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By Simone Manganelli

With the escalation of the financial crisis in the euro area, the ECB started to purchase government bonds in the secondary market, with the goal of restoring appropriate levels of liquidity and protecting the monetary transmission mechanism. The fact that SMP interventions were typically carried out on days of sustained market pressure creates major econometric challenges for assessing the impact of the programme. The papers reviewed in this article adopt different perspectives, data and methodologies to solve the identification problem. They find that the SMP contributed to reducing liquidity risk and bond yield volatility.

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impact, and present an empirical framework permitting an assessment of the likelihood of joint and conditional default of euro area sovereigns based on observed prices for credit default swaps on sovereign debt. In this way we contribute to the discussion about the extent to which euro area capital markets are affected by contagion concerns, and to what extent priced credit risks are affected by policy measures.

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THE IMPACT OF THE SECURITIES MARKETS PROGRAMME

By Simone Manganelli



The announcement of the decision to establish the Securities Markets Programme (SMP) had an immediate impact on yields, but the SMP's effectiveness over the following months is more difficult to quantify. The correlation between SMP interventions and market turbulence raises severe endogeneity problems. This article reviews three papers which together provide a broad perspective on the effects of the SMP, as they rely on different empirical methodologies, as well as on data sampled at different frequencies (weekly, daily and intradaily). The findings suggest that SMP purchases had a positive but short-lived effect on market functioning by reducing liquidity premia and lowering the level as well as the volatility of yields.

On 10 May 2010 the European Central Bank (ECB) launched the SMP “to address the severe tensions in certain market segments”. The ECB started to intervene in the secondary market of some euro area government bonds, with the objective “to ensure depth and liquidity” and “restore an appropriate monetary policy transmission mechanism”. After a first wave of interventions, the programme was re-activated in August 2011, in response to renewed tensions.

The mere announcement of the central bank intervening in the secondary government bond market had an immediate impact on yields and spreads vis-a-vis the German bond. For instance, spreads on ten-year Greek government

bonds decreased by more than 400 basis points on 10 May 2010. Spreads on Italian and Spanish bonds decreased by almost 100 basis points on 8 August 2011, after a press release stating that the ECB would “actively implement its Securities

Markets Programme”. The impact of purchases in the following months, however, is more difficult to quantify.

A major challenge in assessing the effectiveness of the SMP interventions is that they were typically carried out in periods of

stress. The observed level and volatility of yields on intervention days may therefore be higher than average. It would be unwarranted, however, to conclude from this evidence that SMP interventions have

been ineffective or, worse, counterproductive. Their effectiveness can only be judged in

relation to the counterfactual scenario which would have been observed had the interventions not been carried out. From an econometric perspective, this amounts to addressing potential biases related to the endogeneity and simultaneity of interventions.

This article reviews the first available empirical evidence on the effectiveness of the SMP.

It is based on the results of three empirical studies which were presented at an ECB workshop on “Non-standard monetary policy measures: Lessons from recent international experience” in June 2012. The three papers together provide a broad perspective on the effects of the SMP, as they rely on different empirical methodologies, as well as on data sampled at different frequencies (weekly, daily and intradaily). More specifically, the three papers adopt different strategies to deal with endogeneity. Before reviewing each contribution, the next section discusses the rationale behind the SMP, highlighting the differences with respect to other international asset purchase programmes.

Differences between central banks' asset purchase programmes

There are many differences between the ECB's SMP and analogous actions taken by other central banks, such as the large-scale asset purchase programmes launched by the US Federal Reserve System, or the quantitative easing strategy implemented by the Bank of England.

Both the US and the UK programmes had the explicit objective of implementing a more accommodative monetary policy stance – once the lower bound for short-term interest rates had been reached – by lowering long-term yields and injecting more liquidity in the system. However, the primary goal of

The announcement had an immediate effect on yields, but the SMP's impact in the following months is more difficult to quantify.

