EUROPEAN CENTRAL BANK

EUROSYSTEM

RESEARCH BULLETIN

No 14, AUTUMN 2011

THE EURO AREA SOVEREIGN CRISIS: MONITORING SPILLOVERS AND CONTAGION

by Giovanni Amisano and Oreste Tristani

Recent research at the ECB has been assessing whether developments in euro area sovereign bond prices are a manifestation of financial contagion. This article provides an overview of some of the preliminary conclusions emerging from this research.

One of the notable features of the euro area sovereign debt crisis has been its progressive spread across various euro area countries. After the intensification of tensions in the Greek government bond market in spring 2010, Ireland, Portugal and eventually also Spain and Italy became increasingly engulfed in the sovereign crisis. French and German sovereign credit default swaps (CDS) also increased.

Recent research activity at the ECB has focused on assessing the extent to which these developments reflect contagion. A key step in this endeavour is the precise definition of the notion of contagion. The policy perspective typically adopted at the ECB characterises it as one of the possible manifestations of systemic risk: contagion occurs when systemic risk has an idiosyncratic origin, an exogenous trigger point and a sequential impact across different sectors or countries.[1] The operational definition used in the ECB research papers surveyed here, however, is less precise and broadly identifies contagion with an abnormal increase in cross-market linkages. In many cases, contagion is identified with any evidence of exceptional increases, compared with normal circumstances, in the cross-country co-movement of sovereign yields or CDS premia.

A key step in all the papers is the choice of an operational definition of contagion.

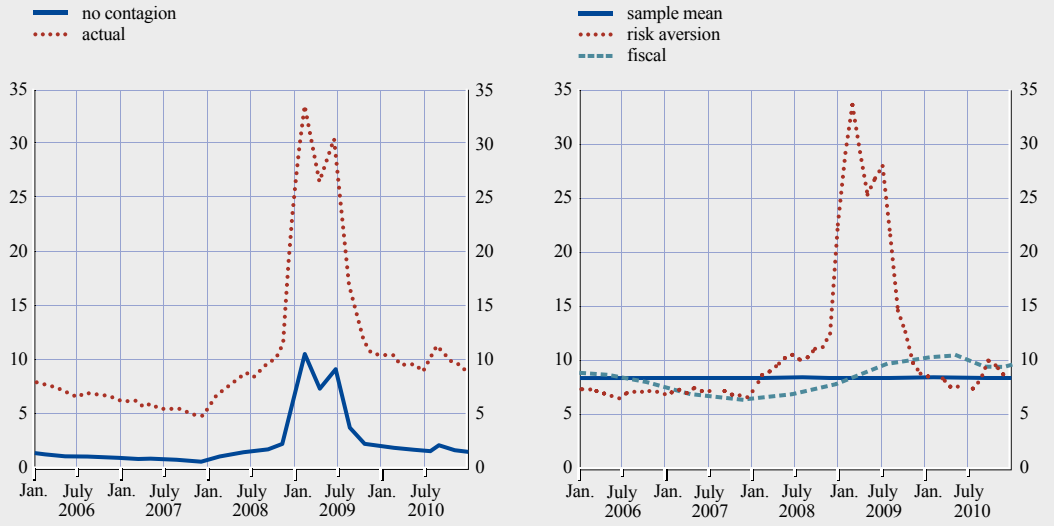
Donati (2011) relies on a dynamic, "state-space" model to ascribe movements in CDS premia to persistent, or short-lived unobservable factors. In a first stage, these factors are independently estimated for sovereign CDS premia in Greece, Ireland and Portugal. In a second stage, they are used as additional explanatory variables, over and above country-specific factors, in models of CDS premia in Germany, France, Italy and Spain. The finding that the additional explanatory variables lead to a statistically significant improvement in the forecasting performance of the models for the second group of countries is interpreted as evidence of contagion. More specifically, swings in perceptions of sovereign risk propagate across euro area countries, despite possibly stark differences in their macroeconomic fundamentals. In the sample period included in the analysis – i.e. up to 8 April 2011 – large increases (or declines) in the CDS premia for the three peripheral countries propagated to the CDS premia of the other euro area countries by triggering – potentially very persistent – rises (or decreases).

The evidence for contagion is more indirect in a recent ECB analysis[2] which finds that co-movement between daily changes in CDS premia among 11 euro area countries has been strong and stable over the past two years. A principal component analysis shows that, over the period from October 2008 to June 2011, the first two principal components account for 70-90% of daily fluctuations in CDS premia. Changes in the first principal component propagate with the same sign across all CDS premia over the recent sub-period from April 2010 to June 2011. Movements in the second principal component, however, have different effects on CDS premia of, on the one hand, countries with higher perceived sovereign risk, and on the other hand, remaining countries.

Fornari (2011) adopts a narrower definition of contagion. The idea is that an increase in cross-country covariance measures is not indicative of contagion, because the covariance could increase purely as a result of heightened volatility.[3] If contagion is identified with an increase in conditional cross-country correlations, the paper finds no clear evidence of contagion from developments in either the Greek or Portuguese sovereign bond spreads to

1 *See de Bandt, Hartmann and Peydro (2009) and European Central Bank (2009) for more detailed discussions.*
2 *See European Central Bank (2011).*
3 *See Forbes and Rigobon (2002).*

Chart 1 Probability of entering the crisis regime: effects of contagion, risk aversion and fiscal determinants for Italy



Source: Amisano and Tristani (2011), Directorate General Research, Monetary Policy Research Division.

the spreads of other euro area countries in the period after 10 May 2010.

Amisano and Tristani (2011) start from the premise that sovereign yield spreads can vary for two reasons. First, spreads respond to "normal" conditions which influence the markets' assessment of the relative probability of a country's default. Second, spreads can vary owing to a shift from a "normal" to a "crisis" regime, such that much higher spreads can suddenly be demanded after a relatively small deterioration in fundamentals. Abrupt variations of this type must be captured using a non-linear model. The particular form of non-linearity assumed by the authors is regime-switching, namely the possibility for sovereign spreads to switch between a low average level also characterised by lower volatility ("normal" regime) and a high average level accompanied by higher volatility ("crisis" regime).

