0.56**	**0.29**	**0.01**	**0.78**	**0.68**
	Panel G: Oil futures market pressure shock (OFP)									**Panel H: Residual oil futures market shock (OFR)**							
	WT	**FB**	**OP**	**OV**	**Y**	N	**M**	**GD**		**FB**	**WT**	**OP**	**OV**	**Y**	**N**	**M**	**GD**
0	**0.72**	**0.24**	**0.36**	**-0.43**	-	-	**-0.06**	0.01	**0**	**4.36**	0.00	**0.30**	**-0.15**	-	-	**0.26**	**0.11**
2	**0.68**	**0.24**	-0.22	**-0.31**	**-0.03**	0.00	**-0.14**	**0.28**	**2**	-0.06	**0.08**	**2.60**	**-0.21**	**0.08**	**0.01**	**0.61**	**0.25**
4	**0.68**	-0.04	**0.78**	**-0.25**	**-0.07**	**0.00**	-0.11	**0.36**	**4**	**0.19**	-0.01	**2.00**	**-0.10**	**0.10**	**0.00**	**0.72**	**0.69**
6	**0.71**	0.01	**0.75**	**-0.26**	**-0.11**	**0.00**	-0.15	**0.60**	**6**	**0.35**	0.00	**2.05**	-0.05	**0.10**	0.00	**0.65**	**0.73**
8	**0.72**	-0.05	**0.73**	**-0.27**	**-0.14**	**0.00**	-0.14	**0.68**	**8**	**-0.26**	0.00	**2.67**	**-0.13**	**0.13**	**0.01**	**0.82**	**0.62**
12	**0.72**	**0.10**	**0.48**	**-0.23**	**-0.18**	0.00	-0.14	**0.79**	**12**	0.00	-0.01	**2.34**	**-0.10**	**0.13**	**0.01**	**0.69**	**0.50**
20	**0.73**	-0.02	**0.59**	**-0.20**	**-0.15**	0.00	-0.06	**0.88**	**20**	0.03	-0.01	**2.42**	**-0.12**	**0.10**	**0.01**	**0.69**	**0.60**
40	**0.73**	0.00	**0.59**	**-0.20**	**-0.15**	0.00	-0.08	**0.85**	**40**	0.00	0.00	**2.39**	**-0.11**	**0.09**	**0.01**	**0.72**	**0.73**
	Panel I: Other real oil price shock (ORP)									**Panel L: Other nominal oil price volatility shock (ONV)**							
	OP	**FB**	**OV**	**Y**	**N**	**M**	**GD**			**OV**	**FB**	**OP**	**Y**	**N**	**M**	**GD**	
0	**3.73**	-	**0.22**	-	-	**-0.41**	**-0.45**		**0**	**0.98**	-	-	-	-	**-0.48**	**-0.51**	
2	**3.69**	**-0.44**	**0.18**	**-0.05**	0.00	**-0.89**	**-0.59**		**2**	**1.28**	**0.30**	0.21	-0.02	**0.01**	**-0.94**	**-0.40**	
4	**3.63**	**-0.41**	**0.10**	**-0.08**	0.00	**-1.05**	**-0.80**		**4**	**1.00**	**-0.49**	**1.79**	**0.07**	**0.01**	**-0.78**	**-0.61**	
6	**3.24**	0.01	**0.12**	**-0.15**	0.00	**-1.09**	**-0.84**		**6**	**0.95**	**-0.35**	**1.75**	**0.08**	**0.02**	**-0.78**	**-0.76**	
8	**2.64**	**0.23**	**0.18**	**-0.21**	**-0.01**	**-1.23**	**-0.83**		**8**	**1.14**	**0.20**	**0.83**	0.02	**0.01**	**-1.11**	**-0.97**	
12	**2.86**	0.05	**0.15**	**-0.23**	**-0.01**	**-1.04**	**-0.46**		**12**	**1.17**	**0.21**	**1.06**	**-0.08**	**0.01**	**-1.14**	**-0.66**	
20	**2.92**	**-0.06**	**0.19**	**-0.19**	**-0.01**	**-0.98**	**-0.44**		**20**	**1.17**	0.00	**0.92**	**-0.12**	**0.01**	**-1.00**	-0.33	
40	**2.95**	0.00	**0.21**	**-0.21**	**-0.01**	**-1.00**	**-0.36**		**40**	**1.19**	**0.01**	**1.05**	**-0.14**	**0.01**	**-0.96**	-0.13	
	Panel M: Real non-energy commodities price shock (PM)																
	M	**FB**	**OP**	**OV**	**Y**	**N**	**GD**										
0	**1.64**	-	-	-	-	-	**0.58**										
2	**2.14**	**-0.25**	**0.79**	**-0.27**	**0.06**	0.00	**0.75**										
4	**2.04**	**0.31**	-0.13	**-0.08**	0.01	0.00	**1.01**										
6	**1.98**	**0.36**	-0.13	0.06	**-0.04**	0.00	**1.11**										
8	**2.09**	**0.11**	**0.34**	-0.03	-0.03	0.00	**1.27**										
12	**2.16**	0.00	**0.36**	**-0.07**	-0.02	0.00	**1.33**										
20	**2.16**	-0.02	**0.37**	-0.05	-0.01	0.00	**1.31**										
40	**2.14**	0.00	**0.32**	-0.04	-0.01	0.00	**1.27**										

Each Panel in the Table reports cumulative impulse responses of selected variables to a given oil market shock, i.e., oil reserves (OR, Panel A), flow oil supply (positive, OSP, Panel B; negative, OSN, Panel C), oil production mix (OX, Panel D), oil consumption and inventories preferences (OC, Panel E; OI, Panel F), oil futures market-pressure (OFP, Panel G), residual oil futures market (OFR, Panel H), other real oil price (ORP, Panel I), nominal oil price volatility (ONV, Panel L) and non-energy commodities price (PM, Panel M). The variables of interest are oil reserves (R), oil production changes (negative and positive: Pm and Pp), refineries margins (RM), oil consumption and inventories (C, INV), Working-T index (WT), oil futures market basis (FB), real oil price (OP), nominal oil price volatility (OV), real activity (Y), core inflation (N) and the non-energy commodities price index (M). Figures in bold denote statistical significance at the 5% level. Cumulative impulse responses are reported in all cases, except for the oil future market basis (FB). A (-) sign denotes imposed zero restrictions on contemporaneous effects.

Table A2: Identification of macroeconomic structural shocks: Impulse response functions of selected variables to macroeconomic structural shocks (up to a 40-quarter horizon)