A major econometric challenge is due to the fact that SMP interventions are typically carried out on days of increasing yields.

the SMP was to address a malfunctioning of certain market segments by ensuring sufficient depth and liquidity. In the days preceding the start of the interventions in May 2010 and August 2011, extreme tensions in some euro area sovereign bond markets had begun to spill over to other markets, further impairing the transmission mechanism of monetary policy. The policy assessment at the time was that these severe market tensions, if left untreated, would create unacceptable downside risks to price stability.

A second major difference is that interventions in the United States and the United Kingdom took place in large and very liquid markets. The SMP, by contrast, was often implemented in smaller and less liquid markets, severely hampered by excessive risk premia. A third major difference is that the announcement of the decision to establish the SMP was not accompanied by explicit targets in terms of volumes to be purchased or yield levels to be attained. In particular, ECB policy-makers emphasised on several occasions that the purpose of the SMP was not to change the monetary policy stance, which continued to be driven by the key policy rates.

The remainder of this article presents three recent studies specifically aimed at evaluating the effectiveness of the SMP. Whether the SMP has achieved its goal is hard to define in precise quantitative terms, and therefore different authors adopt different perspectives. One paper looks at the impact on a particular measure of liquidity, while the other two estimate the effect on the level and volatility of yields. Maintaining sufficient levels of liquidity, limiting volatility and avoiding abrupt market movements are necessary to guarantee proper market functioning, because large institutional investors such as pension funds and insurance companies – which are essential to ensure market depth and liquidity and which typically enforce strict risk limits – may prefer to exit excessively volatile markets, for example in order to avoid hitting their “Value at Risk” constraints.

The SMP differs from large-scale asset purchases implemented by other central banks. Papers on the SMP adopt different identification strategies.

The results of the three papers may be briefly summarised as follows. The first paper evaluates the impact of the SMP by measuring its effect on liquidity premia. It finds that the average weekly purchases reduced liquidity premia by almost 20 basis points on impact, but that this effect dies out over time. The other two papers propose an alternative modelling strategy to address the endogeneity problems which typically affect this kind of estimation. These papers find that, ceteris paribus, purchases for EUR 100 million reduce the spread by up to 25 basis points on average over the 15-minute interval following the purchase. The average daily spread falls by much less, under 2 basis points. Both papers find a strongly significant effect in terms of reducing overall volatility. Needless to say, these estimates are surrounded by considerable model and estimation uncertainty, and should be taken with a grain of salt.

Estimating a structural model to identify liquidity premia from weekly data

De Pooter, Martin and Pruitt (2012) are interested in testing whether the SMP had an impact on sovereign bond liquidity premia. They first develop a structural search-based asset pricing model, adapted to account for default risk. In this model, agents face search frictions that prevent them from selling the asset immediately. As a consequence, the equilibrium price is lower – and the associated yield higher – than the price that would prevail in a frictionless world.

De Pooter, Martin and Pruitt refer to the liquidity premium as the difference between these two prices. Within this model, ECB interventions can affect bond yields by reducing the liquidity premium via two channels, both driven by a reduction in the search frictions of those agents who would like to sell. A stock

channel works via the reduction in the overall supply of bonds in the market. As fewer bonds are available for sale, it becomes less likely that these bonds are in the hands of agents who would like to sell. The flow channel, instead, is





characterised by ECB purchases taking bonds immediately out of the hands of impatient bond holders. As the most impatient and risk-averse agents are driven out of the market, the liquidity risk premium commanded by the remaining agents should decrease.