The model allows for observable determinants of the probability of jumping between the two regimes. Three possible determinants are posited. First, regime switches may be related to the markets' changing perceptions of a country's fiscal sustainability, proxied by the deficit-to-GDP ratio. Second, switches of regime may be attributable to the markets' attitude towards risk, proxied by the US BAA-AAA corporate spread. Contagion is the third determinant of transition probabilities.

Cross-country spillovers are captured by allowing for an explicit interaction between each country's probability of jumping to the "crisis" state and the occurrence of a crisis state in any other country in the previous month. These spillovers qualify as contagion because they are independent of changes in either market risk attitudes or countries' fiscal positions.

Empirical results for Ireland, Greece, Spain, France, Italy and Portugal suggest that all determinants of the switching probabilities have affected sovereign bond yields over the period from January 1999 to December 2010. The cross-country results can be summarised as follows. Increases in market risk aversion play an important role at the outset of the financial crisis in 2008, when shifts towards the crisis regime are weakly related to a worsening of fiscal conditions. Nevertheless, the probability of entering the crisis regime increases when a country's fiscal situation deteriorates; this increase is amplified by contagion. Furthermore, once a country shifts to the crisis regime, only large improvements in its fiscal positions can increase the probability of leaving it.

Chart 1 illustrates these results in the case of Italy. The left-hand panel compares the estimated transition probabilities (the blue line) with the probabilities which would have

been observed in the absence of contagion – that is, had a sovereign crisis not occurred in any other country (the red line).
The contagion effect is much more pronounced after the Lehman crisis when it interacts with increased risk aversion: transition probabilities with and without contagion differ by at most 5% until the beginning of 2008, rising to more than 20% at the beginning of 2009.

Fiscal fundamentals, risk aversion and contagion have all affected euro area sovereign bond yield spreads.

The right-hand panel of Chart 1 highlights the effects of fiscal fundamentals and risk aversion. The probability of falling in the crisis regime had both fiscal deficits and risk aversion remained constant (the blue line) is compared to the probabilities which would have been observed had either of these variables alone evolved as observed in the sample (the green and red lines respectively).
The results illustrate the strong role played by the increase in risk aversion at the end of 2008: the transition probability rises from 8% to 33%.
The deterioration of fiscal conditions plays a role in the course of 2010, but this effect produces only a small increase in the transition probability.

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FINANCIAL FRICTIONS, FINANCIAL INTEGRATION AND THE INTERNATIONAL PROPAGATION OF SHOCKS

By Giovanni Lombardo and Luca Dedola

Financial globalisation leads to a stronger international correlation of asset returns. In this article, we show how it can also lead to a strong correlation of credit spreads. This can suffice to generate strong business cycle co-movements quite independently of the share of foreign assets in the balance sheet of leveraged investors. This analysis thus suggests some caution in assessing the risks of "contagion" on the exclusive basis of quantitative measures of cross-border balance sheet exposure.

Many features of the financial crisis of 2008-10 do not easily find a precedent in the post-war experience of advanced countries. However, a comparison with the Great Depression is arguably justified, given the severity of the ensuing recession and its global repercussions.[1] As the crisis unravelled, trade in goods and assets collapsed after years of steady expansion, ushering in worries of a replay of the protectionist backlash of the late 1930s. In particular, many have posited that international financial linkages have been instrumental in channelling the international propagation of a US-originated shock. For example, Milesi-Ferretti and Tille (2011) and Broner et al. (2010) document the extent of the "global retrenchment" during the crisis, when capital flows went in reverse and were repatriated as financial intermediaries "de-leveraged" their balance sheets.[2] However, it is an open question whether this process was a consequence of the crisis, or actively contributed to its diffusion. International capital could be withdrawn because recessions are a bad time to invest.[3]

Financial globalisation can bring about strong co-movements in borrowing costs.

In a similar vein, in an early analysis of the global diffusion of the crisis, Krugman (2008) argued that an "international financial multiplier" was at work. In a mechanism reminiscent of the vicious cycle in the "financial accelerator" of Bernanke et al. (1999), highly leveraged investors active internationally, whose creditworthiness is determined by the health of their balance sheet, would see their access to credit hampered by a collapse in the value of their domestic or foreign assets. The ensuing contraction of credit would translate into a reduction in investment with obvious consequences for asset prices across the board.