	Panel A: Labor supply shock (LS)									Panel B: (Negative) Labor demand shock (LD)							
	E	W	U	Y	F	H	N			U	W	E	Y	F	H	N	
0	**0.24**	**-0.16**	**-0.10**	**0.13**	**0.09**	**0.13**	**-0.02**		0	**0.28**	**0.03**	-	**-0.07**	**0.11**	**-0.07**	**-0.04**	
2	**0.57**	**-0.40**	**-0.41**	**0.43**	**0.37**	**0.35**	**0.01**		2	**0.40**	0.04	**-0.10**	**-0.14**	**0.19**	0.01	**-0.03**	
4	**0.94**	**-0.52**	**-0.74**	**0.62**	**0.32**	**0.48**	0.00		4	**0.37**	-0.01	**-0.08**	**-0.08**	**0.30**	-0.03	**-0.03**	
6	**1.17**	**-0.60**	**-0.85**	**0.64**	**0.35**	**0.54**	**0.01**		6	**0.31**	**-0.09**	-0.04	-0.06	**0.29**	**-0.12**	**-0.03**	
8	**1.33**	**-0.70**	**-0.92**	**0.60**	**0.34**	**0.53**	**0.01**		8	**0.32**	**-0.10**	-0.01	-0.08	**0.28**	**-0.16**	**-0.04**	
12	**1.38**	**-0.90**	**-0.84**	**0.43**	**0.33**	**0.36**	**0.02**		12	**0.34**	**-0.15**	-0.01	-0.12	**0.34**	-0.14	**-0.04**	
20	**1.23**	**-1.10**	**-0.58**	**0.18**	**0.37**	0.09	0.01		20	**0.31**	**-0.24**	0.06	**-0.12**	**0.39**	-0.08	**-0.04**	
40	**1.31**	**-1.30**	**-0.58**	0.14	**0.47**	0.04	0.01		40	**0.35**	**-0.33**	0.07	**-0.17**	**0.42**	-0.15	**-0.04**	
	Panel C: Aggregate demand shock (AD)									Panel D: Productivity shock (PR)							
	Y	N	F	H	W					W	Y	N	F	H			
0	**0.41**	**0.02**	**0.23**	**0.02**	**-0.10**				0	**0.40**	-	-	**-0.22**	**0.14**			
2	**0.67**	**0.02**	**0.23**	-0.02	**-0.31**				2	**0.66**	**0.04**	**-0.01**	**-0.27**	**0.28**			
4	**0.59**	**0.02**	**0.12**	-0.01	**-0.31**				4	**0.77**	**0.26**	0.00	**-0.17**	**0.48**			
6	**0.39**	**0.01**	**0.07**	0.05	**-0.22**				6	**0.77**	**0.56**	**0.01**	**-0.14**	**0.58**			
8	**0.32**	**0.02**	**0.13**	0.10	**-0.21**				8	**0.86**	**0.67**	**0.02**	**-0.27**	**0.63**			
12	**0.29**	**0.02**	**0.12**	0.01	**-0.25**				12	**1.12**	**0.66**	**0.02**	**-0.40**	**0.80**			
20	**0.28**	**0.02**	**0.13**	-0.05	**-0.23**				20	**1.33**	**0.70**	**0.02**	**-0.55**	**0.79**			
40	**0.29**	**0.02**	**0.13**	-0.04	-0.22				40	**1.58**	**0.85**	**0.02**	**-0.63**	**0.96**			
	Panel E: Core inflation shock (CI)									Panel F: (Negative) Global saving rate shock (GFI)							
	N	U	Y	E						G	F	Y	SR				
0	**0.07**	-	-	-					0	**0.34**	**-0.15**	-	**0.04**				
2	**0.06**	-0.01	**-0.08**	**-0.04**					2	**0.59**	**-0.29**	**-0.25**	**0.04**				
4	**0.05**	**0.05**	**-0.16**	**-0.10**					4	**0.80**	**-0.34**	**-0.49**	**0.03**				
6	**0.05**	**0.15**	**-0.23**	**-0.21**					6	**0.88**	**-0.33**	**-0.63**	**0.01**				
8	**0.05**	**0.19**	**-0.24**	**-0.30**					8	**0.86**	**-0.34**	**-0.70**	0.00				
12	**0.04**	**0.15**	**-0.15**	**-0.34**					12	**0.70**	**-0.30**	**-0.65**	-0.01				
20	**0.05**	0.04	-0.01	**-0.28**					20	**0.54**	**-0.22**	**-0.47**	-0.01				
40	**0.05**	0.02	0.01	**-0.30**					40	**0.59**	**-0.26**	**-0.50**	0.00				
	Panel G: (Negative) US saving rate shock (GDI)									Panel H: Saving glut shock (GTI)							
	Fd	F	Y	SR						Td	F	Y	SR	X			
0	**0.40**	**-0.12**	-	**0.04**					0	**0.16**	**-0.05**	-	**-0.11**	-0.01			
2	**0.18**	**-0.31**	**-0.23**	**0.06**					2	**0.23**	-0.06	**-0.03**	0.00	**-0.05**			
4	**0.20**	**-0.19**	**-0.13**	0.01					4	**0.22**	**-0.13**	**-0.17**	-0.01	**-0.25**			
6	**0.17**	**-0.20**	-0.03	0.02					6	**0.22**	**-0.09**	**-0.30**	**-0.04**	**-0.25**			
8	**0.18**	**-0.25**	0.01	**0.04**					8	**0.27**	0.01	**-0.30**	**-0.05**	**-0.22**			
12	**0.16**	**-0.28**	0.08	**0.04**					12	**0.29**	0.05	**-0.32**	**-0.05**	**-0.19**			
20	**0.16**	**-0.38**	**0.13**	**0.04**					20	**0.29**	0.12	**-0.29**	**-0.04**	**-0.15**			
40	**0.15**	**-0.43**	**0.21**	**0.04**					40	**0.29**	**0.15**	**-0.37**	**-0.04**	**-0.12**			

Each Panel in the Table reports cumulative impulse responses of selected variables to a given macroeconomic shock, i.e., labor supply (LS; Panel A) and demand (LD, Panel B), good's aggregate demand (AD, Panel C), productivity (PR, Panel D), core inflation (CI, Panel E), global saving rate (GFI, Panel F), US saving rate (GDI, Panel G) and ex-US global saving rate (GTI, Panel H). The variables of interest are real activity (Y), core inflation (N), employment (E), the unemployment rate (U), real wage (W), real stock prices (F), real house prices (H), global fiscal stance (G), the ratios of US fiscal and trade deficits to GDP (Fd and Td), the US$ exchange rate return (X) and the real short-term interest rate (SR). Figures in bold denote statistical significance at the 5% level. A (-) sign denotes imposed zero restrictions on contemporaneous effects.

Table A3: **Identification of financial structural shocks: Impulse response functions of selected variables to financial structural shocks (up to a 40-quarter horizon)**