To test the model empirically, the authors first need to extract the liquidity premia implicit in sovereign bond prices. This estimation is performed with the help of an auxiliary term structure model, using both sovereign bonds and sovereign credit default swap (CDS) data,

and assuming that the factors driving CDS liquidity premia are orthogonal to those driving bond liquidity premia. In a second stage, the authors regress the estimated liquidity risk premium on SMP purchases. Although the authors do not explicitly

address any endogeneity issue in their empirical analysis (whereby SMP interventions could be triggered by excessive liquidity premia), they do find that weekly ECB purchases have the desired effect of lowering liquidity premia: on average by 19.4 basis points. However, 14.8 basis points of this effect were temporary, implying that the overall weekly average permanent effect associated with the stock effect was just 4.6 basis points.

Using a factor model with daily data to correct the endogeneity bias

The second paper, by Eser and Schwaab (2012), relies on a panel of daily data for bond yields and SMP interventions. If both ECB bond purchases and yield developments react to an unobserved news flow, regressing yield changes on SMP purchases gives rise to an endogeneity problem. The standard solutions to the endogeneity bias problem are to find either suitable instruments or control covariates. Since valid instruments are not readily available in this case, the authors adopt a factor modelling methodology using as control both observed and unobserved factors that can approximate the unobserved news flow affecting yield developments.

The observed factors used in the analysis are the VIX volatility and the spread between BBB and AAA-rated corporate bonds in the euro area. The latent factors include a common and a country-specific component, which should account for both common and idiosyncratic shocks. When brought to the data, the model shows that SMP purchases have contributed effectively to lowering bond yields. Specifically, the authors' baseline model suggests that, on average, a daily SMP intervention of EUR 100 million lowered yields by 0.1 to 2 basis points. This impact is stronger in markets which are smaller, less liquid, and where risk premia are higher.

A second important finding is that SMP purchases have significantly

contributed to lower yield volatility.

By exploiting the dynamic structure of their model, the authors can also disentangle the transitory and permanent impact of the purchases. The cumulated persistent effect over time of a total purchase of EUR 50 billion results in a cumulative reduction in yields of approximately 90 basis points for large countries and 1,000 basis points for smaller countries. These figures represent the point estimate of the effect.

When interpreting them one should bear in mind that they are surrounded by considerable modelling and estimation uncertainty.

Exploiting intradaily data to bypass endogeneity problems

A third strategy to identify the effectiveness of the SMP is to look at price developments in real time. Part of the ECB's strategy was to prevent abrupt upward movements in yields, without imposing a cap on them. When looking at close-of-day yields in times of stress, it may well be possible to observe no change (or even an increase) in yields, despite ECB's purchases. However, by matching the timing and amounts purchased with the prevailing intraday quotes at sufficiently high frequency, one can isolate the immediate effect of the purchases from the impact of the other shocks that hit the market during the rest of the day. Zero

The papers find that SMP purchases had a moderate positive effect on market functioning by contributing to reduce liquidity premia, ...

... the level of yields ...

or positive correlation between price and quantities at daily frequency is perfectly compatible with negative correlation at higher frequency.

Ghysels, Idier, Manganelli and Vergote (2012) analyse the high-frequency dynamics of bond yields and purchases. Consistent with the above, they find that the estimated coefficients obtained by regressing yield changes on SMP interventions at daily frequencies are often not significantly different from zero and are in some cases positive. However, when running the same regression using high-frequency data sampled at 15-minute intervals, they obtain the expected negative sign, confirming that endogeneity is indeed a serious issue for this kind of analysis. On average, they find that a EUR 100 million intervention has an immediate impact on bond yields of between

0.1 and 25 basis points, depending on the size of the market.

The empirical investigation reveals that SMP purchases have also contributed to reducing the volatility of targeted government bond yields. An additional advantage of using high-frequency data, besides helping to address the endogeneity problem, is that it allows one to estimate time-varying elasticities of SMP interventions. Using two-week rolling-window estimates, it is possible to track how the price impact of ECB purchases for first and second conditional moments have changed over time. The results confirm that SMP purchases had an impact on both the level and the volatility of yields.

... and the volatility of yields.