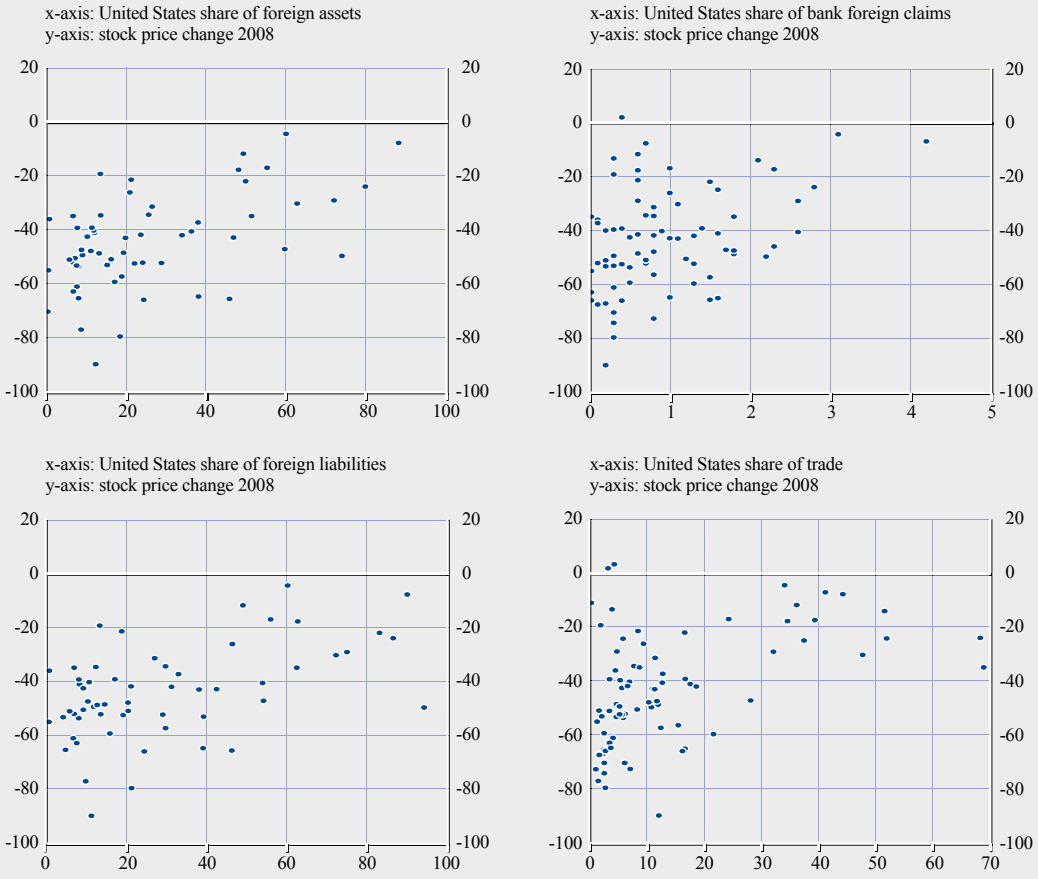
Despite the immediate appeal of this balance sheet exposure channel, many have raised doubts about its role in generating such a synchronous contraction in stock markets and real activity around the world. Even within the US financial system, "the outstanding amount of subprime-related assets was not large enough to cause a systemic financial crisis by itself" (Gorton, 2010).[4] Rose and Spiegel (2010), using a number of alternative estimation techniques, find no evidence of a negative relationship between "exposure" and country performance, both measured in terms of GDP growth and in terms of a synthetic indicator of economic performance. Chart 1 shows some of the data they collected concerning the relationship between the stock market performance of a large set of countries and four measures of "exposure", i.e. the share of US assets held by each country relative to total foreign assets; the share of liabilities towards the United States relative to total liabilities; the share of liabilities towards US banks relative to total foreign banks' liabilities; and the share of trade with the United States relative to total foreign trade.

The propagation of financial shocks in a two-country dynamic stochastic general equilibrium (DSGE) model

In a recent work of ours (Dedola and Lombardo, forthcoming), we analyse the international propagation of shocks in a model of two financially integrated economies characterised by credit frictions. We note that financial globalisation does not merely imply that

1 *See Imbs (2010), among others.*
2 *A similar interpretation of the international transmission of financial crises, based on the idea of a "common lender", was advanced by Kaminsky and Reinhart (2000) in relation to the 1997 East Asian crisis.*
3 *Likewise, there is a growing consensus that the collapse in world trade was a result of the collapse in global demand, see, e.g. Eaton et al. (2011).*
4 *This view echoes Calvo's observation in relation to the spreading of the 1998 Russian crisis to Brazil that such a contagion could not be simply attributed to the exposure to Russian assets, given the relatively small size of the latter in the international capital market (Calvo, 2000).*

Chart 1 Exposure and stock market performance



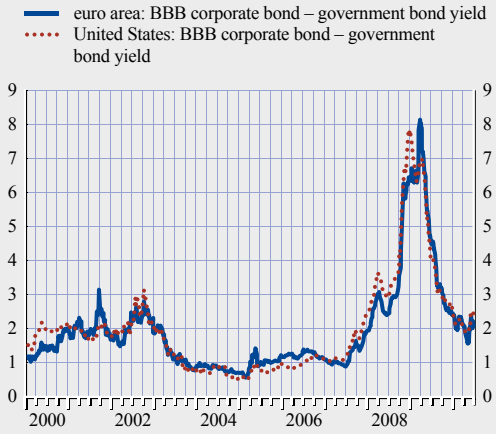
Source: Rose and Spiegel (2010).
Notes: US share of foreign assets measures the share of US assets held by foreign countries relative to total foreign assets held by these countries. US share of foreign liabilities measures the share of liabilities towards the United States relative to total foreign liabilities. US share of bank foreign claims, as before, it restricts liabilities to bank claims. US share of trade measures bilateral trade with the United States relative to total foreign trade.

international investors, facing some form of financial friction akin to the financial accelerator, might be exposed to foreign shocks via the composition of their balance sheet.

On the one hand, under financial integration the same set of risky assets is freely traded across countries, implying that (expected) returns on each type of investment will be the same for all investors. On the other hand, optimality of investors' decisions will require that the returns on domestic and foreign investment be equalised to the cost of raising funds. The latter, expressed as spreads over risk free rates, under very general specifications of a financial accelerator will be a function of investors' net worth (and thus of their investment returns, among other things). As a result, by force of arbitrage, borrowing costs and credit spreads will tend to display similar dynamics – even with segmented, exclusively domestic credit markets. The implications for international transmission and financial "contagion", even when cross-border asset exposure is limited, are quite consequential. Credit spread increases in one country, for instance owing to a negative financial shock, will spill over to other countries and raise credit spreads abroad, potentially resulting in strong co-movements in asset prices, demand for capital, investment and real activity.

Balance sheet exposure might be an imperfect measure of the risks of contagion.