	Panel A: Excess liquidity shock (EL)									Panel B: Short-term interest rate shock (TL)							
	L	**SR**	**TS**	**Y**	**N**	**F**	**LEV**	**FV**		**SR**	**TS**	**Y**	**N**	**F**	**H**	**GD**	**FV**
0	**0.29**	**-0.03**	**-0.01**	-	-	**0.03**	**0.24**	0.01	**0**	**0.17**	**-0.01**	-	-	**0.12**	**0.04**	**-0.65**	**0.03**
2	**0.33**	**-0.04**	**-0.05**	0.02	**0.01**	0.02	**0.24**	**0.12**	**2**	**0.11**	0.01	**0.06**	**0.01**	**0.23**	**0.23**	-0.14	-0.04
4	**0.51**	**-0.03**	0.01	**-0.06**	0.00	**-0.09**	**-0.24**	**0.18**	**4**	**0.11**	-0.02	**0.28**	**0.01**	**0.30**	**0.38**	0.10	-0.02
6	**0.54**	**-0.07**	**0.04**	**-0.09**	0.00	-0.04	**-0.48**	**0.25**	**6**	**0.12**	**-0.02**	**0.44**	**0.01**	**0.31**	**0.47**	0.15	**-0.04**
8	**0.50**	**-0.06**	**0.04**	-0.07	0.00	-0.03	**-0.10**	**0.23**	**8**	**0.13**	**-0.04**	**0.51**	**0.02**	**0.28**	**0.52**	0.01	0.00
12	**0.53**	**-0.06**	**0.04**	**-0.11**	0.00	-0.04	-0.03	**0.27**	**12**	**0.14**	**-0.06**	**0.49**	**0.03**	**0.24**	**0.54**	**-0.51**	**0.04**
20	**0.56**	**-0.06**	**0.04**	**-0.10**	0.00	0.02	0.00	**0.26**	**20**	**0.14**	**-0.04**	**0.34**	**0.02**	**0.19**	**0.39**	-0.24	**0.08**
40	**0.62**	**-0.07**	**0.04**	**-0.14**	0.00	0.04	0.00	**0.28**	**40**	**0.13**	**-0.04**	**0.37**	**0.02**	**0.21**	**0.40**	-0.18	**0.07**
	Panel C: Term structure slope shock (TS)									**Panel D: US terms of trade shock (TT)**							
	TS	**SR**	**Y**	**N**	**F**	**H**	**GD**	**FV**		**X**	**Td**	**Y**	**F**	**H**	**SR**	**TS**	**GD**
0	**0.23**	-	-	-	**0.04**	**0.03**	**-0.42**	**0.04**	**0**	**0.47**	-	-	**-0.05**	-	-	-	**1.45**
2	**0.26**	0.00	**0.07**	**0.01**	0.04	**0.04**	-0.15	0.00	**2**	**0.59**	0.01	0.02	**-0.09**	**-0.07**	**0.03**	-0.01	**1.92**
4	**0.22**	**-0.02**	**0.22**	**0.01**	**0.18**	**0.10**	-0.07	**-0.09**	**4**	**0.61**	**-0.04**	**-0.17**	**-0.15**	**-0.19**	**0.04**	0.01	**2.36**
6	**0.18**	0.01	**0.34**	**0.01**	**0.14**	**0.15**	**-0.59**	**-0.06**	**6**	**0.67**	**-0.08**	**-0.34**	**-0.12**	**-0.27**	**0.04**	0.03	**2.57**
8	**0.18**	0.00	**0.36**	**0.01**	**0.16**	**0.21**	**-0.85**	**-0.05**	**8**	**0.72**	**-0.10**	**-0.45**	-0.08	**-0.35**	**0.04**	**0.05**	**3.02**
12	**0.17**	**0.01**	**0.40**	**0.02**	**0.16**	**0.26**	**-1.05**	-0.02	**12**	**0.78**	**-0.11**	**-0.54**	-0.08	**-0.53**	**0.03**	**0.07**	**3.71**
20	**0.18**	**0.01**	**0.30**	**0.02**	**0.10**	**0.16**	**-0.97**	0.02	**20**	**0.84**	**-0.10**	**-0.54**	-0.02	**-0.66**	**0.02**	**0.10**	**4.22**
40	**0.18**	**0.01**	**0.31**	**0.02**	**0.12**	**0.16**	**-0.87**	0.02	**40**	**0.84**	**-0.10**	**-0.56**	0.02	**-0.68**	**0.02**	**0.10**	**4.26**
	Panel E: Stocks preferences shock (PF)									**Panel F: Housing preferences shock (PH)**							
	F	**H**	**SR**	**TS**	**M**	**OP**	**GD**	**Y**		**H**	**F**	**SR**	**TS**	**M**	**OP**	**GD**	**Y**
0	**0.35**	-	-	-	-	-	**-0.15**	-	**0**	**0.40**	**0.03**	-	-	**0.21**	**-0.87**	**1.26**	-
2	**0.43**	**0.06**	**-0.01**	**-0.02**	**0.25**	**0.61**	**0.15**	**0.08**	**2**	**0.57**	**0.12**	**-0.04**	0.00	**1.12**	**0.73**	**1.69**	**0.19**
4	**0.44**	**0.07**	0.00	**-0.03**	**0.43**	**0.82**	**0.31**	**0.15**	**4**	**0.68**	**0.16**	**-0.03**	**-0.02**	**1.32**	**1.89**	**1.98**	**0.34**
6	**0.43**	**0.07**	**0.01**	**-0.03**	**0.34**	**0.75**	**0.31**	**0.13**	**6**	**0.73**	**0.17**	**-0.01**	**-0.04**	**1.29**	**2.40**	**1.72**	**0.40**
8	**0.44**	**0.06**	**0.00**	**-0.02**	**0.29**	**0.98**	**0.37**	**0.12**	**8**	**0.74**	**0.14**	0.01	**-0.06**	**1.01**	**2.32**	**1.56**	**0.39**
12	**0.45**	0.00	0.00	**-0.02**	**0.29**	**1.27**	**0.50**	**0.08**	**12**	**0.66**	**0.08**	0.01	**-0.05**	**0.80**	**2.61**	**1.53**	**0.29**
20	**0.48**	**-0.08**	0.00	-0.01	**0.33**	**1.07**	**0.82**	-0.01	**20**	**0.44**	0.04	-0.01	-0.01	**0.91**	**2.24**	**2.00**	**0.16**
40	**0.51**	**-0.11**	0.00	-0.01	**0.38**	**1.14**	**1.05**	-0.03	**40**	**0.47**	0.07	-0.01	-0.02	**0.95**	**2.32**	**1.94**	**0.21**
	Panel G: Gold preference shock (PG)									**Panel H: Uncertainty shock (RAV)**							
	GD	**F**	**H**	**SR**	**TS**	**M**	**OP**	**Y**		**FV**	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**
0	**2.47**	-	-	-	-	-	-	-	**0**	**0.57**	-	-	**-0.26**	-	-	-	**-0.35**
2	**2.80**	0.00	**-0.04**	**0.01**	0.00	**0.75**	**0.97**	**0.06**	**2**	**0.60**	**-0.08**	**0.12**	**-0.18**	**0.04**	-0.01	0.01	-0.05
4	**3.26**	**-0.06**	**-0.09**	**0.02**	**0.02**	**0.77**	**0.51**	0.00	**4**	**0.42**	0.00	0.04	-0.03	**0.25**	**-0.05**	-0.01	-0.06
6	**3.44**	-0.03	**-0.09**	**0.01**	**0.04**	**0.76**	**0.78**	0.00	**6**	**0.31**	**0.14**	-0.02	0.07	**0.44**	**-0.02**	**-0.08**	0.07
8	**3.61**	0.01	**-0.12**	0.00	**0.04**	**0.92**	**1.52**	0.02	**8**	**0.26**	**0.18**	0.02	0.09	**0.56**	-0.01	**-0.13**	0.04
12	**3.58**	0.00	**-0.17**	**0.01**	**0.03**	**0.86**	**1.28**	0.01	**12**	**0.34**	**0.13**	**0.25**	0.03	**0.66**	0.01	**-0.14**	-0.35
20	**3.80**	0.01	**-0.23**	0.01	**0.04**	**0.89**	**1.33**	-0.04	**20**	**0.40**	0.00	**0.34**	-0.04	**0.44**	0.00	**-0.10**	-0.34
40	**3.93**	0.04	**-0.26**	0.00	**0.05**	**0.92**	**1.34**	-0.06	**40**	**0.38**	0.03	**0.30**	0.00	**0.45**	0.00	**-0.10**	-0.23
	Panel I: Size shock (SZ)									**Panel L: Value shock (VL)**							
	SMB	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**		**HML**	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**
0	**3.08**	-	-	**0.33**	-	-	-	**0.44**	**0**	**3.81**	-	-	**-0.10**	-	-	-	**0.74**
2	**2.71**	**0.19**	**-0.18**	**0.54**	**0.22**	**-0.02**	**-0.03**	**1.35**	**2**	**3.57**	-0.03	**-0.07**	**-0.17**	**0.03**	0.01	**-0.04**	**1.15**
4	**2.01**	**0.45**	**-0.25**	**0.65**	**0.36**	-0.01	**-0.13**	**2.60**	**4**	**4.38**	0.03	**-0.15**	**-0.25**	**0.14**	0.01	**-0.05**	**1.18**
6	**1.43**	**0.49**	0.03	**0.56**	**0.45**	**0.05**	**-0.15**	**2.11**	**6**	**3.99**	0.07	**-0.20**	**-0.31**	**0.23**	0.00	**-0.04**	**1.43**
8	**1.36**	**0.47**	**0.27**	**0.61**	**0.54**	**0.02**	**-0.12**	**1.96**	**8**	**4.16**	**0.18**	**-0.27**	**-0.31**	**0.31**	0.00	**-0.04**	**1.61**
12	**1.40**	**0.48**	**0.44**	**0.65**	**0.43**	**0.03**	**-0.13**	**2.03**	**12**	**3.88**	**0.32**	**-0.34**	**-0.34**	**0.43**	0.01	**-0.06**	**1.61**
20	**1.60**	**0.19**	**0.65**	**0.63**	0.16	**0.02**	**-0.10**	**1.92**	**20**	**3.90**	**0.36**	**-0.36**	**-0.43**	**0.53**	**0.01**	**-0.08**	**1.34**
40	**1.74**	0.15	**0.72**	**0.71**	0.09	**0.02**	**-0.09**	**2.08**	**40**	**3.87**	**0.41**	**-0.49**	**-0.49**	**0.58**	**0.02**	**-0.08**	**1.33**
	Panel M: Momentum shock (MM)									**Panel N: Stock market liquidity shock (SL)**							
	MOM	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**		**PSL**	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**
0	**3.50**	-	-	**-0.12**	-	-	-	**-0.21**	**0**	**6.34**	-	-	**0.11**	-	-	-	**-0.09**
2	**2.51**	**-0.07**	**0.09**	**-0.16**	**-0.06**	**0.01**	**0.04**	**-0.66**	**2**	-0.18	**0.07**	**-0.06**	**0.10**	**-0.07**	**0.01**	0.00	**-0.70**
4	**2.42**	**-0.17**	**0.14**	**-0.16**	**-0.14**	0.00	**0.07**	**-1.04**	**4**	**-0.39**	**0.11**	**-0.09**	**0.15**	**-0.18**	**0.02**	**-0.02**	**-0.60**
6	**2.15**	**-0.19**	**0.06**	**-0.11**	**-0.22**	**-0.01**	**0.07**	**-0.93**	**6**	**-0.19**	0.04	**-0.05**	**0.09**	**-0.27**	**0.02**	-0.01	**-0.86**
8	**2.36**	**-0.23**	0.03	**-0.13**	**-0.29**	0.00	**0.07**	**-0.99**	**8**	0.02	-0.03	0.00	**0.08**	**-0.31**	**0.02**	0.00	**-1.03**
12	**2.17**	**-0.30**	0.00	**-0.12**	**-0.31**	**-0.01**	**0.08**	**-1.02**	**12**	0.01	-0.04	**-0.06**	**0.13**	**-0.35**	0.00	**0.02**	**-0.83**
20	**2.29**	**-0.22**	-0.06	**-0.09**	**-0.27**	**-0.01**	**0.08**	**-0.87**	**20**	0.01	-0.01	-0.06	**0.18**	**-0.27**	0.00	0.01	**-0.80**
40	**2.31**	**-0.23**	-0.03	**-0.08**	**-0.27**	**-0.01**	**0.08**	**-0.90**	**40**	0.00	-0.05	0.01	**0.19**	**-0.30**	0.00	0.01	**-0.82**

Table A3 (ctd): Identification of financial structural shocks: Impulse response functions of selected variables to financial structural shocks (up to a 40-quarter horizon)