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CONDITIONAL PROBABILITIES AND CONTAGION MEASURES FOR EURO AREA SOVEREIGN DEFAULT RISK

By Bernd Schwaab



The issue of measuring and monitoring interconnected sovereign default risk has received a lot of interest in the wake of the sovereign debt crisis in the euro area. In this article we review some approaches to measuring sovereign default risk and its cross-country impact, and present an empirical framework that permits an assessment of the likelihood of joint and conditional default of euro area sovereigns based on observed prices for credit default swaps on sovereign debt. Conditional probabilities quantify the extent to which euro area capital markets are affected by contagion concerns, and to what extent priced credit risks are affected by policy measures.

Does the cost of sovereign debt service in one euro area Member State depend on the possibility of a credit event elsewhere in the euro area? For example, does the, say, Italian government have to pay more interest on its sovereign debt owing to the possibility of a (second) credit event in Greece? Is it possible to assess the probability – as perceived by market participants and priced into credit derivative contracts – of a credit event in Portugal if one materialises in, say, Spain? What is the joint probability of a credit event in *both* Portugal and Spain over a one-year horizon? To what extent do policy measures at the European level affect sovereign risks? Such questions have attracted a lot of attention in the academic literature and from central banks. Clearly, dynamic models of risk dependence and risk interconnectedness are required to answer such questions. In this paper we first review available models for sovereign credit risk and risk contagion, before presenting one particular model in more detail which can address the above questions.

Sovereign risk contagion: literature and evidence

The volume of recent literature on modelling sovereign default risk has expanded rapidly. Part of the literature focuses on the theoretical development of sovereign default decisions (Adam and Grill (2012) and Tirole (2012)). Another strand of literature tries to empirically disentangle the different priced components of sovereign default risk using asset pricing methodology (Longstaff, Pan, Pedersen and Singleton (2011) and Ang and Longstaff (2011)). In addition, several studies investigate the link between sovereign credit risk and macro fundamentals (Hilscher and Nosbusch (2010)). This sovereign default risk literature, however, does not necessarily focus on sovereign risk *contagion*.

In the literature, the term “contagion” is interpreted in different ways, depending on the point of view. From a policy perspective, contagion could be defined as a situation in which instability in one specific financial market, institution or country is transmitted to one or several other markets, institutions or countries (González-Páramo (2011)). In this definition, contagion would not occur without an initial trigger event, and therefore contains a “directional” element. Also, contagion is here different from risk dependence that is due to shared exposure to common risk factors. Finally, the transmission of instability could also be required to be in some way abnormal, for example, in terms of its speed, strength or scope.

The academic literature does not usually adhere to such a strict definition. For example, Forbes and Rigobon (2002) and Forbes (2012) distinguish contagion from a situation of mere “interdependence”. Roughly speaking, contagion is a situation of increased dependence in bad times, controlling for uncertainty (volatility) that also tends to increase in such scenarios. This strand of literature does not require directionality, which is hard to establish empirically in the absence of exogenous variation or time lags. It also does away with the requirement that increased dependence in bad times is not due to now more volatile common factors, which are hard to observe in their entirety in practice.

Anecdotal evidence for contagion during the euro area sovereign crisis abounds. For example, when Moody’s downgraded Portugal on 5 July 2011, it cited, among other factors, developments in Greece, see Constâncio (2011) and De Santis (2012). Moody’s apparently believed that contagion from a default of Greece made it more likely that Portugal would require a second round of official financing.

Moreover, referring to Greece as a precedent, Moody's indicated that a second round of official financing would entail private sector participation also in Portugal. Clearly, the risk developments in one country had impacted the risks of another euro area Member State.