Chart 2 Correlation of credit spreads

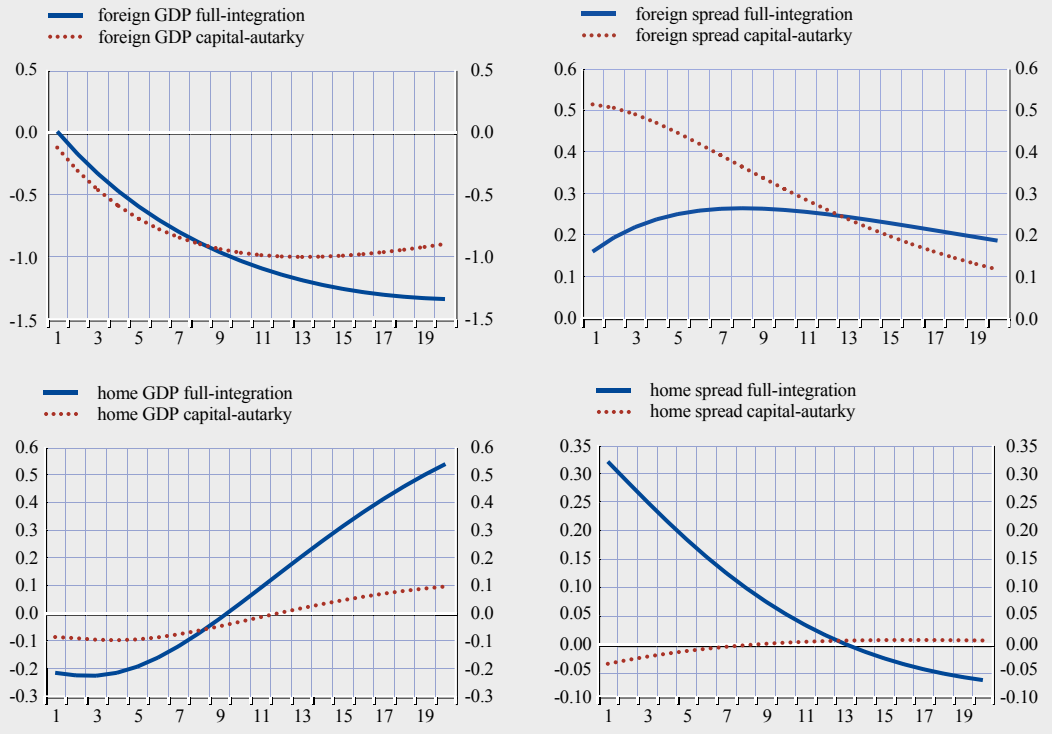


Source: Datastream.
Note: Credit spreads are computed as the difference between BBB corporate bond yields (Merril Lynch) and government bond yields of ten-year maturity.

Chart 2 displays a measure of credit spreads for the United States and the euro area (BBB corporate bond yields minus government bond yields of comparable maturity) between 2000 and 2010. Even considering only the period to June 2007, the correlation between spreads is extremely high (around 0.9), indicating that at least one necessary element of the above mechanism is present in the data. However, despite the tight correlation in spreads, macroeconomic developments between the euro area and the United States were rather decoupled between 2000 and 2007, relative to close synchronisation in 2008-10. According to our model, financially integrated economies tend to co-move more strongly when hit by shocks originating in the financial sector, as opposed to other economic disturbances, e.g. productivity shocks. And when credit markets are imperfect, the more so the more financially integrated they are.

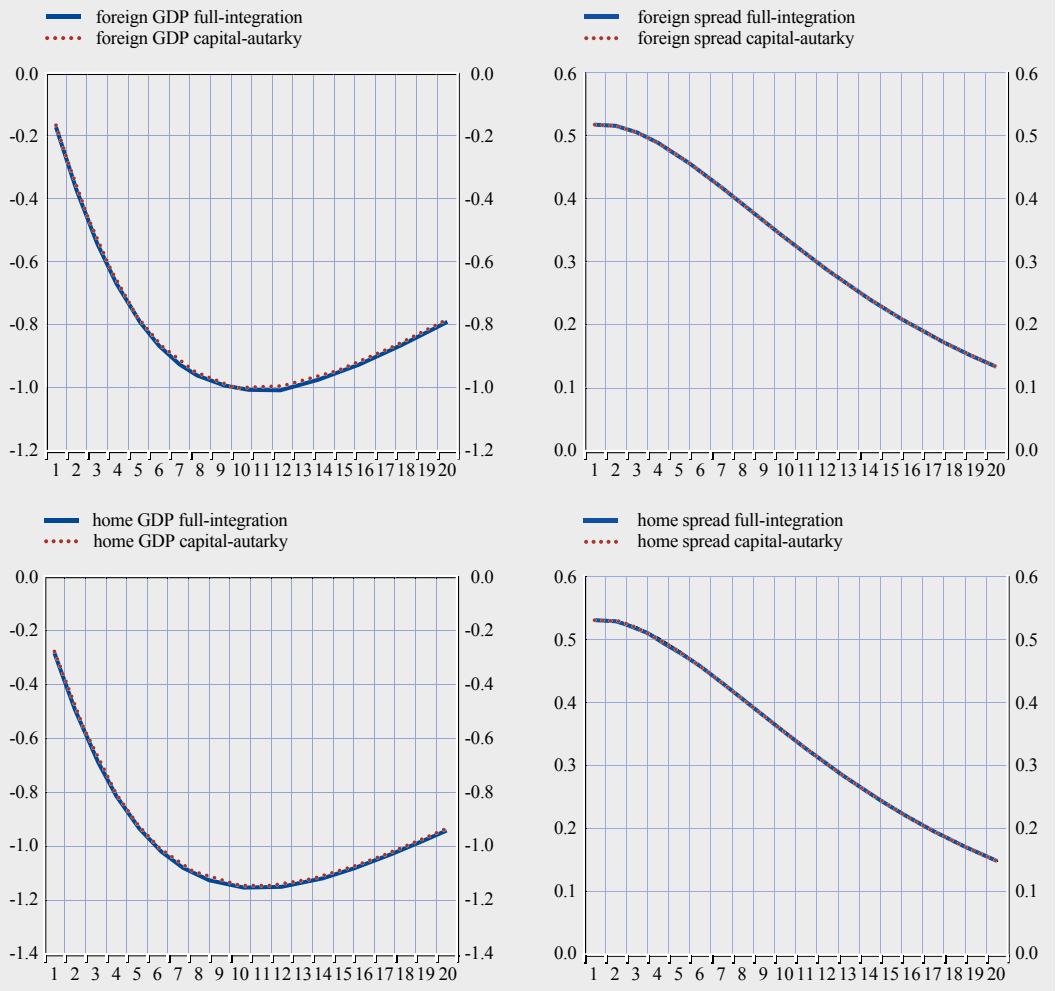
A word of caution is in order concerning the interpretation of the return equalisation channel. This channel is based on non-arbitrage conditions that might not hold in each instant of time, in particular during a financial crisis. Nevertheless, it can be argued that return differentials across similar asset classes set

Chart 3 Response of GDP and spreads to a net worth shock: trade in bonds only



Source: Model simulation.
Note: Time measured in quarters.