	Panel O: Leverage shock (LV)									**Panel P: Risk appetite shock (RAP)**							
	LEV	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**		**FRA**	**Y**	**L**	**F**	**H**	**SR**	**TS**	**M**
0	**3.78**	-	-	**-0.10**	-	-	-	-0.03	**0**	**0.04**	-	-	-	-	-	-	-
2	**-0.26**	**-0.10**	0.02	**-0.19**	**-0.09**	**0.02**	**0.03**	**-0.45**	**2**	**0.04**	0.00	0.01	**0.03**	**0.01**	0.00	**0.01**	**0.06**
4	0.11	**-0.24**	**0.06**	**-0.28**	**-0.23**	**0.03**	**0.05**	**-0.75**	**4**	**0.04**	**0.03**	0.00	**0.05**	**0.03**	**-0.01**	0.00	0.04
6	**-0.23**	**-0.31**	0.00	**-0.27**	**-0.32**	0.00	**0.09**	**-0.72**	**6**	**0.04**	**0.06**	0.00	**0.07**	**0.05**	**-0.01**	-0.01	0.07
8	-0.01	**-0.34**	**-0.09**	**-0.29**	**-0.40**	0.00	**0.10**	**-0.63**	**8**	**0.04**	**0.06**	**0.03**	**0.06**	**0.05**	0.00	**-0.01**	0.03
12	0.01	**-0.31**	**-0.24**	**-0.27**	**-0.41**	**-0.01**	**0.11**	**-0.42**	**12**	**0.04**	**0.04**	**0.08**	**0.06**	**0.05**	0.00	**-0.01**	-0.05
20	**0.05**	**-0.17**	**-0.32**	**-0.23**	**-0.25**	0.00	**0.08**	**-0.39**	**20**	**0.04**	0.01	**0.10**	**0.06**	0.02	0.00	-0.01	-0.03
40	0.00	**-0.19**	**-0.31**	**-0.26**	**-0.24**	0.00	**0.08**	**-0.49**	**40**	**0.04**	0.01	**0.11**	**0.08**	0.01	**0.00**	0.00	0.00

Each Panel in the Table reports cumulative impulse responses of selected variables to a given financial shock, i.e., monetary policy stance or excess liquidity (EL, Panel A), real short-term interest rate (TL, Panel B), term structure slope (TS, Panel C), US terms of trade shocks (TT, Panel D), stocks (PF, Panel E), housing (PH, Panel F) and gold (PG, Panel G) preferences, uncertainty (RAV, Panel H), size (SZ, Panel I), value (VL, Panel L), momentum (MM, Panel M), stock market liquidity (SL, Panel N) , financial leverage (LV, Panel O) and risk appetite (RAP, Panel P). The variables of interest are excess liquidity (L), real short term rate (SR) and term spread (TS), real housing prices (H), real stock prices (F), US$ exchange rate index (X), real activity (Y), core inflation (N), real oil prices (OP), real non-energy commodities prices (M), real gold prices (GD), stock market volatility (FV), Fama-French size and value factors (SMB, HML), Carhart momentum factor (MOM), Pastor-Stambaugh stock market liquidity factor (PSL), Adrian-Etula-Muir leverage factor (LEV), financial fragility index (FRA). Figures in bold denote statistical significance at the 5% level. Apart from LEV and PSL, cumulated impulse responses are reported in all cases. A (-) sign denotes imposed zero restrictions on contemporaneous effects.

Table A4: Forecast Error Variance Decomposition: real activity, employment, excess liquidity, real short term rate, leverage, US$ exchange rate index, real stock and housing prices factors; contribution of structural shocks.

Panel A: real activity

	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	20.2	9.6	9.6	-	10.6	8.5	2.1	-	0.0	-	0	79.8	79.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	25.3	4.4	2.2	2.2	20.5	17.2	2.9	0.4	0.1	0.3	2	74.7	58.2	8.4	4.5	3.8	0.1	0.2	0.6	0.1	0.2	0.3	3.3	0.4	2.6	4.0	0.4	2.2	0.0	0.7
4	30.9	5.9	2.5	3.4	23.0	20.7	1.4	0.9	1.8	0.2	4	69.1	35.3	12.4	9.3	2.4	0.7	0.8	3.8	0.1	2.3	1.4	5.5	0.9	4.5	11.3	0.3	7.4	0.1	2.0
6	33.6	7.2	3.5	3.7	20.5	18.3	0.8	1.4	5.8	0.1	6	66.4	21.5	15.3	12.1	1.3	1.9	2.4	7.4	0.3	4.3	2.8	6.1	0.8	5.2	13.9	0.5	8.8	0.1	2.9
8	36.2	8.8	4.8	4.0	18.3	16.2	0.6	1.5	9.0	0.1	8	63.8	14.4	16.5	13.4	0.8	2.3	3.8	9.1	0.2	5.7	3.2	5.9	0.7	5.1	14.1	0.7	8.1	0.5	3.1
12	36.4	11.1	6.6	4.5	14.3	12.5	0.5	1.3	10.9	0.1	12	63.6	9.5	17.1	13.8	0.6	2.7	5.9	10.8	0.2	6.7	3.9	4.9	0.5	4.3	15.5	0.8	8.0	1.4	3.2
20	38.9	14.1	9.5	4.6	10.3	8.9	0.5	0.9	14.5	0.0	20	61.1	6.7	16.6	13.1	0.6	2.9	8.6	10.9	0.3	6.5	4.1	3.6	0.3	3.2	14.7	0.6	6.2	2.9	2.8
40	44.9	20.0	15.3	4.7	5.8	4.8	0.6	0.4	19.1	0.0	40	55.1	4.9	15.4	11.1	0.8	3.5	9.8	9.8	0.4	5.7	3.7	2.6	0.2	2.4	12.4	0.3	3.5	4.4	2.1

Panel B: employment

	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	100.0	10.0	10.0	-	90.0	90.0	-	-	-	-	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	73.7	13.3	12.7	0.6	58.9	57.2	1.5	0.2	1.5	0.1	2	26.3	7.4	12.0	4.7	5.4	1.9	0.1	0.4	0.3	0.1	0.0	1.9	0.7	0.8	4.5	0.1	2.3	1.1	0.4
4	64.0	14.2	12.9	1.3	48.9	47.8	0.8	0.3	0.9	0.1	4	36.0	5.6	13.8	7.5	5.5	0.8	0.3	1.6	0.3	1.1	0.2	3.5	1.5	1.9	11.3	0.1	7.9	0.4	1.5
6	57.1	14.3	12.5	1.8	42.4	41.4	0.3	0.7	0.4	0.0	6	42.9	3.5	14.1	9.7	4.1	0.3	0.9	3.4	0.1	2.3	1.0	4.4	1.7	2.6	16.5	0.6	11.3	0.3	2.4
8	54.1	15.4	13.4	2.0	38.2	37.0	0.2	1.0	0.5	0.1	8	45.9	2.1	14.3	11.1	3.0	0.2	1.7	5.0	0.1	3.4	1.5	4.6	1.7	2.9	18.2	1.2	11.9	0.2	3.0
12	51.2	17.9	15.5	2.4	32.5	31.1	0.1	1.3	0.7	0.1	12	48.8	1.0	14.2	12.0	2.1	0.1	2.7	6.8	0.1	4.5	2.2	4.3	1.5	2.8	19.9	1.9	12.4	0.1	3.5
20	50.3	21.0	18.6	2.4	28.7	27.3	0.1	1.3	0.6	0.1	20	49.7	0.5	13.7	11.8	1.8	0.1	3.9	7.6	0.1	4.8	2.7	3.5	1.4	2.0	20.4	2.1	12.6	0.1	3.5
40	52.1	24.4	22.1	2.3	27.4	26.1	0.1	1.2	0.4	0.1	40	47.9	0.3	13.2	11.1	2.0	0.1	4.1	7.3	0.1	4.5	2.7	3.1	1.5	1.6	19.7	1.8	12.5	0.1	3.2