A substantial number of empirical papers point towards sovereign risk contagion in the euro area. Using a multitude of econometric approaches, including quantile regression and non-parametric techniques, Caporin, Pelizzon, Ravazzolo and Rigobon (2012) conclude that bond or credit default swap (CDS) spreads in some countries of the euro area have been impacted by other countries' bond yields or CDS spreads. Barbosa and Costa (2012) point out that European sovereign credit spreads – measured either as CDS spreads or government bond yield spreads over German bonds – are highly correlated: a first common factor explains up to 80% of the common variation across CDSs across both core and peripheral euro area countries, consistent with a highly interconnected system. Amisano and Tristani (2012) estimate a panel data regime-switching model and find that risk conditions in one euro area Member State matter for the regime-switching probabilities of other euro area Member States.

Rigorous general equilibrium asset pricing models that allow for an explicit contagion risk channel – and provide an acceptable empirical fit to a panel of sovereign CDSs during the European debt crisis – are rare. In this respect the study of Benzoni, Collin-Dufresne, Goldstein and Helwege (2012) stands out. In this paper, contagion risk arises because agents are uncertain about both some underlying “states” of the economy and the probabilities associated with these states. In a sense, the agents have “fragile beliefs” regarding these states. Together, these two ingredients – hidden states and fragile beliefs – can generate significant correlation in spreads even if common movements in macroeconomic fundamentals are relatively modest. However, it is not entirely clear what interpretation to give to the hidden states in the euro area context.

In the remainder of this article we review a recent empirical framework attributable to Lucas, Schwaab and Zhang (2012). This

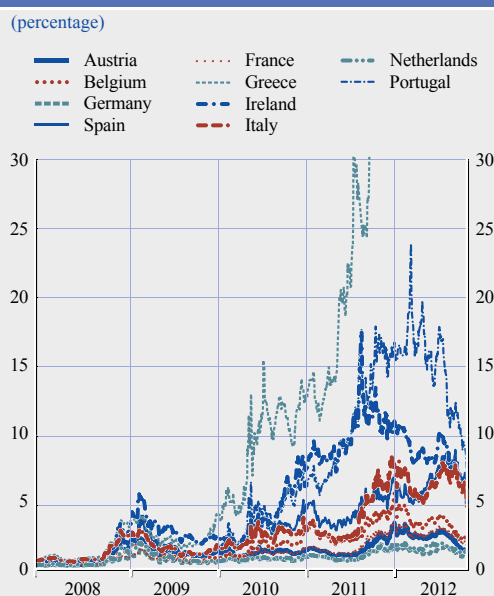
framework is unique in that it allows us to construct the probability of *joint* and *conditional* sovereign defaults from observed CDS prices. At its core, the model is based on a dynamic multivariate framework which captures the salient features of European CDS data, such as skewed and heavy-tailed changes in the price of CDS protection against sovereign default, as well as dynamic volatilities and correlations. As a result, both uncertainty and risk dependence can increase in times of stress. The framework is applied here to euro area sovereign CDS spreads.

Marginal and joint euro area sovereign default risk over time

Conditional and joint risk assessments are interesting from a risk management and financial stability surveillance point of view. Financial instruments, such as government bonds and CDS contracts, are traded in relatively liquid markets and contain information about the country-specific marginal probabilities of default as perceived by financial market participants. In addition, the co-movement of CDS spreads over time contains information about how interacting sovereign risks are connected.



Chart 1 CDS-implied risk neutral pd's for ten euro area Member States



Source: Author's calculation assuming a 25% recovery rate.



One way of illustrating the default risk of sovereigns is to use implied probabilities of default to obtain marginal and joint risk estimates. Chart 1 plots estimates of CDS-implied probabilities of default (PDs) over a one-year horizon. The calculations are directly based on CDS spreads, assuming a 25% recovery rate at default and flat term structures for default probabilities and interest rates. The market-implied risk neutral PDs do not depend on parametric assumptions regarding their joint distribution. Estimated PDs range from below 1% for Germany and the Netherlands to above 5% for Greece and Portugal at the end of our sample. The market-implied PDs of the other countries – Austria, Belgium, France, Ireland, Italy, and Spain – lie in between these values.

