

7. The Effects of the US Economic and Financial Crises on Euro Area Convergence

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1. INTRODUCTION

Since the 1980s the European economy has undergone a progressive process of economic integration, involving both real and financial markets. This process has not been monotonous, with the main stages marked by the introduction of the European Exchange Rate Mechanism (ERM) in March 1979, the ratification of the Maastricht Treaty in November 1993, and the start of the Economic and Monetary Union (EMU) in January 1999. Many studies have approached the integration process from different perspectives, focusing on business cycle synchronization, inflation convergence and persistence, and financial markets integration. Though the available empirical evidence is not fully clear-cut, the finding of a stronger co-movement in real and financial variables across euro area countries over the 1990s is fairly robust. Yet, so far EMU does not seem to have contributed decisively to further increasing euro area economic and financial integration, relatively to pre-EMU levels.

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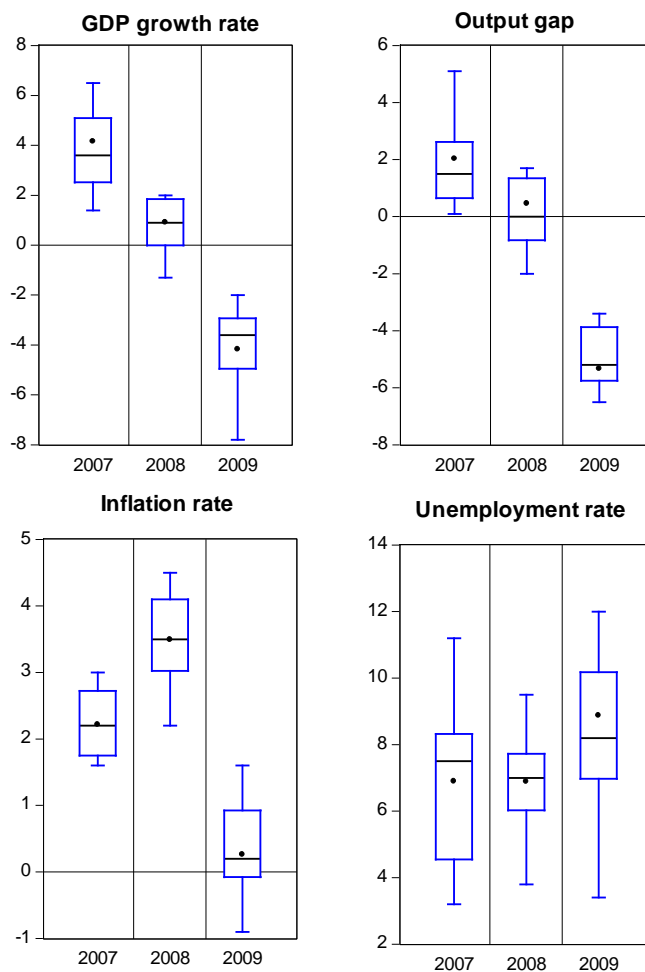
For instance, as regards real convergence and the existence of a euro area business cycle, the evidence suggests that business cycle synchronization across euro area countries is still weak (de Haan *et al.*, 2008; Camacho *et al.*, 2005), concerns subsets of countries rather than the whole area (Aguar-Contraria and Soares, 2009; Mink *et al.*, 2007; Giannone *et al.*, 2009)¹, and with stronger regional than international coordination (Montoya and de Haan, 2007). International trade emerges as one of the key sources of euro area business cycle synchronization (Bower and Guillemineau, 2006), with a positive effect also on nominal convergence (Honohan and Lane, 2003). Convergence in inflation trends seems to have occurred within the euro area, though persistent inflation differentials remain, due to cyclical dynamics (Cavallero 2010; Angeloni and Ehrmann, 2004). Evidence of recent divergence in inflation rates has been provided by Buseti *et al.* (2007).

Moreover, financial market integration, while benefiting at least in the aftermath of the EMU from the elimination of currency risk (Fratzcher, 2002), leading to a decrease in stock market volatility for the most volatile markets of the euro zone, *i.e.* Italy and Spain, relative to the least volatile ones, *i.e.* France and Germany (Morana and Beltratti, 2002), as well as to a reduction in the equity home bias for portfolios owned by European institutional investors (Adam *et al.*, 2002), would be still in progress. For instance, market participation of households across euro zone countries is indeed still heterogeneous (Guiso *et al.*, 2003). Actually, the degree of stock market integration could even have decreased in the last few years relative to the 1990s, as stock markets co-movements appear to be stronger for subsets of countries rather than for the whole area (Morana, 2010).

Since economic and financial integration between the euro area and the US is strong (Giannone *et al.*, 2009; Morana, 2010), it is likely that the ongoing crisis, which heavily hit also the US economy, may have had an impact on the process of convergence in the euro area. This is consistent with the fact that apparently symmetric shocks may have had different effects across countries, according to the country-specific degree of shock persistence. The convergence process should however imply both a progressive reduction in the cross-country dispersion about the mean/median euro-area value of various macroeconomic indicators, as well as a more symmetric cross-sectional distribution. To provide a first look at the evidence, Figure 4.1 depicts the recent behaviour (2007-2009) of the distribution of several macroeconomic variables across 14 euro-area countries, showing that the crisis has so far had quite a deep impact on euro-area economic activity and some effects on its cross-sectional dispersion as well. In 2009 median GDP growth became negative (-3.6%), with a cross-sectional distribution featuring negative skewness and increased dispersion with respect to the previous two years. Some changes in the cross-sectional distributions of the output gap, the inflation

rate and the unemployment rate can also be detected. All variables show pronounced skewness, and changes also in the dispersion around median values (-5.2%, 0.2% and 8.2% in 2009 for the output gap, the inflation rate and the unemployment rate, respectively).

In the light of the above evidence, the paper investigates the linkages between the US and the euro-area economies over the 1980-2009 period, aiming at assessing whether spillovers of macroeconomic and financial shocks from the US may have affected the convergence process of nominal and real variables in the euro area.



Note: The box plots in this and the following figures show, for each distribution, the mean value (represented by a dot), the median value (a straight line), the interquartile range (IQR, containing 50% of the observations, represented by a box), and the values that are outside the first and third quartiles but within the first (third) quartile minus (plus) 1.5 times the IQR (represented by vertical lines ending with a staple).