Panel C: excess liquidity

	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	22.1	9.8	9.0	0.8	6.6	2.3	3.9	0.4	5.7	-	0	77.9	29.5	13.3	11.9	0.1	1.3	-	35.0	35.0	-	-	-	-	-	-	-	-	-	-
2	31.1	12.8	11.5	1.3	13.1	6.2	6.0	0.9	5.0	0.2	2	68.9	30.8	13.2	11.4	1.3	0.5	0.3	19.3	19.2	0.0	0.1	0.3	0.2	0.1	5.0	1.2	2.5	0.4	0.0
4	28.5	17.2	16.1	1.1	8.2	3.7	3.9	0.6	3.0	0.1	4	71.5	22.6	13.3	12.1	0.9	0.3	2.7	23.1	21.6	0.2	1.3	0.5	0.1	0.1	9.3	0.9	4.9	1.4	0.2
6	29.6	20.5	19.2	1.3	6.3	3.1	2.6	0.6	2.5	0.3	6	70.4	15.9	13.1	10.6	2.2	0.3	5.7	26.2	24.1	0.1	2.0	1.5	0.3	0.3	8.0	0.6	3.4	2.2	0.1
8	35.7	24.9	23.5	1.4	7.8	5.0	2.0	0.8	2.7	0.3	8	64.3	11.1	11.5	8.0	3.3	0.2	6.9	23.8	22.0	0.2	1.6	2.9	0.7	1.1	8.2	0.4	3.4	3.0	0.2
12	46.5	31.2	29.1	2.1	13.5	10.4	1.2	1.9	1.7	0.1	12	53.5	6.0	7.4	3.8	3.4	0.2	5.9	17.8	16.1	0.9	0.8	5.3	1.3	2.9	11.0	0.9	4.9	3.7	0.9
20	54.0	35.5	33.4	2.1	17.0	13.4	0.7	2.9	1.4	0.1	20	46.0	3.1	4.9	1.7	3.0	0.2	3.8	12.9	10.6	1.9	0.4	6.3	1.7	3.4	15.1	1.9	7.7	3.3	1.7
40	61.5	42.1	40.3	1.8	16.8	13.1	0.8	2.9	2.6	0.0	40	38.5	1.9	4.2	0.6	3.5	0.1	2.7	9.7	7.9	1.6	0.2	5.3	1.8	2.4	14.7	1.6	7.8	3.4	1.5

Panel D: real short term interest rate

	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	40.5	5.3	4.9	0.4	9.5	0.9	4.2	4.4	25.7	-	0	59.5	13.9	15.3	1.9	1.4	12.0	-	30.3	0.8	29.5	-	-	-	-	-	-	-	-	-
2	38.4	7.6	6.4	1.2	11.2	3.2	4.1	3.9	19.5	0.1	2	61.6	12.9	14.1	2.2	4.4	7.5	0.5	31.1	2.8	28.3	0.0	1.6	0.1	1.4	1.4	0.1	0.3	0.0	0.6
4	38.9	9.9	8.0	1.9	11.9	2.9	3.4	5.6	16.5	0.6	4	61.1	9.8	12.3	2.7	3.4	6.2	2.1	32.3	2.8	29.2	0.3	2.1	0.1	1.6	2.7	1.1	0.3	0.1	0.8
6	36.1	9.5	7.3	2.2	11.8	2.4	3.1	6.3	14.1	0.7	6	63.9	8.0	10.8	2.4	2.9	5.5	3.1	35.5	4.1	31.1	0.3	1.9	0.1	1.4	4.6	1.8	1.2	0.1	0.7
8	36.1	9.8	7.5	2.3	11.0	2.0	3.0	6.0	14.6	0.7	8	63.9	6.5	10.4	2.0	2.7	5.7	3.2	37.9	5.1	32.5	0.3	1.6	0.1	1.1	4.4	1.6	1.4	0.1	0.6
12	36.6	10.4	7.5	2.9	8.8	1.5	2.5	4.8	16.9	0.5	12	63.4	4.7	9.4	1.5	2.8	5.1	3.0	41.3	5.8	35.2	0.3	1.2	0.1	0.9	3.7	1.2	1.3	0.1	0.5
20	35.9	9.9	6.2	3.7	7.0	1.0	2.0	4.0	18.5	0.5	20	64.1	3.2	9.0	1.1	3.1	4.8	2.3	45.2	6.9	37.9	0.4	0.9	0.1	0.6	3.6	0.8	1.7	0.2	0.4
40	37.2	9.2	5.3	3.9	6.7	0.8	1.7	4.2	20.9	0.4	40	62.8	2.0	8.6	0.6	3.6	4.4	1.7	47.5	7.9	39.3	0.3	0.6	0.1	0.4	2.5	0.4	1.2	0.3	0.2

Table A4 (ctd): Forecast Error Variance Decomposition: real activity, employment, excess liquidity, real short term rate, leverage, US$ exchange rate index, real stock and housing prices factors; contribution of structural shocks.

Panel E: financial leverage																														
	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	20.3	10.3	7.3	3.0	6.6	3.5	0.9	2.2	3.4	-	0	79.7	0.0	6.1	0.0	1.1	5.0	0.3	1.6	0.2	0.9	0.5	2.3	-	2.0	69.5	12.1	2.2	0.2	53.8
2	30.1	14.1	9.5	4.6	8.2	4.7	1.9	1.6	7.4	0.4	2	69.9	1.2	16.3	0.6	10.5	5.2	0.4	3.7	0.7	1.3	1.7	2.3	0.3	1.4	46.4	13.4	3.2	1.1	26.9
4	31.5	15.2	10.9	4.3	9.0	5.5	1.8	1.7	6.9	0.4	4	68.5	1.3	14.9	0.6	9.7	4.6	0.6	4.2	0.8	1.3	2.1	2.8	0.4	1.3	45.2	14.2	3.3	1.3	24.0
6	33.3	17.5	12.9	4.6	8.9	5.3	1.9	1.7	6.5	0.5	6	66.7	1.2	14.2	0.6	9.3	4.3	0.8	5.1	1.6	1.3	2.2	4.3	0.4	1.2	43.1	14.1	3.3	1.3	22.3
8	33.7	18.0	13.6	4.4	8.7	5.1	1.9	1.7	6.5	0.5	8	66.3	1.3	13.9	0.6	9.1	4.2	0.9	5.0	1.6	1.3	2.1	5.5	0.5	1.2	42.6	14.1	3.6	1.4	21.2
12	34.2	18.6	14.5	4.1	8.8	5.1	2.0	1.7	6.4	0.5	12	65.8	1.4	13.8	0.6	9.0	4.2	0.9	5.0	1.6	1.3	2.1	5.9	0.5	1.2	42.2	14.0	3.6	1.4	20.7
20	34.4	18.7	14.9	3.8	8.8	5.1	2.0	1.7	6.4	0.5	20	65.6	1.4	13.8	0.7	8.9	4.2	0.9	5.0	1.6	1.3	2.1	5.6	0.5	1.2	42.0	14.0	3.6	1.4	20.5
40	34.4	18.7	14.8	3.9	8.8	5.1	2.0	1.7	6.3	0.5	40	65.6	1.4	13.8	0.7	8.9	4.2	0.9	5.0	1.6	1.3	2.1	5.3	0.5	1.2	42.0	13.9	3.7	1.4	20.5

Panel F: US$ exchange rate index																														
	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	35.0	10.3	6.0	4.3	24.7	7.2	13.5	4.0	0.0	-	0	65.0	12.4	0.2	0.2	0.0	0.0	49.6	2.6	0.9	0.7	1.0	0.2	-	0.2	-	-	-	-	-
2	43.2	18.6	7.1	11.5	24.1	8.1	11.2	4.8	0.1	0.4	2	56.8	8.6	2.3	1.6	0.5	0.2	35.5	3.3	2.5	0.5	0.3	3.3	0.1	1.9	3.7	0.4	1.2	0.3	0.8
4	44.2	23.3	8.1	15.2	20.3	6.2	9.1	5.0	0.2	0.4	4	55.8	4.6	4.5	1.4	1.1	2.0	30.8	3.9	1.5	2.1	0.3	5.0	0.3	3.1	7.2	0.3	4.2	0.2	0.7
6	43.5	23.8	8.5	15.3	19.1	5.5	8.3	5.3	0.2	0.4	6	56.5	3.0	5.0	1.3	1.0	2.7	29.4	4.4	1.5	2.6	0.3	6.0	0.3	3.6	8.9	0.4	5.0	0.2	0.8
8	44.0	25.0	9.3	15.7	18.3	5.1	8.0	5.2	0.2	0.5	8	56.0	2.2	4.8	1.1	1.0	2.7	28.9	4.3	1.5	2.6	0.2	6.4	0.3	3.6	9.4	0.4	4.9	0.3	0.7
12	43.9	25.8	10.2	15.6	16.9	4.5	7.6	4.8	0.5	0.7	12	56.1	1.7	3.9	0.7	0.8	2.4	29.8	4.0	1.4	2.4	0.2	6.4	0.3	3.2	10.4	0.3	5.6	0.3	0.7
20	44.0	25.7	10.3	15.4	16.4	4.4	7.2	4.8	1.2	0.7	20	56.0	1.5	2.8	0.4	0.6	1.8	31.4	3.5	1.4	2.0	0.1	6.4	0.4	3.1	10.4	0.4	5.7	0.2	0.6
40	44.6	25.4	10.9	14.5	16.4	5.3	6.0	5.1	2.1	0.7	40	55.4	1.4	1.8	0.3	0.3	1.2	31.0	3.3	1.4	1.8	0.1	6.5	0.5	3.0	11.3	0.5	6.8	0.1	0.7