Chart 2 reports the probability of *two or more* credit events among these ten euro area sovereigns over a one-year horizon. This joint default probability is based on CDS data and our empirical model for default dependence. The joint risk measure is calculated by

“The joint announcement of the SMP and the EFSF had an immediate and strong effect on priced sovereign default risk. The perceived probability of two or more credit events over a one-year horizon decreased from about 6% to approximately 3% around 10 May 2010”.

simulation at each point in time. Essentially, the risk estimate from Chart 2 combines all marginal and joint default information into a single time series plot. No causality is implied here.

The development of joint sovereign risk captures the deterioration of perceived risk conditions over time. The probability of two or more defaults over a one-year horizon, as reported in Chart 2, is essentially zero until September 2008. The possibility of several simultaneous credit events in the euro area has not been priced by market participants for most of the year 2008. The risk of a clustered default starts to pick up in the weeks after the Lehman Brothers’

bankruptcy and the Irish guarantee of its banking system in September 2008. The joint probability estimate peaks initially in the first quarter of 2009, at the height of the Irish debt crisis, then decreases until the third quarter of 2009. It then continues to increase until mid-2012. Importantly, the joint probability decreases sharply around 10 May 2010 – from approximately 6% to approximately 3%. This large drop corresponds to the announcement relating to the European Financial Stability Facility and the European Central Bank’s (ECB) Securities Markets Programme (see below). The reduction in joint risk is large but temporary.

Chart 2 Perceived probability of two or more defaults for ten euro area Member States

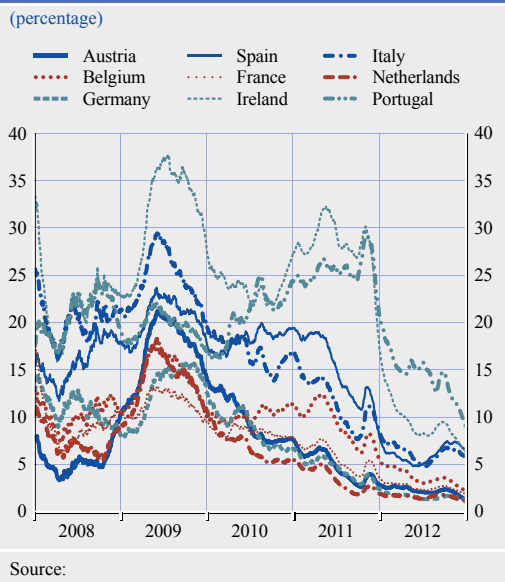


Source: Author’s calculations.

Cross-country risk spillovers

Sovereign credit risks in the euro area are perceived to be strongly interconnected. Chart 3 plots conditional probabilities of default in the event Greece was to default with certainty as perceived by market participants over time at a daily frequency. Conditional probabilities are reported for nine euro area countries. Countries such as Ireland and Portugal seem to be most affected by a Greek default around mid-2011, with risk-neutral conditional probabilities of default of around 30%. Other countries may be perceived as more “ring-fenced” as of June 2011, with conditional default probabilities below 10%. The conditional

Chart 3 Priced probability of a credit event in another country given a certain credit event in Greece



probabilities converge quickly to their marginal probabilities towards the end of 2011, when the perceived probability of a credit event in Greece is practically equal to one.

From 2008 to mid-2011, the conditional probabilities plotted in Chart 3 are substantially higher than the respective unconditional probabilities from Chart 1. We may interpret these differences as either a spillover component or a contagion effect. The level of estimated spillovers is substantial. It suggests that the cost of debt refinancing in some euro area countries may depend to a substantial degree on risk conditions elsewhere.

Event study: The 10 May 2010 rescue package and sovereign default risk dependence

To what extent are sovereign default risk premia and cross-country spillover effects affected by policy measures at the European level? To investigate this issue, we study the risk impact of a comprehensive rescue package announced by euro area Heads of State during a weekend meeting preceding 10 May 2010. This first rescue package was designed to mitigate sovereign risk conditions and perceived risk contagion in the euro area.