Figure 4.1 Box plots of the distribution of GDP growth, output gap, inflation rate and unemployment rate in 2007-2009 for 14 euro-area countries (in percentage)

While there is a vast literature on the economic and financial convergence in the euro area, we are unaware of other papers which have so far dealt with the likely consequences of the US crisis on the euro area convergence process. The paper tries to innovate in terms of the depth and wideness of the analysis and econometric methodology, providing an accurate investigation of the euro area-US macro/finance interface. In addition to 14 euro-area member countries and the US, 35 additional economies, covering advanced and major emerging countries, have been considered, in order to set the analysis in a proper open economy framework. The econometric model counts about 300 equations, considering key macroeconomic and financial variables, and is set in the factor vector autoregressive (F-VAR) framework.

The contribution of US crises to the euro-area convergence process has then been assessed by measuring the dynamic responses of key euro-area country macroeconomic variables to real and financial shocks originating in the US. The features of the cross sectional distribution of such dynamic responses over different horizons is subsequently assessed in order to gauge the likely short- and medium-term consequences of the ongoing crisis.

The findings of the paper indeed point to a likely contribution of US real and financial factors to real divergence in the euro area. In fact, a slowdown in US economic activity may not only lead to a contraction in the first moment of the cross-sectional distribution of GDP growth in the euro area, but also to an increase in second and third moments. US financial factors may also contribute to the increase in dispersion and skewness of the euro area GDP growth distribution, but are less likely to affect its first moment. Differently, neither real nor financial US factors are likely to have affected the process of nominal convergence in the euro area during the current crisis, given the near independence of the euro area inflation rate distribution from the US real and financial cyclical dynamics. Not surprisingly, both real and financial US factors are found to be important for euro area financial convergence, consistent with the strong economic and financial integration of the two areas and the leading role of the US economy: destabilizing US financial conditions may then have contributed to destabilizing financial markets in the euro area. In particular, US excess liquidity and real estate and stock prices, seem to have contributed to euro area stock market fluctuations. Moreover, the downturn in US GDP growth would have contributed to the contraction in euro area stock prices, as well as to the increase in volatility and downside risk for both house and stock prices.

The rest of the paper is organized as follows. The next section introduces the econometric methodology, while in section 3 the data and their properties are presented. Then, section 4 discusses the specification and estimation of the F-VAR model and shows the main results. Finally, conclusions are drawn in section 5.

2. ECONOMETRIC METHODOLOGY

The econometric model is composed of two sets of equations. The first one refers to the US economy (with variables collected in vector X_t), while the second to the other $m-1$ non-US countries (collected in vector Y_t). The joint dynamics of q macroeconomic variables for each of the m countries of interest (in vector $Z_t = [X_t \ Y_t]$) are modeled by means of the following F-VAR model:

$$F_t = \Phi(L)F_{t-1} + \eta_t \quad (1)$$

$$G_t = \Psi(L)G_{t-1} + \zeta_t \quad (2)$$

$$Z_t - \mu_t = \Lambda F_t + \Xi G_t + \mathbf{D}(L)(Z_{t-1} - \mu_{t-1}) + \nu_t \quad (3)$$

In (3) $Z_t \sim I(0)$ is the $n \times 1$ stationary vector of variables of interest, with $n = m \times q$, and $\mu_t = \begin{bmatrix} \mu_t^X & \mu_t^Y \end{bmatrix}$ is a $n \times 1$ vector of deterministic components, including an intercept term, and linear or non-linear trend components. F_t is a $r \times 1$ vector of observed or unobserved common factors, generated by the autoregressive process in (1), where $\Phi(L)$ is a $r \times r$ finite order matrix lag polynomial, and η_t is a vector of i.i.d shocks driving the F_t factors. G_t is a $s \times 1$ vector of non-US factors, generated by the autoregressive process in (2), where $\Psi(L)$ is a $s \times s$ finite order matrix lag polynomial, and ζ_t is a vector of i.i.d. shocks driving the G_t factors. The effects of both sets of factors on the US and non-US variables in Z_t is captured by the loading coefficients collected in the matrices $\Lambda = \begin{bmatrix} \Lambda^X & \Lambda^Y \end{bmatrix}'$ and $\Xi = \begin{bmatrix} \Xi^X & \Xi^Y \end{bmatrix}'$ (of dimension $n \times r$ and $n \times s$, respectively). Finally, $\mathbf{D}(L)$ is a $n \times n$ finite order matrix lag polynomial, partitioned as

$$\mathbf{D}(L) = \begin{bmatrix} \mathbf{D}_{XX}(L) & \mathbf{0} \\ \mathbf{D}_{YX}(L) & \mathbf{D}_{YY}(L) \end{bmatrix}$$

$\begin{matrix} q \times q & q \times (m-1)q \\ (m-1)q \times q & (m-1)q \times (m-1)q \end{matrix}$

with

$$\mathbf{D}_{YY}(\mathbf{L}) = \begin{bmatrix} \mathbf{d}_{11}(\mathbf{L}) & \mathbf{0} & \dots & \mathbf{0} \\ q \times q & & & \\ \mathbf{0} & \mathbf{d}_{22}(\mathbf{L}) & \dots & \mathbf{0} \\ & q \times q & & \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{0} & \mathbf{0} & \dots & \mathbf{d}_{m-1,m-1}(\mathbf{L}) \\ & & & q \times q \end{bmatrix}$$

and $v_t = \begin{bmatrix} v_t^X \\ v_t^Y \end{bmatrix}'$ is the $n \times 1$ vector of reduced-form idiosyncratic (i.e. country-specific) i.i.d. disturbances. It is assumed that all polynomial matrices $\Phi(\mathbf{L})$, $\Psi(\mathbf{L})$, and $\mathbf{D}(\mathbf{L})$ have all roots outside the unit circle. Moreover, $E(\eta_{jt} v_{is}) = E(\zeta_{jt} v_{is}) = 0$ for all i, j, t and s .

The specification of the model has important implications for cross-country linkages: firstly, US idiosyncratic shocks (v_t^X) do not only affect the US (through $\mathbf{D}_{XX}(\mathbf{L})$), but also the other countries (through $\mathbf{D}_{YX}(\mathbf{L})$). Differently, non-US idiosyncratic disturbances (v_t^Y) do not affect US variables, while only own-country linkages are relevant for the other countries ($\mathbf{D}_{YY}(\mathbf{L})$ is block diagonal). The specification selected is then consistent with the view that the US play a leading role in the transmission of macroeconomic shocks, interpreting US macroeconomic dynamics in terms of global dynamics (see for instance Beltratti and Morana, 2010 and Bagliano and Morana, 2009). This however does not prevent interlinkages between the US and the other countries, which are parsimoniously described by means of the non-US factors G_t .