Chart 4 Response of GDP and spreads to a net worth shock: trade in bonds and equities



Source: Model simulation.
Note: Time measured in quaters.

in motion adjustment processes that generate the strong co-movements in asset prices and spreads observed in the data.

Simulation results

Charts 3 and 4 present a set of model simulations contrasting the spread equalisation channel with the balance sheet channel under different degrees of financial integration, when leveraged investors in one of the countries (dubbed "foreign") are hit by an adverse financial shock. Considering the international propagation patterns of such shocks could be particularly interesting in the context of the 2008-10 financial crisis, characterised by large and synchronised declines in asset prices and macroeconomic variables in many countries which were driven by negative developments in financial institutions and markets.[5] Chart 3 shows the response of the two countries under the assumption that the only internationally traded assets are nominal bonds denominated in each country's currency. Leveraged investors, facing a financial accelerator constraint, can only actively trade in domestic equities. Nevertheless, in order to assess the

[5] *Specifically, the shock is modelled as an unexpected contraction of investors' net worth. This reduced-form shock can be interpreted in a number of ways and compared to different financial shocks studied in the literature. For example, it can be interpreted as a reduction in the ability of the borrower to obtain credit against her assets, similar to the liquidity shock in Kyiotaki and Moore (2008) and Del Negro et al. (2010). Devereux and Yetman (2010), in an analysis similar to ours, focus instead on the effects of productivity shocks.*

importance of the balance sheet channel (à la Krugman), we consider the possibility of investors being endowed with a share of foreign equities. So, for the sake of comparison, in both charts we report two scenarios: full "home bias" (circled black line), i.e. investors only hold domestic equities; and "full diversification" (plain red line), i.e. 50% of investors' assets comprise foreign assets. Chart 4 allows for international trade in equities and thus for an active portfolio allocation by leveraged investors. In this case both return equalisation and balance sheet effects are present. To summarise, the differences between the two charts demonstrate the importance of the return equalisation channel brought about by optimal portfolio choices under financial integration, while the differences between the two lines within each panel demonstrate the role of balance sheet exposure.

We start with the case of trade only in nominal bonds displayed in Chart 3.[6] The climb in the foreign spread brings about a sharp contraction in foreign GDP. By contrast, the home spread falls slightly while home GDP contracts only for a few quarters before expanding considerably. Adding a large exposure to foreign equities goes some way to improving the cross-country correlation of spreads. Nevertheless, the response of home GDP is still counterfactual. Overall, the balance sheet effect generated by the large (ad hoc) exposure does not seem to produce, by itself, the expected sign and strength of international propagation.

Turning to the effects of financial integration in bonds and equities, Chart 4 shows that the return equalisation channel brings about almost perfect co-movement between home and foreign variables. Moreover, it is immediately apparent that the differences between the cases of full home bias and full diversification are negligible, implying that the size of home bias in portfolios is largely inconsequential for the sign and strength of the international propagation of shocks. As discussed above, this is particularly important in the light of the (otherwise puzzling) rapid propagation of shocks even when exposure to those very assets in cross-border portfolios appears to be rather limited.

Conclusions

Our analysis shows that balance sheet exposure to foreign assets, while per se a potentially powerful channel of international transmission, may represent an imperfect indicator of the risks of "contagion". Financial globalisation has much to do with the increased participation of financial investors in international financial markets. While optimal portfolios may display large or small shares of foreign assets, optimal investment decisions will generally tend to produce a strong international correlation of asset returns. In the presence of frictions in domestic credit markets, the international correlation of returns can translate into a strong correlation of credit spreads across countries. As credit spreads can have strong effects on macroeconomic developments, cross-country correlation of the former will generate cross-country correlation of the latter.

The spread equalisation channel can have important policy implications. First of all, it must be noted that a stronger cross-border diffusion of shocks, resulting from international financial integration, does not need to have negative welfare implications. Financial integration softens the impact of adverse shocks in the epicentre country, so that ex ante financial integration can provide mutual insurance across countries. Second, to the same extent that financial shocks have strong spillover effects across countries via financial integration, policy interventions will also be propagated across countries. For example, policies aimed at sustaining the net worth of domestic financial intermediaries will induce reductions in foreign credit spreads, with expansionary effects on the foreign economy. These policy spillovers can generate free-riding incentives for policy-makers, potentially resulting in insufficient interventions. Our analysis gives further grounds for international policy cooperation in times of financial distress.

International financial integration calls for more economic policy cooperation.

6 *The shock has been normalised to have a 1% drop in foreign GDP at the trough of the home bias case (circled black line).*

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REVISITING THE INFORMATION CONTENT OF CORE INFLATION

by Michele Lenza

Changes in energy and food prices in the euro area are transmitted, with a delay, to other items in the consumer price basket. Hence, it may be inadvisable for a medium-term-oriented policy-maker to exclude them from the index of consumer prices. The article discusses the empirical evidence supporting this argument and proposes a more sophisticated method to assess medium-term-oriented inflationary pressures that does not a priori exclude any components of consumer prices.[1]

The fluctuations in commodity prices in recent years have revived the debate on the appropriate measure of inflation dynamics for a medium-term-oriented monetary policy.[2] Central to the debate is whether inflation dynamics related to energy and food prices, mostly fuelled by changes in global commodity prices, should be disregarded owing to their supposedly temporary effect on consumer prices. In fact, a popular measure of medium-term inflationary pressures is the Harmonised Index of Consumer Prices (HICP) excluding energy and unprocessed food prices (HICPex). The HICPex is a good measure of medium-term inflationary pressures if energy and food prices only affect headline inflation in the short term. However, if food and energy prices have a lasting impact on inflation, for example by affecting other items in the consumer price basket through higher production costs, excluding them from headline inflation may distort the timeliness and reliability of signals of future inflationary pressures.