This section analyses the impact of the resulting simultaneous announcement, relating to the European Financial Stability Facility (EFSF) and the ECB's Securities Markets Programme (SMP), on euro area joint risk and conditional risk. We do so by comparing implied risk conditions closely before and after the announcement of 10 May 2010.

The agreed upon rescue fund, the EFSF, is a limited liability facility with the objective of preserving financial stability in the euro area by providing temporary financial assistance to euro area Member States in economic difficulties. A second key component of the announcement was the ECB's government bond buying programme, the SMP. Specifically, the ECB announced that it would start to intervene in secondary government bond markets to ensure depth and liquidity in dysfunctional market segments.

The joint impact of the 10 May 2010 announcement relating to the EFSF and the SMP, as well as of the initial bond purchases on joint sovereign risk estimates, can be seen in Chart 2. The chart suggested that the probability of two or more credit events in a portfolio of ten countries decreases by around half after the announcement – from approximately 6% to approximately 3%.

To further investigate the immediate impact on risk of the policy measures communicated on 10 May 2010, Table 1 reports model-based estimates of joint and conditional sovereign default risk. We report risk estimates for two dates, Thursday 6 May 2010 and Tuesday 11 May 2010, i.e. two days before and after the announced change in policy. The top panel of Table 1 confirms that the joint probability of a credit event in, say, both Portugal and Greece, or Ireland and Greece, declines from 4.8% to 2.3% and 3.1% to 1.8% respectively. These are large decreases in joint risk. For any country in the sample, the probability of that country failing simultaneously with Greece or Portugal over a one-year horizon is substantially lower after the policy announcement than before.

Did the large reduction in joint risk come from a decrease in perceived risk dependence? Table 1b reports conditional default risk estimates



**Table 1a Joint risk, Pr(credit event in i and j)**

(percentage)				
	Thurs. 6 May 2010		Tues. 11 May 2010	
	Portugal	Greece	Portugal	Greece
Germany	1.0	1.1	0.8	0.8
Greece	4.8	-	2.3	-
Ireland	2.6	3.1	1.4	1.8
Netherlands	0.9	0.9	0.6	0.7
Portugal	-	4.8	-	2.3

Table 1b Conditional risk, Pr(credit event in i given j)

(percentage)				
	Thurs. 6 May 2010		Tues. 11 May 2010	
	Portugal	Greece	Portugal	Greece
Germany	16	8	26	12
Greece	78	-	80	-
Ireland	43	23	49	26
Netherlands	14	7	21	10
Portugal	-	36	-	33

that suggest that this is not the case. Instead, the conditional probabilities of a credit event in, for example, Greece or Ireland, given a credit event in Portugal, increased from 78% to 80% and from 43% to 49% respectively. As a bottom line, based on the initial impact of the first rescue package on priced risk, our analysis suggests that the two main policies may have been perceived by market participants to be less of a “firewall” or “ring-fence” measure, i.e. intended to lower the impact and spread of an adverse development should it actually occur. Rather, markets appear to have perceived the measures much more as a means of reducing the probability of individual adverse outcomes, but without decreasing overall dependence. Contagion concerns have remained a relevant

source of cross-country sovereign risk dependence.

Conclusions

We reviewed an empirical framework to assess the likelihood of joint and conditional default of euro area sovereigns. The methodology is novel in that the joint risk measures are derived from a dynamic multivariate framework which naturally accommodates fat tails and time variation in volatilities and dependence. Using the example of the two key measures announced on 10 May 2010, we saw how an explicit modelling framework can contribute to our understanding of market perceptions about specific policy measures.