By substituting (1) and (2) into (3), the dynamic factor model can be written in standard vector autoregressive form as

$$\begin{pmatrix} F_t \\ G_t \\ Z_t - \mu_t \end{pmatrix} = \begin{pmatrix} \Phi(\mathbf{L}) & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \Psi(\mathbf{L}) & \mathbf{0} \\ \Lambda \Phi(\mathbf{L}) & \Xi \Psi(\mathbf{L}) & \mathbf{D}(\mathbf{L}) \end{pmatrix} \begin{pmatrix} F_{t-1} \\ G_{t-1} \\ Z_{t-1} - \mu_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_t^F \\ \varepsilon_t^G \\ \varepsilon_t^Z \end{pmatrix} \quad (4)$$

where

$$\begin{pmatrix} \varepsilon_t^F \\ \varepsilon_t^G \\ \varepsilon_t^Z \end{pmatrix} = \begin{pmatrix} \mathbf{I}_r \\ \mathbf{0} \\ \Lambda \end{pmatrix} \eta_t + \begin{pmatrix} \mathbf{0} \\ \mathbf{I}_s \\ \Xi \end{pmatrix} \zeta_t + \begin{pmatrix} \mathbf{0} \\ \mathbf{0} \\ v_t \end{pmatrix},$$

or $Z_t^* = \mathbf{H}^*(\mathbf{L})Z_{t-1}^* + \varepsilon_t$ (5)

with $Z_t^* = [F_t \ G_t \ Z_t - \mu_t]'$, and variance-covariance matrices

$$E(\varepsilon_t \varepsilon_t') = \Sigma_\varepsilon = \begin{pmatrix} \Sigma_\eta & \mathbf{0} & \Sigma_\eta \Lambda' \\ \mathbf{0} & \Sigma_\zeta & \Sigma_\zeta \Xi' \\ \Lambda \Sigma_\eta & \Xi \Sigma_\zeta & \Lambda \Sigma_\eta \Lambda' + \Xi \Sigma_\zeta \Xi' + \Sigma_\nu \end{pmatrix}$$

and $\Sigma_\eta = E(\eta_t \eta_t')$, $\Sigma_\nu = E(\nu_t \nu_t')$, and $\Sigma_\zeta = E(\zeta_t \zeta_t')$. The inversion of the F-VAR form to obtain the reduced vector moving average (VMA) form for the Z_t^* process, as well as the identification of the structural shocks, is discussed in Bagliano and Morana (2010).

In our analysis, the impact of a change in the variables of interest (X_t, F_t, G_t) on the Y_t block is investigated by exploiting the reduced form VAR structure of the model:

$$\begin{aligned} & (\mathbf{I} - \mathbf{D}_{YY}(\mathbf{L}))(Y_t - \mu_t^Y) \\ &= \left(\Lambda^Y \Phi(\mathbf{L}) \quad \Xi^Y \Psi(\mathbf{L}) \quad \mathbf{D}_{YX}(\mathbf{L}) \right) \begin{pmatrix} F_{t-1} \\ G_{t-1} \\ X_{t-1} - \mu_{t-1}^X \end{pmatrix} + \varepsilon_t^Y \end{aligned} \quad (6)$$

and computing the dynamic multipliers, *i.e.*

$$Y_t - \mu_t^Y = \mathbf{V}(\mathbf{L}) \begin{pmatrix} F_{t-1} \\ G_{t-1} \\ X_{t-1} - \mu_{t-1}^X \end{pmatrix} + \varepsilon_t^Y, \quad (7)$$

where $\mathbf{V}(\mathbf{L}) = (\mathbf{I} - \mathbf{D}_{YY}(\mathbf{L}))^{-1} \left(\Lambda^Y \Phi^Y(\mathbf{L}) \quad \Xi^Y \Psi^Y(\mathbf{L}) \quad \mathbf{D}_{YX}(\mathbf{L}) \right)$.

The latter is equivalent to the impulse response analysis carried out from the reduced form VMA representation, and is appropriate when the focus is on the impact of a change in a given forcing variable, say US GDP, independently of its underlying economic cause (*i.e.* a given structural shock), on the Y_t block. The F-VAR model is estimated by means of a consistent and efficient iterative procedure, featuring the Granger and Jeon (2004) robust approach, yielding median estimates for all the parameters of interest, obtained through simulation with 1000 replications (see Bagliano and Morana, 2010 for details).

3. THE DATA

We use seasonally adjusted quarterly macroeconomic time series data, over the period 1980:1 through 2009:1, for 14 euro area member states (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovakia, Slovenia and Spain), the US, and 16 additional advanced economies (Australia, Canada, the Czech Republic, Denmark, Hong Kong, Iceland, Israel, Japan, New Zealand, Norway, Singapore, South Korea, Sweden, Switzerland, Taiwan, United Kingdom), 5 additional 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), *i.e.* a total of 50 countries.²

The data set for euro area member countries consists of real GDP, the CPI all-items index, real bank loans to the private sector relative to GDP, the real short-term interest rate (either a 3-month interbank rate or a 3-month Treasury Bills rate, depending on availability), and real house and stock prices. Due to lack of data availability, housing prices have not been considered for Austria, Belgium, Greece, Luxembourg, Portugal, Slovakia, and Slovenia. A similar dataset has also been employed for the remaining non-US countries (house prices are only available for few additional OECD countries, *i.e.* Australia, Canada, Japan, New Zealand, Denmark, Norway, Sweden, Switzerland, and the UK). All these variables are included in the Y_t vector.

Differently, the dataset for the US is larger and composed of real GDP, civilian employment, real private consumption, real private investment, fiscal deficit to GDP, current account deficit to GDP, CPI all-items index, three-month Treasury Bills real rate, 10-year Federal government securities real rate, real house prices, the real effective exchange rate, real share prices (S&P500). A few financial variables have also been included, in order to monitor the impact of the financial crisis. In particular, the economic/financial fragility index and the excess liquidity index proposed in Bagliano and Morana (2010).³

All the above variables enter in the vector X_t . In order to keep the US-euro area spillover analysis manageable, and consistent with previous work on the Great Recession, only a sub-set of US macroeconomic and financial factors has been selected for the computation of dynamic multipliers, namely GDP growth, excess liquidity, house and stock prices and an economic/financial fragility indicator.⁴ Finally, also the crude oil price and primary commodities price shocks (excluding energy), computed following Hamilton (1996), have been considered and included in the vector F_t . In order to account for feedback effects from the world economy to the US economy, a single common non-US GDP growth factor, accounting for about 20% of

total variance, has been extracted from the GDP growth series of the 37 countries for which data are available since 1980:1.⁵ This factor is included as the only element in the G_t vector.