Panel G: real stock prices																														
	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	21.3	8.8	6.0	2.8	3.6	1.3	2.2	0.1	8.4	0.5	0	78.7	9.1	7.0	3.9	2.6	0.5	0.4	2.8	0.1	2.5	0.2	21.1	20.9	0.2	38.2	11.2	19.1	1.9	1.7
2	24.4	8.3	6.4	1.9	9.4	6.7	2.0	0.7	6.4	0.3	2	75.6	6.6	12.6	5.5	6.6	0.5	0.4	3.8	0.1	3.5	0.2	16.8	15.9	0.8	35.4	5.7	21.6	2.5	2.1
4	28.4	11.7	9.1	2.6	12.2	7.0	3.8	1.4	4.3	0.2	4	71.6	3.9	11.2	6.0	4.6	0.6	0.8	5.2	0.2	4.3	0.7	15.3	13.9	1.2	35.3	3.0	22.9	2.9	3.2
6	31.6	15.2	12.6	2.6	13.0	6.7	4.3	2.0	3.2	0.2	6	68.4	2.7	10.5	6.2	3.7	0.6	0.9	6.1	0.3	4.8	1.0	14.2	12.9	1.3	34.0	2.1	21.8	3.9	3.6
8	34.4	17.6	15.0	2.6	13.4	6.7	4.3	2.4	3.2	0.2	8	65.6	2.1	10.2	6.3	3.4	0.5	0.8	5.9	0.2	4.7	1.0	13.4	12.1	1.2	33.1	1.6	21.1	4.2	3.8
12	38.4	20.5	18.2	2.3	13.5	6.3	4.5	2.7	4.3	0.1	12	61.6	1.6	9.4	5.7	3.4	0.3	0.6	5.4	0.2	4.2	1.0	12.2	11.2	0.9	32.3	1.1	20.8	4.6	3.7
20	46.8	26.5	24.5	2.0	13.5	5.6	5.2	2.7	6.7	0.1	20	53.2	1.0	8.5	4.2	3.9	0.4	0.4	3.9	0.1	3.1	0.7	10.6	10.0	0.5	28.7	0.6	18.2	5.2	2.9
40	55.1	33.0	31.2	1.8	13.4	5.7	5.1	2.6	8.6	0.1	40	44.9	0.6	7.5	2.7	4.4	0.4	0.2	2.6	0.1	2.0	0.5	8.7	8.5	0.3	25.1	0.3	15.3	5.9	2.2

Panel H: real housing prices																														
	Supply-side shocks											Demand-side and financial shocks																		
	Total	OIL	OS	OO	LM	LS	LD	CI	PR	PM		Total	AD	SAV	GFI	GDI	GTI	TT	MP	EL	TL	TS	PA	PF	PH	RF	RAV	SZ	VL	LV
0	22.4	4.3	3.9	0.4	9.1	6.8	2.1	0.2	9.0	-	0	77.6	0.2	6.8	4.6	1.2	1.0	0.0	1.8	0.7	0.6	0.5	68.8	-	68.8	-	-	-	-	-
2	35.5	14.5	11.4	3.1	12.7	10.9	0.3	1.5	8.2	0.1	2	64.5	0.1	11.7	9.3	0.6	1.8	0.5	7.4	3.2	4.0	0.2	40.4	0.2	40.1	4.3	0.1	3.1	0.1	0.5
4	39.6	18.4	14.0	4.4	12.3	10.3	0.1	1.9	8.7	0.2	4	60.4	0.1	13.9	11.2	0.8	1.9	1.1	9.4	3.9	5.2	0.3	26.6	0.2	26.2	9.3	1.4	4.7	0.5	1.4
6	41.1	21.2	15.6	5.6	11.1	9.1	0.2	1.8	8.6	0.2	6	58.9	0.1	14.4	12.0	1.0	1.4	1.6	9.6	3.8	5.4	0.4	20.3	0.2	19.9	12.8	2.8	4.9	0.9	2.0
8	41.8	23.8	17.4	6.4	9.6	7.7	0.3	1.6	8.2	0.2	8	58.2	0.1	14.5	12.3	1.2	1.0	1.9	9.6	3.9	5.2	0.5	16.4	0.1	16.1	15.4	4.0	5.0	1.4	2.3
12	44.0	28.0	21.0	7.0	7.2	5.5	0.4	1.3	8.6	0.2	12	56.0	0.1	14.4	12.1	1.7	0.6	2.7	9.8	4.1	4.9	0.8	12.0	0.1	11.6	17.1	5.3	4.4	1.9	2.5
20	47.9	34.0	27.4	6.6	4.3	3.1	0.3	0.9	9.4	0.2	20	52.1	0.1	13.4	10.8	2.2	0.4	4.5	9.2	4.3	4.2	0.7	8.6	0.1	8.2	16.1	5.0	2.9	3.2	2.1
40	54.2	40.8	34.9	5.9	2.1	1.4	0.3	0.4	11.0	0.3	40	45.8	0.1	11.7	8.9	2.6	0.2	5.9	8.2	4.6	3.1	0.5	6.4	0.1	5.4	13.5	3.9	1.4	4.2	1.4

The table reports the forecast error variance decomposition of the global factors for real activity, employment, excess liquidity, real short-term rate, leverage, the US$ exchange rate index, real stock and housing prices at various horizons (impact (0) and 2 to 40 quarters), relative to various identified structural shocks. Supply-side shocks: oil market supply-side (OS), other oil market (OO), joint oil market (OIL: OS + OO); labor supply (LS) and demand (LD), core inflation (CI), joint labor market (LM: LS+LD+CI); productivity (PR); non-energy commodities price (PM). Demand-side and financial shocks: goods aggregate demand (AD); global (GFI), US (GDI) and global ex-US (GTI) saving rate, joint global saving rate (SAV: GFI+GDI+GTI); US terms of trade (TT); excess liquidity (EL), term structure level (TL) and slope (TS), monetary policy stance (MP: EL+TL+TS); stocks (PF) and housing (PH) preference, joint portfolio allocation (PA: PF+PH+gold preference shock; the latter shock is not reported); size (SZ), value (VL), leverage (LV), uncertainty (RAV); joint risk factor (RF: RAV+SZ+VL+LV+momentum+stocks' liquidity+risk appetite; the latter three shocks are not reported). A (-) sign denotes imposed zero restrictions on contemporaneous effects.

Table A5: Historical decomposition (selected periods): contribution of various categories of shocks to fluctuations in global core inflation, the leverage factor, the exchange rate index, and the short-term interest rate factor.

Panel A: Core inflation

	Supply side shocks				Demand side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	N
90(2)-93(3)	**-0.17**	**0.10**	**0.05**	**-0.32**	**-0.47**	**0.00**	**-0.13**	**-0.18**	**-0.10**	**0.02**	**-0.08**	**0.04**	**0.00**	**-0.04**	**-0.03**	**-0.04**	**-0.01**	**-0.01**	**-0.64**
93(4)-94(3)	0.23	0.06	-0.01	0.18	0.06	0.01	0.09	-0.01	0.02	-0.01	-0.03	-0.08	-0.01	0.05	0.02	0.03	-0.05	0.00	0.29
96(3)-97(2)	-0.01	-0.15	-0.06	0.20	0.00	0.06	-0.04	0.03	-0.10	0.00	0.05	0.03	-0.03	0.01	0.02	0.00	0.02	-0.01	-0.01
97(3)-98(3)	**0.17**	**0.05**	**0.08**	**0.04**	**-0.40**	**-0.16**	**-0.07**	**-0.02**	**-0.08**	**-0.04**	**-0.02**	**-0.03**	**0.05**	**-0.01**	**-0.03**	**-0.03**	**0.02**	**0.00**	**-0.23**
98(4)-99(3)	0.11	0.06	0.04	0.01	-0.20	0.09	-0.12	-0.09	-0.08	-0.01	0.00	0.10	-0.07	-0.02	0.01	-0.03	0.01	-0.01	-0.09
00(4)-03(2)	**-0.07**	**0.04**	**-0.13**	**0.02**	**-0.16**	**-0.03**	**-0.01**	**-0.01**	**0.17**	**0.02**	**-0.30**	**-0.08**	**-0.12**	**-0.04**	**-0.03**	**0.02**	**-0.06**	**0.01**	**-0.24**
03(3)-04(2)	0.03	-0.01	-0.01	0.04	-0.11	0.01	-0.03	-0.02	-0.02	-0.03	-0.02	0.03	-0.04	0.03	0.02	-0.04	0.00	-0.01	-0.08
08(2)-09(3)	**-0.15**	**-0.05**	**-0.14**	**0.04**	**-0.22**	**-0.04**	**0.07**	**-0.02**	**-0.07**	**-0.01**	**-0.15**	**-0.10**	**0.01**	**0.02**	**0.01**	**-0.04**	**-0.05**	**0.00**	**-0.36**
09(4)-10(3)	0.20	0.06	0.01	0.14	0.02	-0.01	0.08	-0.04	-0.01	0.00	0.00	-0.01	-0.03	0.06	0.00	0.01	-0.03	0.00	0.22