HICP excluding energy and unprocessed food is a lagging indicator of headline inflation.

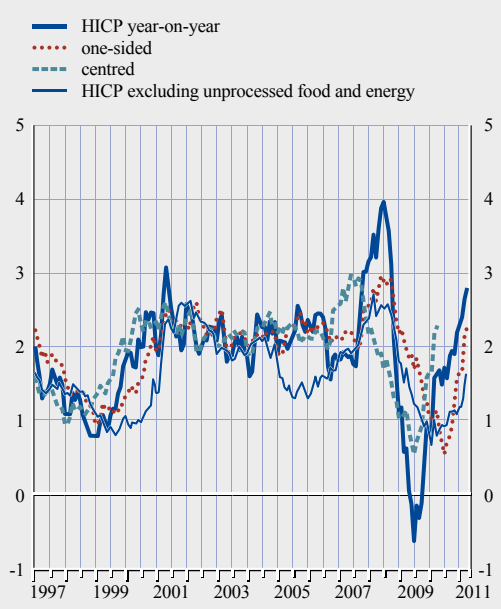
In general, a medium-term measure of inflationary pressures should eliminate components that have only a short-run effect on inflation (i.e. to achieve smoothness) and should be timely. One approach is to construct centred moving averages of monthly inflation, that is a linear combination of its past, present and future values. However, the unavailability of future monthly inflation rates limits the usefulness of this approach for policy-makers although it can be applied as a benchmark to assess other indicators. In particular, we may ask whether the HICPex tracks a long and timely moving average of monthly inflation (where the latter is available) without lags. In that case, we would conclude that such an index provides a good assessment of medium-term inflationary pressures.

We address this issue here using euro area data. Chart 1 below shows year-on-year headline inflation in the HICP which, by construction, is a lagging indicator of month-on-month inflation; year-on-year HICPex inflation; and two long moving averages of headline inflation.[3] The two-year centred moving average of monthly headline inflation, being a linear combination of past, present and future inflation, has one year of data missing at the end of the sample. The one-sided moving average is constructed from the current and previous two years of observations.

By construction, the centred moving average of monthly headline inflation leads actual inflation while the one-sided moving average lags it. The HICPex generally tracks the one-sided moving average closely but it does not track the centred moving average well. Clearly, on euro area data, the HICPex is not a timely or reliable signal of inflationary developments.
One potential explanation for this is that energy and food prices contain useful leading information on headline inflation and it is therefore a mistake to exclude them when constructing a predictor of medium-term inflation. Recent work (see Giannone et al., 2010) seems to support this claim. Chart 2 shows the impulse response of the log level of headline inflation to a 10% increase in global

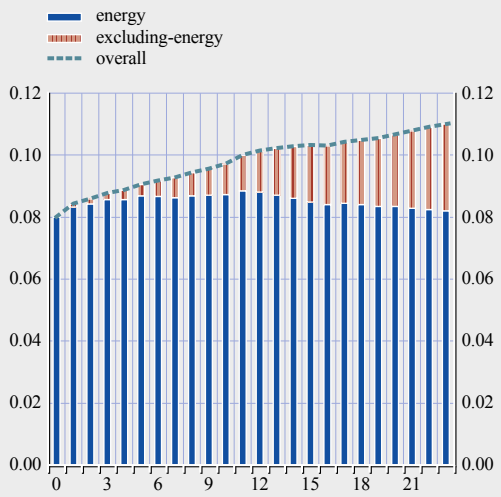
1 *See also Lenza and Reichlin (2011).*
2 *See, for example, Bini Smaghi (2011) and Krugman (2011).*
3 *The choice of 24-month moving averages to smooth month-on-month inflation is arbitrary. The moving averages must be long enough to smooth out high-frequency fluctuations.*

Chart 1 HICP, HICPex, centred moving average and one-sided moving average



Note: The chart reports the year-on-year growth rates of HICP (blue solid line) and HICPex (blue solid line) together with the 24 months centred moving average of HICP (petrol blue dashed line) and the 24 months one-sided moving average of HICP (red dotted line) in the sample January 1997 – April 2011.

Chart 2 Contribution of energy and non-energy components to the response of the log level of HICP



Note: The chart shows the contribution of the energy (blue bars) and non-energy (red bars) components to the response of the HICP log level (green dashed line). The horizontal axis refers to the months after the shock.

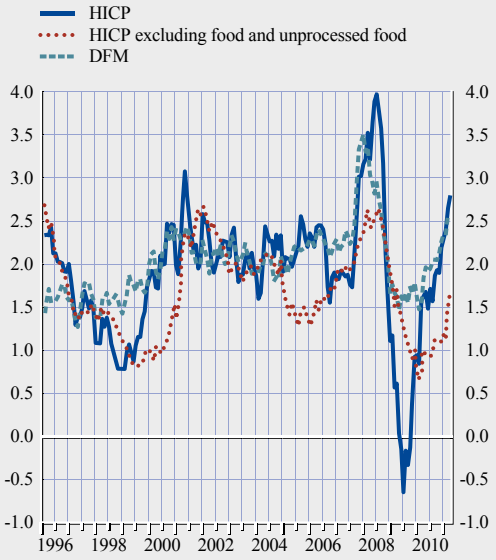
oil prices and decomposes the responses in the contributions owing to direct effects (i.e. directly affecting the energy component of the HICP) and indirect effects (i.e. affecting services, non-industrial goods and food prices of the HICP).

The chart shows that the non-energy components of the HICP are also affected, with a delay, by an increase in global oil prices. This is probably attributable, at least in part, to the impact of higher energy costs on the production of the other items in the consumer price basket. This suggests that inflation dynamics related to energy and food prices, although mostly fuelled by changes in global commodity prices, should not be completely disregarded.