As the econometric model is set in a stationary representation, data have been transformed accordingly⁶; in particular, on the basis of the KPSS test (Kwiatkowski *et al.*, 1992; Becker *et al.*, 2006).

Weak stationarity, in deviation or not from a non-linear deterministic trend component, modelled by means of the Gallant (1984) flexible functional form, *i.e.* $\mu_t = \mu_0 + \mu_1 t + \mu_2 \sin(2\pi t/T) + \mu_3 \cos(2\pi t/T)$, was assumed for the levels of the long-term and short-term real interest rates, the US current account to GDP ratio, the US public deficit to GDP ratio, and for the growth rates of all the remaining series. These deterministic terms are included in vector μ_t .⁷

4. US ECONOMIC AND FINANCIAL SHOCKS AND EURO AREA CONVERGENCE DYNAMICS

The ordering of the variables in the econometric model is country-by-country and standard, from relatively ‘slow’ to relatively ‘fast’ moving variables. Then, the X_t vector for the US is ordered as follows: employment growth, real GDP growth, the Federal Deficit/GDP ratio, real private consumption growth, real private investment growth, the current account/GDP ratio, the CPI inflation rate, the excess liquidity index, the real three-month Treasury bills rate, the real ten-year Government Bonds rate, real house price returns, real effective exchange rate returns, real stock price returns, the financial fragility index. Similarly, the ordering for the Y_t vector, concerning the non-US countries, is: real GDP growth, CPI inflation, real excess credit growth, the real short-term rate, real house price returns (when available), and real stock price returns.

The dynamic specification of the econometric model has been selected by means of the BIC information criterion, pointing to an optimal first order F-VAR system. Assuming an own-variable diagonal structure for the corresponding elements of the $\mathbf{D}(L)$ matrix for the non-US countries diagonal ($\mathbf{D}_{YY}(L)$), the euro area block then counts 77 equations, each containing 13 parameters, of which 1 for the lagged own variable, 5 are for the lagged US series, 3 for the lagged F_t and G_t series, and 4 for the deterministic component (including a constant, a linear trend and two non-linear components, as described in the data section); similarly, for the remaining elements in the vector Y_t . Differently, the 14 equations corresponding to the US block X_t contain 21 parameters each, of which 14 are for the lagged US series, 3 for

the lagged F_t and G_t series, and 4 are for the deterministic component. The full system therefore counts 278 equations.

The impact of the US economic and financial shocks on euro area convergence dynamics is assessed by means of the properties of the cross-sectional distributions of the dynamic multipliers, measuring the response of euro area variables to a unitary change in the US variables included in (7) at two forecasting horizons, namely 2-quarter (short-term) and 12-quarter (medium-term). This is consistent with the fact that a different degree of shock persistence in each country may lead a symmetric shock to have different effects across countries. The results reported in Table 4.1 and Figures 4A.1-4A.5 refer to the case of a unitary increase in the US variables. The effects of a unitary contraction in these variables, which is the case of interest for some of them (output growth, for instance), can be read from the table and plots by reversing the sign of the dynamic multipliers and associated statistics.

4.1 The effects of US financial shocks

In a boom-bust credit cycle interpretation of the recent crisis (see *e.g.* Bagliano and Morana, 2010), asset prices misalignments in the US housing and stock markets would have initially been fuelled by the availability of excess liquidity and low interest rates.⁸ The ballooning US trade deficit likely also contributed to the latter dynamics, as huge capital inflows were redirected from the Treasury and stock markets to the housing market. Then, expected but not materialized housing price appreciation have lead the predatory lending mechanism to break down and a generalized decline in asset prices and tight credit conditions, as financial institutions were forced into deleveraging and recapitalization.⁹ Due to the strong integration of US and euro area (EA) financial markets (Giannone *et al.*, 2009; Morana, 2010), and the leading role of the US economy, the US financial cycle has affected financial markets in the EA economy as well. In particular, the spillover of the US financial crisis to the EA and the rest of the world is likely to have taken place through housing prices (see Bagliano and Morana, 2010; Beltratti and Morana, 2010), as well as through excess liquidity and stock market dynamics.

Results concerning the impact of US financial shocks over our investigated sample (1980-2009) on the EA convergence process are collected in Table 4.1 (columns 2 through 5) and Figures 4A.2 through 4A.5, presenting descriptive statistics and corresponding box plots of the cross sections of dynamic responses of selected EA variables (GDP growth, inflation rate, real excess credit growth (the rate of change of real loans to GDP), real house price returns and real stock returns to various US disturbances over the 2- and 12-quarter time horizons. Several results are remarkable.

Table 4.1 Descriptive statistics for the cross-section of dynamic responses after 2 quarters and 12 quarters for euro area variables: mean, standard deviation, first, second (median) and third quartile, index of skewness and kurtosis

EA variables		US variables									
		GDP		excess liquidity		house prices		stock prices		fragility index	
Responses after		2q	12q	2q	12q	2q	12q	2q	12q	2q	12q
GDP	mean	0.336	0.264	-0.081	-0.057	-0.198	-0.152	-0.007	-0.005	-0.340	-0.256
	std. dev	0.554	0.415	0.287	0.217	0.623	0.472	0.068	0.052	1.098	0.830
	Q1	0.050	0.050	-0.110	-0.090	-0.120	-0.095	-0.005	-0.005	-0.450	-0.340
	Q2	0.130	0.110	0.010	0.010	-0.030	-0.020	0.001	0.001	-0.050	-0.050
	Q3	0.300	0.260	0.050	0.045	0.005	0.005	0.010	0.010	0.012	0.012
	skew.	2.061	2.053	-2.378	-2.377	-2.777	-2.776	-1.931	-2.076	-2.169	-2.165
	kurt.	6.650	6.686	7.869	7.906	9.613	9.603	7.425	7.665	7.579	7.557
	inflation	mean	-0.029	-0.042	-0.009	-0.023	-0.003	-0.004	0.006	0.008	0.039
std. dev		0.055	0.066	0.069	0.111	0.022	0.037	0.010	0.010	0.088	0.147
Q1		-0.082	-0.113	-0.032	-0.055	-0.025	-0.032	0.001	0.001	-0.030	-0.036
Q2		-0.010	-0.026	-0.011	-0.032	-0.005	-0.008	0.003	0.004	0.031	0.034
Q3		0.005	0.008	0.022	0.028	0.012	0.022	0.004	0.007	0.085	0.159
skew.		-0.901	-0.431	-1.260	-1.546	0.183	-0.091	2.159	1.491	0.301	0.408
kurt.		2.709	1.584	5.053	5.850	1.830	2.015	6.638	3.755	2.539	2.406