Panel B: Leverage factor

	Supply side shocks				Demand side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	LEV
90(2)-93(3)	**-8.00**	**6.07**	**-8.99**	**-5.09**	**43.28**	**1.01**	**4.25**	**18.14**	**-3.04**	**0.43**	**28.53**	**28.98**	**1.36**	**2.36**	**0.53**	**-4.11**	**-6.06**	**-0.58**	**35.28**
93(4)-94(3)	19.67	8.64	9.03	2.00	10.44	1.70	-6.23	-8.03	-1.29	1.25	-6.14	-3.91	-1.00	-3.84	0.42	0.71	29.18	1.48	30.11
97(3)-98(3)	**17.70**	**28.10**	**-7.38**	**-3.02**	**-7.39**	**-2.45**	**0.22**	**2.45**	**3.45**	**0.10**	**-17.03**	**-17.61**	**-2.29**	**1.77**	**1.08**	**-0.35**	**5.87**	**0.36**	**10.31**
98(4)-99(3)	-9.97	-9.76	-6.74	6.52	-9.12	-0.25	-4.51	-7.69	-1.90	0.26	0.36	14.50	-2.96	-4.17	-0.59	-4.97	4.60	-1.45	-19.10
00(4)-03(2)	**20.97**	**1.26**	**9.36**	**10.35**	**-23.04**	**1.71**	**-7.59**	**5.36**	**-2.11**	**-0.19**	**-8.02**	**-15.01**	**2.66**	**2.13**	**-1.90**	**3.01**	**-12.21**	**1.10**	**-2.08**
03(3)-04(2)	7.13	5.87	-2.01	3.27	-7.93	-3.06	-1.03	-0.28	0.70	-0.11	-7.04	-4.92	-2.48	-0.56	-1.42	1.55	2.88	0.79	-0.81
08(2)-09(3)	**-16.06**	**-5.70**	**10.04**	**-20.40**	**-44.38**	**-2.58**	**-10.72**	**-5.20**	**-2.85**	**-1.17**	**-32.73**	**-22.90**	**-1.32**	**-1.77**	**-3.07**	**-4.00**	**10.87**	**0.32**	**-60.44**
09(4)-10(3)	2.39	-3.40	-0.67	6.46	3.89	0.53	4.96	-1.29	-1.79	2.00	4.61	-0.30	0.42	1.66	1.95	0.59	-5.14	0.29	6.28

Panel C: US$ exchange rate index

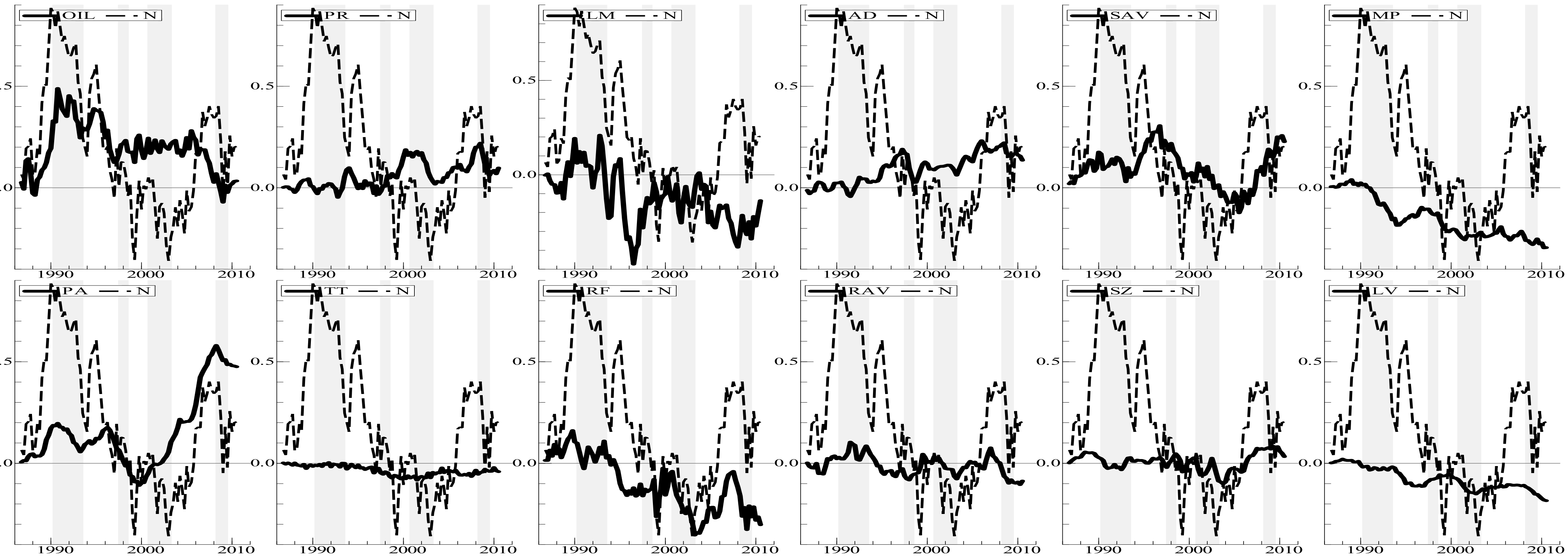
	Supply side shocks				Demand side and financial shocks							Risk factor shocks							Actual
	Total	OIL	PR	LM	Total	AD	SAV	MP	PA	TT	RF	RAV	SZ	VL	MM	SL	LV	RAP	X
90(2)-93(3)	**-1.74**	**-0.34**	**0.44**	**-1.84**	**-3.68**	**-0.16**	**-0.72**	**-1.37**	**-1.11**	**-0.54**	**0.21**	**-0.23**	**0.53**	**-0.14**	**-0.25**	**0.22**	**0.20**	**-0.11**	**-5.42**
93(4)-94(3)	-0.52	-0.61	-0.78	0.87	1.24	-0.09	0.55	0.32	1.22	0.18	-0.95	-0.14	-0.47	0.09	0.17	0.15	-0.75	0.00	0.71
97(3)-98(3)	**-2.69**	**-1.94**	**-0.06**	**-0.68**	**-2.24**	**-1.96**	**1.62**	**0.24**	**-0.54**	**-1.90**	**0.31**	**0.33**	**0.52**	**-0.03**	**-0.03**	**-0.28**	**-0.29**	**0.09**	**-4.93**
98(4)-99(3)	1.59	1.92	-0.41	0.07	-2.39	2.29	-1.23	-0.56	-0.04	-1.55	-1.29	-0.27	-1.12	-0.23	-0.06	0.45	-0.06	0.01	-0.80
00(4)-03(2)	**1.26**	**-1.80**	**0.06**	**2.99**	**2.39**	**-0.56**	**0.14**	**-1.14**	**1.13**	**1.90**	**0.93**	**0.53**	**-0.72**	**1.13**	**-0.20**	**-0.18**	**0.33**	**0.04**	**3.65**
03(3)-04(2)	0.24	-0.45	0.07	0.62	0.25	0.67	-0.34	-0.23	-0.08	1.11	-0.90	-0.10	-0.53	-0.15	0.06	-0.28	0.13	-0.01	0.49
08(2)-09(3)	**-2.33**	**0.32**	**-0.58**	**-2.07**	**-0.49**	**-0.24**	**0.58**	**-0.20**	**-0.49**	**0.21**	**-0.34**	**0.21**	**-0.04**	**-0.03**	**-0.16**	**0.22**	**-0.56**	**0.02**	**-2.82**
09(4)-10(3)	0.92	0.29	0.66	-0.03	-0.75	-0.33	-0.11	0.21	0.39	-0.34	-0.57	-0.08	-0.21	-0.24	0.03	-0.04	-0.05	0.02	0.17

Table A5 (ctd.): Historical decomposition (selected periods): contribution of various categories of shocks to fluctuations in global core inflation, the leverage factor, the exchange rate index, and the short-term interest rate factor.