Is it possible to improve on these simple measures of medium-term inflationary pressures and provide more sophisticated indexes of core inflation? Research has suggested using a large set of indicators in order to match long moving averages of monthly inflation, such as all available disaggregated consumer prices, commodity prices, surveys and financial variables. The idea is to consider variables which lead monthly inflation and use them as proxies of unavailable future information on inflation. The resulting index is a weighted average of leading, lagging and coincident indicators of monthly inflation. Averaging appropriately produces a smooth version of monthly inflation which is closely correlated with its one-year moving average but has no missing observations at the end of the sample. In Cristadoro et al. (2005) such an index is proposed and constructed for the euro area. Along with the year-on-year HICP and HICPex, Chart 3 shows a version of this index (dynamic factor model, DFM),

Oil price shocks are transmitted, first, to energy prices and then, with a delay, to other consumer prices.

Chart 3 HICP, HICP excluding food and energy and a multivariate index (DFM)



Note: The chart reports the year-on-year growth rates of HICP (blue solid line) and HICPex (red dotted line) and the dynamic factor model index extracted from month-on-month growth rates of HICP sub-components (petrol blue dashed line) in the sample January 1997 – April 2011.

which is based on the whole range of disaggregated prices included in the HICP.[4]

The index based on multivariate information leads year-on-year headline inflation rates, improving on the timeliness of the HICPex while, at the same time, retaining the smoothness of year-on-year rates. This is despite the fact that it is extracted from highly volatile monthly growth rates of disaggregated prices.

In conclusion, some caution is needed when excluding energy and food prices from the HICP because changes in energy and food prices do not have only temporary effects on consumer prices. As an alternative, multivariate information can be exploited in order to smooth out temporary fluctuations and provide a more accurate assessment of medium-term inflationary pressures in a timely way.

4 *Here we focus only on the DFM index as an alternative to the HICPex. Other alternative methods to compute core inflation are available. See, for example, European Central Bank (2001, 2009) for a wider discussion of different methods and their relative merits.*

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Box 1

WIM DUISENBERG RESEARCH FELLOWSHIP PROGRAMME

The Wim Duisenberg Research Fellowship Programme was established in 2006. It aims to promote policy-relevant research meeting the highest academic standards and offers research staff at the ECB the opportunity to gain exposure to the most recent advances in economic research. Moreover, prominent scholars are given the opportunity to gain an insight into the policy-making environment of the ECB. Fellows in the programme spend between three and eleven months at the ECB during a given calendar year.

Research fellows are encouraged to interact with ECB staff members, both in Directorate General Research (DG/R) and in other business areas. They will have access to the ECB library and to the computing and statistical facilities necessary to conduct their research. While at the ECB, research fellows are expected to produce a research paper of a theoretical or empirical nature for presentation at internal seminars and external conferences, and for publication in the ECB Working Paper Series and, possibly, a leading academic referred journal. Candidates must present a proposal for a research project as part of the application procedure.

Opportunities to participate in the programme are advertised once a year on the ECB website. Fellows are selected from the applicants by a selection committee comprising DG/R staff and representatives of other business areas.

Six leading economists are visiting the ECB this year: Fernando Enrique Alvarez (University of Chicago) who analysed "Microeconomics of menu cost as source of price rigidities"; Harald Hau (INSEAD) who studied "The international transmission of the financial crisis"; Jean Imbs (Paris School of Economics) who analysed "Trade elasticities"; Michael Devereux (University of British Columbia) and Charles Engel (University of Wisconsin) with the joint research project "Real exchange rate adjustment in and out of the eurozone"; and Eric Ghysels (University of North Carolina) with the research project "Forecasting and nowcasting economic activity with mixed frequency data.

Other Duisenberg Research Fellows and their research projects of recent years include:

Philipp Bacchetta (University of Lausanne) 2010
co-authors: C. Tille and E. van Wincoop
"On the Dynamics of Leverage, Liquidity, and Risk"

Harry Huizinga (Tilburg University) 2010
co-authors: S. Corradin, R. Gropp and L. Laeven
"Who invests in home equity to exempt wealth from bankruptcy?"

Kenneth West (University of Wisconsin) 2010
"Understanding exchange rates"

Steven Ongena (CentER Tilburg University) 2009
co-authors: G. Jiménez, J-L. Peydró and J. Saurina
"Credit Supply: Identifying Balance-Sheet Channels with Loan Applications and Granted Loans"

Sylvester Eijffinger (CentER Tilburg University) 2009
co-authors: C.A B. van der Cruijsen and L. Hoogduin
"Optimal Central Bank Transparency"

Volker Wieland (Johann-Wolfgang Goethe University, Frankfurt) 2008-2009
co-author: G.W. Beck
"Money in monetary policy design: Monetary cross-checking in the New-Keynesian model"

Charles Engel (University of Wisconsin) 2009
"Currency Misalignments and Optimal Monetary Policy: A Reexamination"

Box 2

CONFERENCE ON THE ROLE OF NON-LINEAR METHODS IN EMPIRICAL MACROECONOMICS AND FORECASTING

Many economic relationships are inherently non-linear. Such non-linearities can arise owing to the nature of household preferences or the production technology that is available to firms. In addition, "frictions" such as the cost of changing the capital stock or of hiring and firing workers and costs associated with default on debt and the monitoring of risky lending can give rise to such potentially important non-linearities. For example, the parameters governing these economic relationships may change over time, or the nature of the relationship may depend on the level of the variables in question or the magnitude and sign of the particular economic shocks that are driving them. Yet, in practice, economists have in the past often relied on linear approximations when trying to capture economic interdependence. One reason for this is that the estimation of non-linear models involves many challenges. Moreover, it has often proved difficult to outperform simple linear models, e.g. in forecasting business cycle developments. The experience of the recent crisis has raised the question whether non-linear models should receive more prominence than they have in the past.

On 1 September 2011 the Directorate General Research of the ECB in collaboration with the Working Group on Econometric Modelling (WGEM) of the European System of Central Banks (ESCB) organised a one-day workshop on the role of non-linear methods in empirical macroeconomics and forecasting. A key goal of the workshop was to contribute to the assessment of the possible benefits and challenges related to using non-linear methods in business cycle analysis, in conducting policy-relevant simulations and in producing reliable macroeconomic forecasts. The workshop was attended by representatives and experts from EU central banks as well as by prominent scholars in macroeconomics, econometric modelling and forecasting and monetary policy analysis.