Table 4.1 (continued)

EA variables		US variables									
		GDP		excess liquidity		house prices		stock prices		fragility index	
		2q	12q	2q	12q	2q	12q	2q	12q	2q	12q
credit	mean	1.260	1.145	-0.939	-0.954	1.170	1.188	-0.083	-0.099	1.995	1.815
	std. dev	3.941	3.435	3.337	2.925	3.707	3.313	0.367	0.319	3.953	3.100
	Q1	-0.145	-0.135	-0.850	-1.115	-0.235	-0.250	-0.160	-0.175	0.010	-0.010
	Q2	0.280	0.340	-0.160	-0.200	0.100	0.090	-0.060	-0.080	0.670	0.840
	Q3	0.620	0.590	0.170	0.175	0.660	0.700	0.000	0.005	1.520	1.615
	skew.	2.864	2.737	-2.598	-2.411	2.698	2.562	-0.939	-0.983	2.172	1.931
	kurt.	9.972	9.497	9.000	8.173	9.357	8.760	5.944	5.499	6.781	5.896
house prices	mean	0.020	-0.141	-0.257	-0.407	0.417	0.486	0.024	0.027	-0.219	-0.201
	std. dev	0.876	1.694	0.632	0.967	0.760	0.654	0.046	0.067	0.503	0.986
	Q1	-0.605	-1.360	-0.945	-1.287	0.038	0.080	-0.015	-0.035	-0.672	-1.202
	Q2	-0.025	-0.055	-0.260	-0.695	0.085	0.185	0.014	0.015	-0.365	-0.405
	Q3	0.550	0.797	0.055	0.153	0.253	0.542	0.033	0.070	-0.005	0.008
	skew.	-0.812	-0.976	-0.279	-0.027	1.510	1.242	0.643	-0.273	0.186	0.540
	kurt.	2.401	2.632	1.486	1.192	3.561	3.044	2.151	1.390	1.393	1.903

Table 4.1 (continued)

EA variables		US variables									
		GDP		excess liquidity		house prices		stock prices		fragility index	
		2q	12q	2q	12q	2q	12q	2q	12q	2q	12q
stock prices	mean	21.78	25.30	11.81	13.86	24.09	26.59	0.543	0.464	-6.764	-7.649
	std. dev	20.05	22.16	15.43	20.09	16.73	18.37	1.903	2.143	16.17	19.29
	Q1	8.555	9.905	2.265	2.680	10.39	11.09	-0.750	-1.020	-20.80	-19.40
	Q2	17.60	19.30	7.080	6.950	23.40	21.60	0.630	0.690	0.390	0.420
	Q3	26.05	29.10	13.85	14.20	28.85	37.60	1.475	1.760	1.095	1.445
	skew.	1.343	1.072	0.861	1.038	0.469	0.395	-0.453	-0.852	-1.025	-1.159
	kurt.	4.640	3.348	2.685	2.919	2.020	1.763	2.433	2.865	2.357	2.843

First, concerning the effects of the US financial shocks on real convergence, from Table 4.1 it can be noted that neither US excess liquidity, nor US housing or stock prices, or US economic/financial fragility, have a sizable impact on the median of the EA output growth distribution, neither in the short- nor the medium-term. Yet, in two cases, *i.e.* US housing prices and economic/financial fragility, the mean impact is sizable, and stronger in the short- (-0.2%, -0.34%) than in the medium-term (-0.15% and -0.26%). Moreover, US financial factors do have an impact on the second and third moments of the EA output growth distribution, with a sizable increase in both dispersion (0.29% through 1.1% in the short-term, apart from stock prices) and skewness (-2 through -2.8 in the medium-term).

Second, concerning the effects of US financial factors on nominal convergence, it can be noted that, apart from the medium-term impact of US excess liquidity and economic/financial fragility dynamics on the dispersion of the EA inflation rate cross-sectional distribution (0.11% and 0.15%, respectively), no sizable effects on first, second and third order moments of the inflation rate distribution can be noted.

Finally, concerning the impact of US financial factors on financial convergence within the EA, much richer interactions, of similar size in the short- and medium-term, can be noted. For instance, mean credit growth is sizably affected by US excess liquidity (-0.95%), housing prices (1.19%) and economic/financial conditions (2%); the median impact on the other hand is somewhat smaller (-0.2%, 0.09% and 0.84%, respectively); the impact on EA credit growth dispersion is also sizable (2.9% through 3.3%), as well as its impact on skewness (-2.4 through to 2.6). Similar findings hold for EA house price returns, as US excess liquidity, house prices and economic/financial fragility conditions fairly largely affect both the mean (-0.41%, 0.49%, -0.21%, respectively), median (-0.69%, 0.19%, -0.41%) and dispersion (0.97%, 0.65% and 0.99%) of the EA housing price distribution, while the impact on skewness is more attenuated. Differently, US financial factors, stock returns included, are important for both the first and second moments of the distribution of EA stock returns, while their impact on skewness is more modest; for instance, the mean (median) impacts are 13.9%, 26.7%, 0.46%, and -7.65% (6.95%, 21.6%, 0.69%, and 0.42%) for US excess liquidity, house prices, stock prices and economic/financial fragility conditions; the impact on dispersion is also large (20.1%, 18.4%, 2.14%, 19.3%).

Overall, US financial factors appear to be important determinants of euro area financial conditions, coherent with the strong integration of financial markets between the two countries: destabilizing US financial conditions may have then contributed to destabilizing euro area financial markets. In particular, US excess liquidity, house and stock prices, may have contributed

to keep momentum in the euro-area stock markets during the boom phase of the credit cycle, yet contributing to a market crash during deleveraging. Similarly, US house prices would have contributed to the cyclical phase in euro area house prices. The interactions across financial markets are complex, involving not only first moments, but also second and third moments.