Panel D: Short-term interest rate																			
	Supply-side shocks				**Demand-side and financial shocks**							**Risk factor shocks**							**Actual**
	Total	**OIL**	**PR**	**LM**	**Total**	**AD**	**SAV**	**MP**	**PA**	**TT**	**RF**	**RAV**	**SZ**	**VL**	**MM**	**SL**	**LV**	**RAP**	**SR**
90(2)-93(3)	**0.73**	**0.64**	**-0.30**	**0.39**	**-0.88**	**0.09**	**-0.22**	**-0.48**	**-0.03**	**-0.01**	**-0.22**	**-0.03**	**-0.09**	**0.01**	**0.00**	**-0.01**	**-0.11**	**0.01**	**-0.16**
93(4)-94(3)	-0.47	-0.31	0.41	-0.56	0.03	0.07	0.11	-0.08	-0.07	-0.04	0.04	0.00	0.05	-0.06	-0.04	-0.03	0.13	0.01	-0.44
97(3)-98(3)	**0.79**	**0.41**	**0.04**	**0.34**	**-0.64**	**0.76**	**-0.57**	**-0.48**	**-0.23**	**-0.08**	**-0.05**	**-0.11**	**-0.14**	**0.00**	**0.04**	**0.01**	**0.15**	**0.00**	**0.15**
98(4)-99(3)	-0.48	-0.35	-0.10	-0.03	-0.28	-0.76	0.02	0.22	-0.03	0.04	0.24	0.15	0.24	-0.01	0.00	-0.11	0.00	-0.02	-0.76
00(4)-03(2)	**-0.31**	**0.20**	**-0.13**	**-0.37**	**0.83**	**0.11**	**0.45**	**0.52**	**-0.04**	**0.18**	**-0.38**	**-0.27**	**0.19**	**-0.13**	**0.00**	**0.04**	**-0.24**	**0.03**	**0.51**
03(3)-04(2)	-0.02	0.07	0.05	-0.14	-0.61	-0.47	0.01	0.04	-0.02	0.00	-0.17	-0.04	-0.05	0.01	-0.08	-0.01	-0.01	0.02	-0.63
08(2)-09(3)	**0.22**	**-0.27**	**0.09**	**0.40**	**0.08**	**0.08**	**0.00**	**0.28**	**0.00**	**0.04**	**-0.31**	**-0.22**	**0.00**	**0.01**	**-0.04**	**-0.12**	**0.06**	**0.00**	**0.30**
09(4)-10(3)	-0.20	0.20	-0.44	0.03	0.24	0.15	0.09	0.03	-0.12	-0.02	0.10	0.03	0.00	0.05	0.05	0.03	-0.06	0.00	0.03

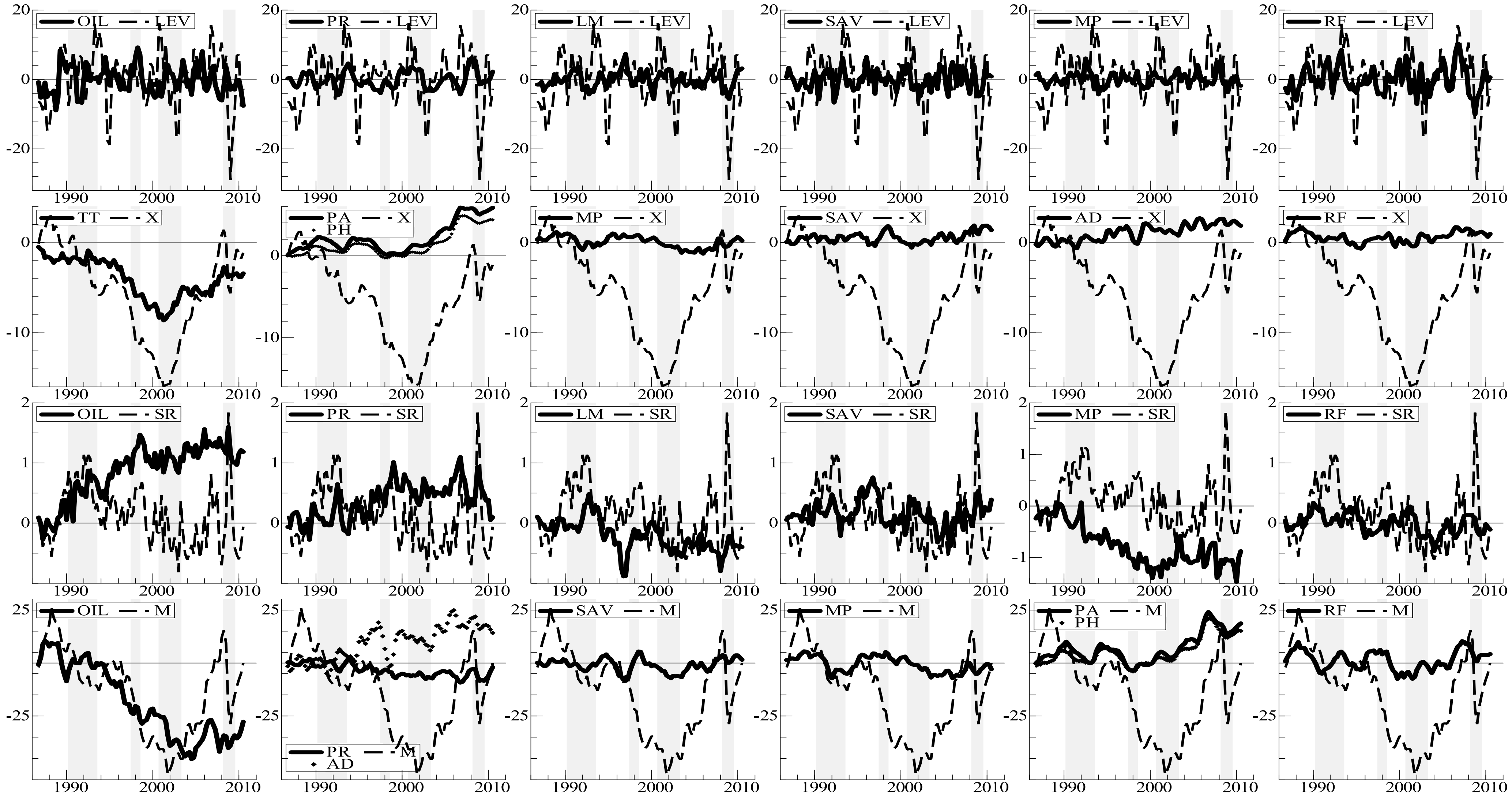
In the table the contributions of various categories of structural disturbances to fluctuations in the global core inflation factor (N, Panel A), in the leverage factor (LEV, Panel B), in the US$ exchange rate index (X, Panel C), and in the global short-term interest rate factor (SR, Panel D) are reported for the four global recessionary episodes occurred in the 1986-2010 period (in bold): the early 1990s recession (1990:2-1993:2); the late 1990s recession (1997:3-1998:3); the early 2000s recession (2000:4-2003:2), and the Great Recession (2008:2-2009:3). The contributions of structural shocks in the four quarters following recessions are also shown. For each period, the overall actual changes in N, LEV, X, and SR are displayed in the last column "Actual". The categories of structural disturbances are: oil market shocks (OIL), productivity shocks (PR), labor market shocks (LM); goods' aggregate demand shocks (AD); saving rate shocks (SAV); monetary policy stance shocks (MP); portfolio allocation shocks (PA); US terms of trade shocks (TT); overall risk factor shocks (RF). For the latter category of disturbances the Table shows also the specific contributions of uncertainty shocks (RAV), size factor shocks (SZ), value factor shocks (VL), momentum shocks (MM), stock market liquidity shocks (SL), leverage shocks (LV), and risk appetite shocks (RAP).

Figure A1: Historical Decomposition: core inflation; contributions of structural shocks.



In the Figure the historical decomposition for core inflation (N), relatively to the various identified structural shocks, is plotted: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labor market (LM: labor supply and demand, core inflation); good's aggregate demand (AD); saving rate (SAV: global saving rate, US saving rate, global ex-US saving rate), monetary policy (MP: excess liquidity, term structure level and slope); US terms of trade (TT); portfolio allocation (PA: stocks, housing and gold preferences); risk factor (RF: size (SZ), value (VL), momentum (MM), stocks' liquidity (SL), leverage (LV), uncertainty (RAV), risk appetite (RAP)).

Figure A2: Historical Decomposition: leverage factor, US$ exchange rate, short-term interest rate, non-energy commodity prices; contributions of structural shocks.



The Figure plots the historical decomposition of the leverage factor (LEV), the US$ exchange rate index (X), the real short-term rate factor (SR) and the non-energy commodity price index (M) relative to the following selected identified structural shocks: oil market (OIL: oil reserves, flow oil supply, oil production mix, oil consumption and inventories preferences, oil futures market-pressure, residual oil futures market, other real oil price and nominal oil price volatility), productivity (PR), labor market (LM: labor supply and demand, core inflation); aggregate demand (AD); saving rate (SAV: global saving rate, US saving rate, global ex-US saving rate), monetary policy (MP: excess liquidity, term structure level and slope); US terms of trade (TT); portfolio allocation (PA: stock, housing (PH) and gold preferences); risk factor (RF: size, value, momentum, stocks' liquidity, leverage, uncertainty, risk appetite).