The workshop was structured into two broad parts with contributions covering both methodological aspects and economic analysis. The first part focused on reduced-form models, which do not provide a fully structural interpretation of economic interrelationships but which nonetheless have advantages in short-term forecasting and business cycle analysis. A range of non-linear time series models have been developed and employed in empirical analyses. The second part focused on structural macroeconomic models, including dynamic stochastic general equilibrium (DSGE) models. Such models have explicit micro-foundations which link the cyclical and long-run

properties of the economy, potentially allowing for relevant non-linearities. However, in estimating and evaluating such models, it is common practice to use linear approximations thus effectively excluding many potentially relevant and interesting features. While this may be a reasonable approach when shocks are relatively small, it may give rise to misleading conclusions when there are large disturbances, when there are fundamental changes in agents' behaviour or when some variables are constrained (e.g. nominal interest rates which are subject to a zero lower bound). Recent research efforts have therefore been aimed at solving and simulating these structural models in a more realistic setting.

One promising approach to exploring non-linearities which can be applied to both structural and reduced-form models is to use a regime-switching framework which assumes that key economic relationships of the model might change over time and can be attributed to different regimes. The recent discontinuous, abrupt shifts in shocks and economic behaviour can be captured particularly well by Markov-switching models. Examples of issues that can be addressed using such an approach include the analysis of non-standard monetary policy measures, the identification of time-varying risk premia driving the term structure of interest rates and the impact of financial stress on the monetary policy transmission mechanism. Another insight highlighted at the workshop was that fundamental non-linearities in the economy may be proxied by considering multiple models simultaneously and allowing for switching between different models over time in response to new information. One important direction of research is to develop further the micro-foundations of macro models given the non-linearities observed in the recent crisis. Overall, a growing number of complementary approaches are emerging to modelling and investigating non-linearities in economic relationships, and using these models for forecasting. While the estimation and analysis of non-linear models are certainly very challenging, advances in modelling technology are starting to resolve many of the analytical and computational difficulties associated with their implementation. There are therefore good reasons to be optimistic that such approaches will help close the gap in our understanding of non-linearities in the economy and offer useful insights for policy-making institutions such as the ECB.

The contributions to the workshop can be downloaded from the ECB's website at: http://www.ecb.europa.eu/events/conferences/html/ws_ecb_emp_macro.en.html

Box 3

CONFERENCE ON ALTERNATIVE APPROACHES TO MODELLING SYSTEMIC RISK

On 9 and 10 June 2011 the European Central Bank, together with the Federal Reserve Bank of New York and the Centre for Financial Studies, organised a conference in Frankfurt am Main on alternative approaches to understanding systemic risk. The main goal of the conference was to foster cross-discipline collaboration by exploring parallels between the concept of systemic risk in economics and in other selected scientific domains.

The conference featured the participation of prominent scholars in the fields of biology, physics, engineering and, of course, economics. The general themes of the conference were non-linearity, complexity, networks and agents' heterogeneity.

Traditional approaches to systemic risk assuming a linear system, decomposable into separate parts, are ill equipped to capture the interconnectedness and fragility of the financial system.

There are many instances in biology and ecology where rapid and unexpected shifts typically precede catastrophic events, such as climate change or fishery collapse. These are all non-linear, non-equilibrium systems that undergo rapid state changes. Complexity and network theory look at the basic principles that tie these events together, trying to establish whether they exhibit common patterns in their transition to a state of disequilibrium, and whether universal early warning signals can be derived from these patterns.

Physicists adopt a similar methodological approach, i.e. trying to infer general laws about the behaviour of macro aggregates from the behaviour of its elementary constituents. A key factor to understand the micro/macro link of any system is the type of interaction among its micro elements. If this interaction is relatively weak, the macro behaviour of the system resembles that of its individual constituents. If, however, the micro interaction reaches a critical threshold, it triggers a phase transition where the macro and micro properties of the system become completely different. Many physicists consider the terabytes of data produced daily by financial markets as the ideal laboratory for developing theories consistent with both microeconomic and macroeconomic behaviour.

Engineers in a variety of fields, from the aerospace industry to supply chain management, share many challenges with economists in managing the risk of complex systems. Financial systems can be studied as a supply chain network where the service rate of a bank (the provision of loans) depends on the availability of capital, the arrival rate of savings depends on the supply of securities, and the two are linked via the economy. It is important to guarantee coordination among the different elements of the chain by developing incentives and processes to control "bullwhip effects", i.e. the amplification in the variation in demand for services as one moves up the supply chain away from the end-consumer. Devising and following clear procedures and regulations are necessary to prevent disastrous failures. Fostering a questioning environment and maintaining a diversity of opinion are also indispensable complements to procedures.

A common criticism that other sciences level at economics focuses on its reliance on a representative agent model. Non-linearities and phase shifts stemming from agents' interactions are difficult to reconcile with this framework. Agent-based models represent an alternative approach in economics which moves beyond the representative, rational agent paradigm, for example focusing explicitly on heterogeneity in expectations. This body of research generates interesting insights on how the introduction of new securities can lead to instability. As the new instruments generate profits, other agents enter the market, further reinforcing the initial price trends. But as more and more traders adopt the same strategies, "resonance" and instability become much more likely and, by this token, more financial instruments may end up destabilising markets.

The contributions to this conference can be downloaded from the ECB's website at: http://www.ecb.int/events/conferences/html/conf_ecb_ny_fed.en.html

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Imprint
The opinions expressed in this publication are those of the authors and do not necessarily reflect those of the European Central Bank. Editors: Günter Coenen, Filippo di Mauro, Philipp Hartmann, Geoff Kenny, Huw Pill, Frank Smets. Responsible editor for this edition: Filippo di Mauro. Assistance to editors: Daniela Rothermel, Carina Stubenrauch. Contact for general information and subscription to the Research Bulletin: ECB-ResearchBulletin@ecb.europa.eu

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ISSN 1977-12X (online)