4.2 The effects of US GDP shocks

There are different mechanisms that can explain how the US crisis originated in the financial sector then became an economic crisis, as both tight credit conditions and falling asset prices (wealth and Tobin's Q effects) may have constrained aggregate demand.¹⁰ A present value model, relating future developments in dividends and rents to output dynamics, can also account for second round effects, linking the slowdown in real activity to asset price deflation. According to the results reported in Levchenko *et al.* (2010) and Bems *et al.* (2010), external demand can be singled out as one of the key mechanisms through which the slowdown in US economic activity has been transmitted to the world economy.¹¹

Results concerning the implications of US economic disturbances (captured in our framework by GDP shocks) for the convergence process in the euro area are collected in Table 4.1 (first column) and Figure 4A.1. As for the effects of US recessions on the real convergence within the EA, it can be noted that a contraction in US GDP may lead to mean and median negative responses of EA GDP growth. The impact is in both cases inelastic, with a stronger point impact in the short-term (-0.34% and -0.13%) than in the medium-term (-0.26% and -0.11%); dispersion is also larger in the very-short term (0.55%) than in the medium-term (0.42), while skewness is sizable, but similar at both horizons (about -2). Hence, the evidence does point to a role of the slowdown in US economic activity in the explanation of current real divergence in the EA. Yet, apart from Greece (result not reported), cyclical responses still appear to be synchronised¹². The divergence effect also appears to be slightly attenuated in the medium-term, due to a smaller dispersion. Moreover, concerning the effects of US recessions on EA nominal convergence, the evidence does not support any direct linkage between the state of the US business cycle and inflation dynamics in the EA. In fact, neither first, nor second or third moments of the cross-sectional inflation distribution do seem to have been influenced.

Finally, concerning the effects of the contraction in US GDP on EA financial convergence, while for housing prices only the dispersion of the cross-sectional distribution seems to have been affected in both the short- and medium-term (0.88% and 1.69%, respectively), more sizable effects can be detected for credit growth and stock returns. In both cases a contraction in US

GDP is associated with negative mean and median responses, stronger in the medium-term (-0.34% for credit; -19.3% for stock returns) than in the short-term. The impact on dispersion and skewness is also notable for both stock returns (20%, -1.07) and credit growth (3.94%, -2.74). Hence, euro area financial convergence may have been affected by the slowdown in US GDP growth, particularly in the credit and the stock markets.

5. CONCLUSIONS

The aim of the paper is to assess whether the US economic and financial crises may have had some effect on the process of real and nominal convergence in the euro area. The current paper addresses this issue by investigating the linkages between the US and the euro area countries for a large set of real and financial variables over the 1980-2009 period. In addition to 14 euro area member countries and the US, 35 additional countries, covering advanced and major emerging countries, have been included in the econometric model, set in the factor vector autoregressive (F-VAR) framework.

The findings of the paper indeed point to a likely contribution of US real and financial factors to real divergence in the euro area. In fact, a slowdown in US economic activity may not only lead to a contraction in the first moment of euro area GDP cross sectional distribution, but also to an increase in second and third moments. US financial factors may also contribute to the increase in dispersion and skewness of the euro area output growth distribution, but are less likely to affect the first moment of the distribution. Differently, neither real nor financial US factors are likely to have affected the process of nominal convergence in the euro area during the current crisis, given the near independence of the euro rate inflation distribution from the US real and financial cyclical dynamics.

Both real and financial US factors are found to be important for euro area financial convergence, coherent with the strong economic and financial integration for the two areas and the leading role of the US economy: destabilising US financial conditions may then have contributed to destabilise euro area financial markets. In particular, US excess liquidity, house and stock prices, would have contributed to euro area stock market fluctuations, while US house prices would have contributed to euro area house prices cyclical dynamics. Moreover, the downturn in US GDP growth would have contributed to the contraction in euro area stock prices, as well as to the increase in volatility and downside risk for both house and stock prices.

Overall, the interactions between US and EA real and financial markets appear to be complex, involving not only first moments, but also second and third ones.

APPENDIX 4A FIGURES 4A.1 TO 4A.5

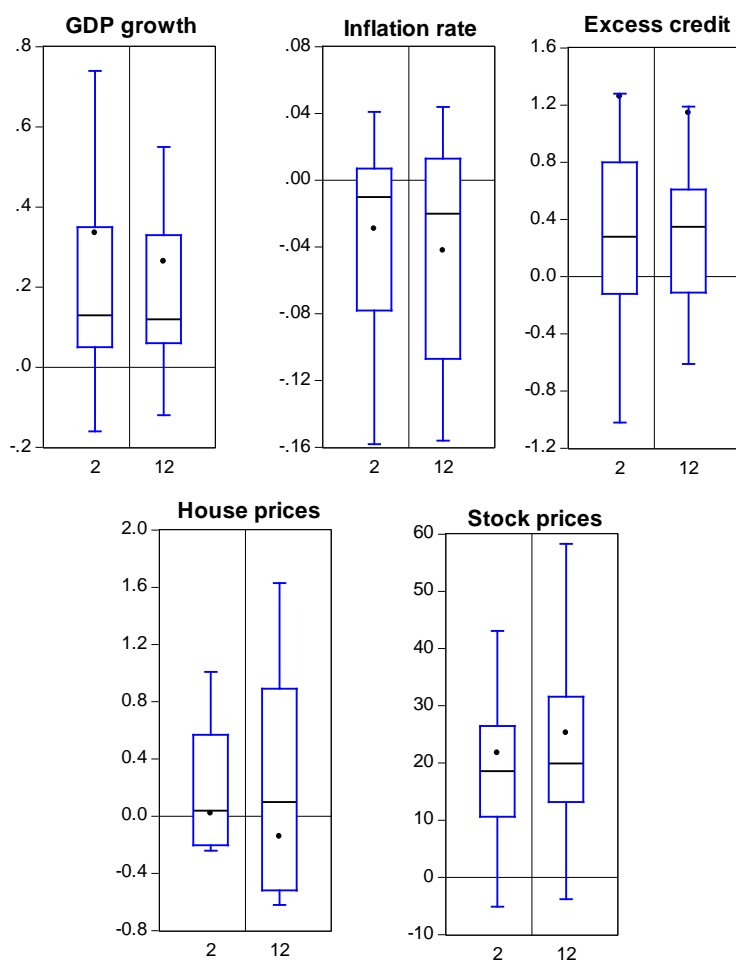


Figure 4A.1 Responses of euro area macro variables to a US output 1% increase at 2- and 12-quarter horizons

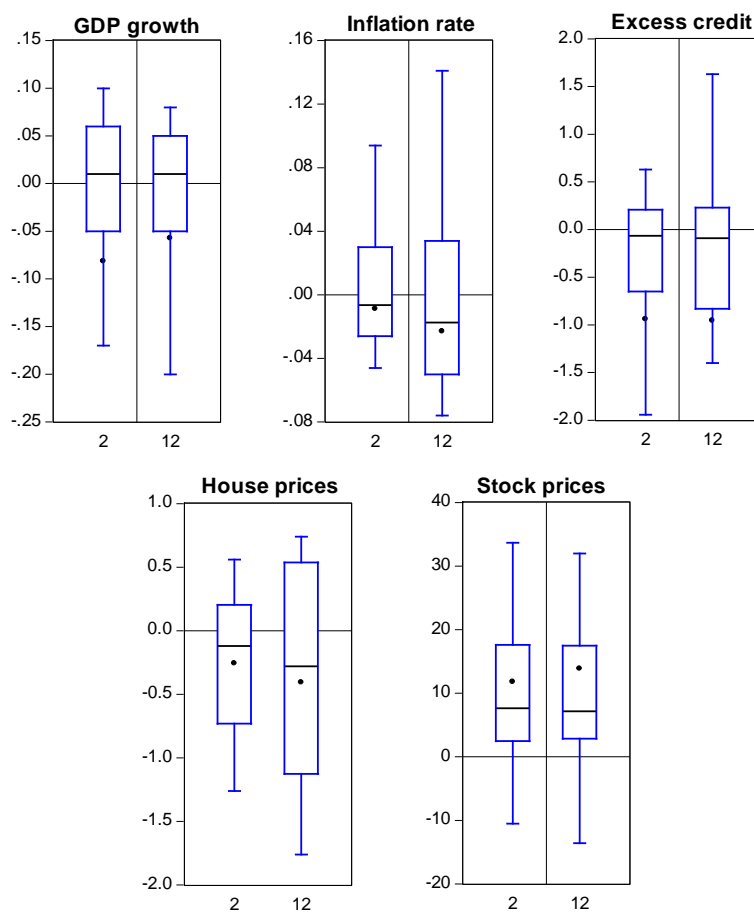


Figure 4A.2 Responses of euro area macro variables to a US excess liquidity 1% increase at 2- and 12-quarter horizons

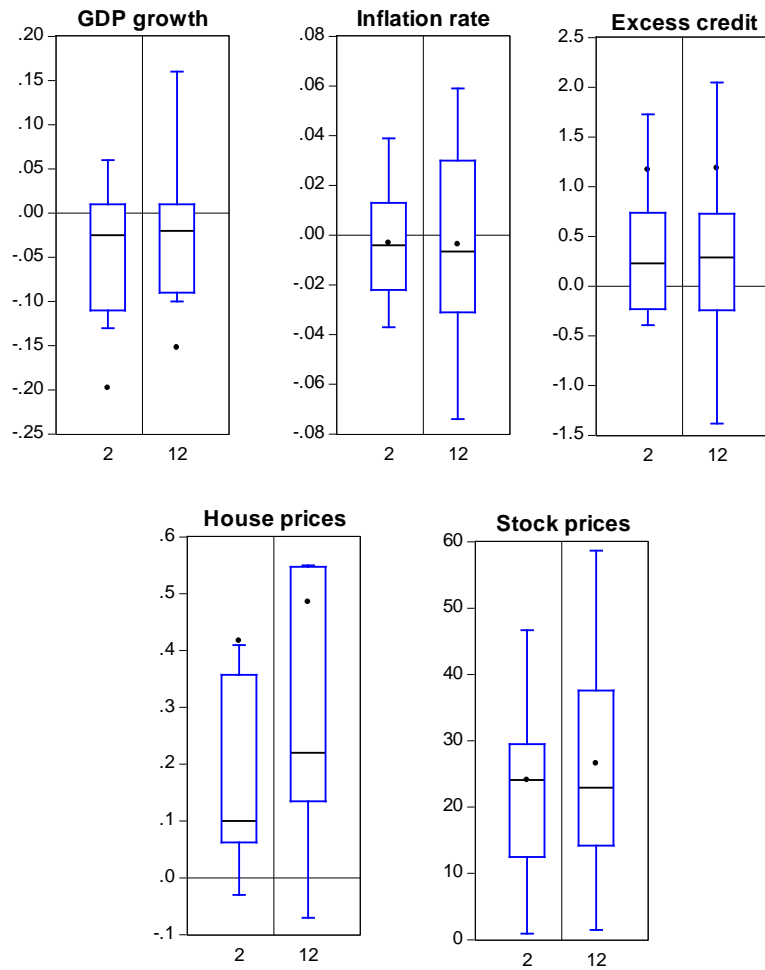


Figure 4A.3 Responses of euro area macro variables to a US house prices 1% increase at 2- and 12-quarter horizons

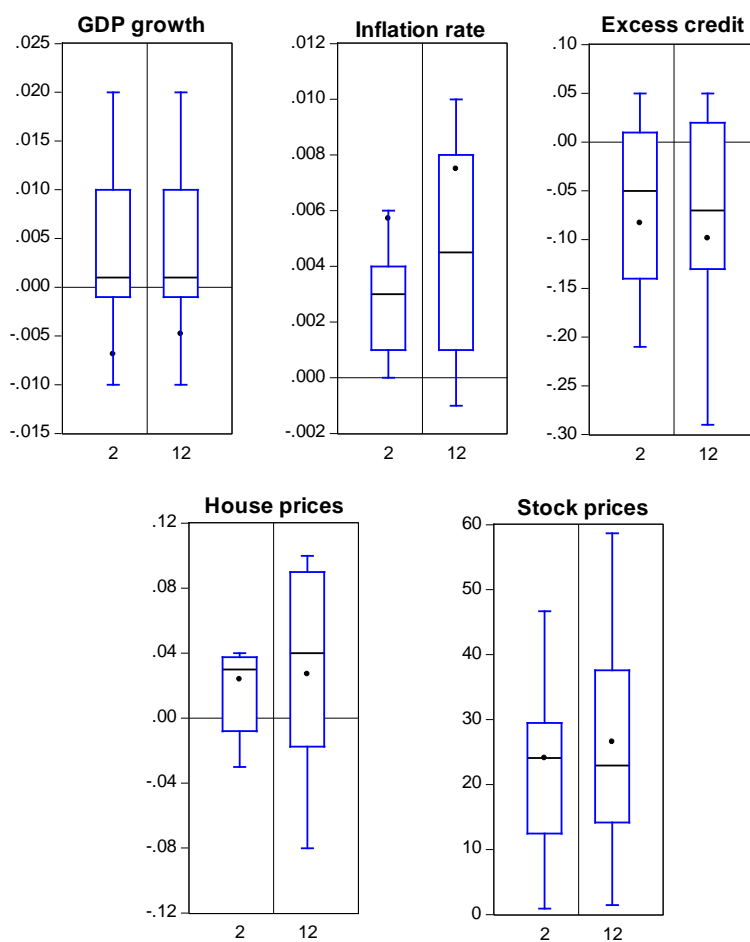


Figure 4A.4 Responses of euro area macro variables to a US stock prices 1% increase at 2- and 12-quarter horizons

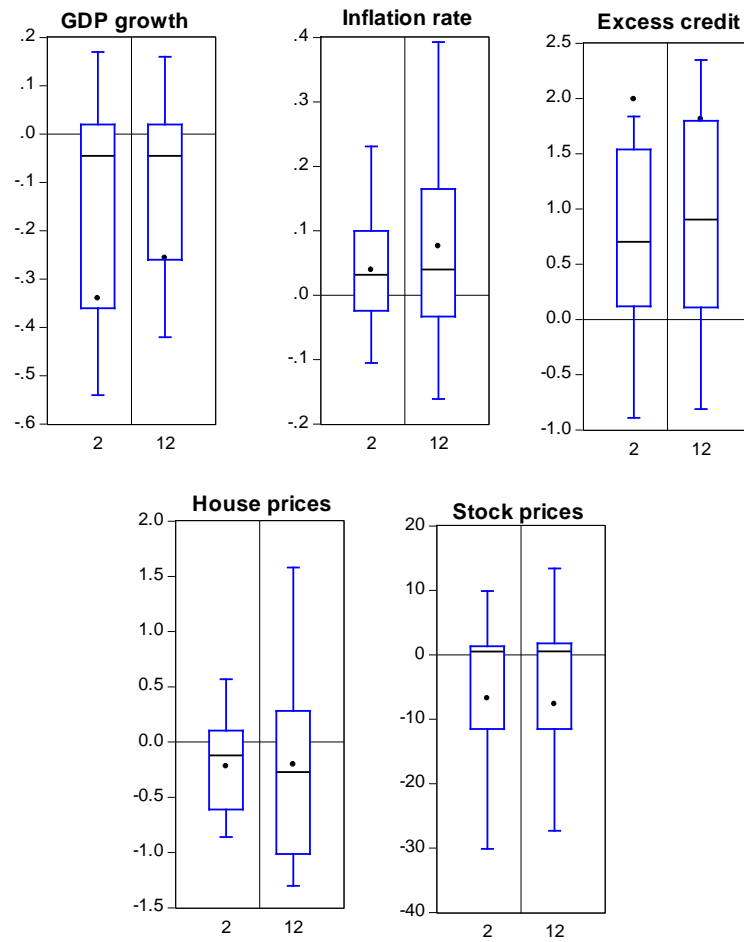


Figure 4A.5 Responses of euro area macro variables to a US financial fragility index 1% increase at 2- and 12-quarter horizons

NOTES

1. For instance, Aguiar-Contraria and Soares (2009) find that Germany, Austria, France, Spain, the Netherlands, Belgium and Luxembourg would form the euro-core, while Portugal, Greece, Italy and Finland are in the periphery. Yet, the evidence in favour of an upward trend is weak at most. See also Mink *et al.* (2007).
2. US data are from FRED2; OECD countries data are from OECD *Main Economic Indicators*, integrated with IMF *International Financial Statistics* (bank loans series); data for the other countries are from IMF *International Financial Statistics*; house price series for OECD countries are taken from a non-official OECD database (see <http://www.oilis.oecd.org/oilis/2006doc.nsf/linkto/ECO-WKP%282006%293>). The authors are grateful to P. Donati, S. Ejerskov, P. Benczur, M. Jensen for help with some of the data.
3. The economic/financial fragility index is computed as the first principal component extracted from the TED spread, the AGENCY spread, and the BAA-AAA corporate spread, providing an overall measure of credit/liquidity risk, stress in the mortgage market and risk appetite. The excess liquidity index is computed as the first principal component extracted from the M2 to GDP ratio and the total loans and leases at commercial banks to GDP ratio.
4. For instance, Bagliano and Morana (2010) find that the trade channel is the likely key transmission mechanism of the US economic crisis to the rest of the world, while US housing and stock prices and excess liquidity would have all contributed to the spillover of the US financial crisis to foreign countries. See also Levchenko *et al.* (2010) and Bems *et al.* (2010).
5. That is, the largest 18 OECD countries (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK, Australia, Canada, Japan and New Zealand), and a selection of the Latin American countries (Argentina, Brazil, Chile, Mexico, Peru), Asian countries (China, Hong Kong, Korea, Taiwan, Indonesia, Malaysia, Philippines, Singapore, Thailand, India, Pakistan, Turkey) and African countries (South Africa).
6. Of the 14 euro area member countries, there are 7 countries for which 6 macroeconomic series are available, yielding 42 equations; for the other 7 only 5 macroeconomic series are available. This yields 35 additional equations, in a total of 77.
7. Details are not included for reasons of space, but are available upon request from the authors.
8. Recent empirical evidence for the US point to a positive linkage between excess liquidity and house and stock prices, and to a negative linkage between interest rates and asset prices, with the latter being stronger than the former. See Bagliano and Morana (2010) for details.
9. See also Bagliano and Morana (2010) for significant interactions between housing and stock prices during the deleveraging process.
10. The empirical evidence is consistent with a linkage between asset prices and aggregate demand, pointing to an inelastic response of real activity, particularly for housing prices (Bagliano and Morana, 2010; Beltratti and Morana, 2010; Case *et al.*, 2005; Chirinko *et al.*, 2004; Carroll *et al.*, 2006).
11. Levchenko *et al.* (2010) report a contraction in US imports of about 40% relatively to the level that would otherwise have occurred in a no-crisis environment. Moreover, according to Bems *et al.* (2010), real world trade declined 15% between 2008Q1 and 2009Q1. 27% of the fall in US GDP was transmitted to foreign countries through a demand spillover, affecting durable goods in particular.
12. The negative correlation of the Greek business cycle with the euro area business cycle is a well established fact in the literature. See for instance Bower and Guillemineau (2006).

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