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BANK DEPENDENCE AND INVESTMENT DURING THE FINANCIAL CRISIS

By Philip Vermeulen



Aggregate investment collapsed in the euro area during the recent financial crisis. As the financial crisis evolved into a banking crisis a natural question is whether credit provision by banks played a role in the investment collapse. This article summarises research that provides empirical evidence of the causal role played by bank credit supply in the drop in investment. One of the main findings is that firms that were more dependent on bank finance reduced investment to a much larger extent than less dependent firms.

During the financial crisis, aggregate fixed capital formation in the euro area collapsed. Using annual national accounts data, Chart 1 summarises, for six euro area countries (Belgium, Germany, Spain, France, Italy and Portugal), the average annual growth in aggregate fixed capital formation during years of positive investment growth (booms), years of negative growth excluding 2009 (downturns) and in 2009. As Chart 1 shows, 2009 was a particularly bad year. How can this substantial drop in the midst of the financial crisis be explained?

Credit constraints and investment

One explanation emphasises the role of credit in propagating shocks over the business cycle. Alternative models of the credit channel put

the emphasis on either borrowers (i.e. firms or households) or lenders (i.e. banks or financial intermediaries). Fluctuations in the net worth of borrowers in the presence of credit market imperfections will lead to higher borrowing costs. Alternatively, shocks to lenders' balance sheets might affect the supply of bank-intermediated credit. If bank credit has few substitutes, for at least some borrowers in the

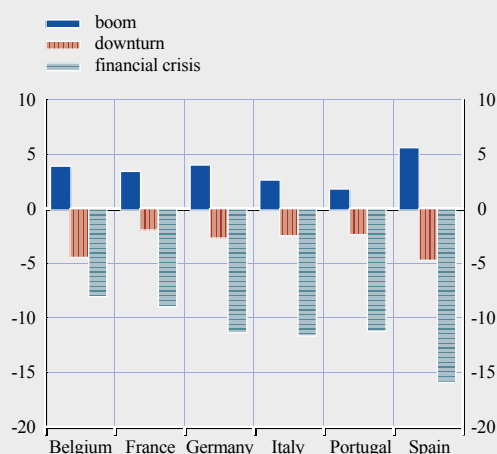
economy, shifts in bank credit supply will have real effects. These real effects are likely to be seen in the investment spending of firms that are dependent on banks. Without doubt, the financial crisis has caused large shocks to banks' balance sheets. Recent empirical findings in the economics literature point towards a reduction of credit supply by financial institutions during the recent financial crisis, both in the United States and the euro area. See, for example, Ivashina and Scharfstein (2010), Iyer, Lopes, Peydró and Schoar (2010) and Bonaccorsi di Patti and Sette (2012).

As for firms, financing constraints during the financial crisis and their effect on spending has been investigated by, among others, Campello, Graham and Harvey (2010) and Almeida, Campello, Laranjeira and Weisbenner (2012). All of these studies point towards behaviour of firms consistent with binding credit constraints during the crisis. Understanding the effects of the financial crisis requires knowledge of the impact on firms dependent on bank-intermediated credit. Did firms' investment decisions during the crisis differ according to the degree to which the firms were financed by banks? How is the financial crisis different from earlier periods in which investment was weak? Were the effects of the crisis asymmetric across countries?

The recent financial crisis has renewed interest in understanding more deeply the role of credit in propagating shocks over the business cycle.

Chart 1 Aggregate fixed capital formation in investment booms, downturns and 2009

(average annual growth; percentage points)



Sources: Buca and Vermeulen (2012).
Note: Data refer to the period 2001-2009.

Empirical evidence

In Buca and Vermeulen (2012) we investigate these questions using the BACH database. This database is constructed by aggregating a large number of individual firms' annual balance sheet and profit and loss accounts data. Aggregate firm data are constructed per country and per year for three firm size classes and for different industries. In the study we follow the investment behaviour of 24 manufacturing industries for six euro area countries – Belgium, Germany, Spain, France, Italy and Portugal – over the period 2000-09.

Firms that depend on banks are identified as firms with high bank borrowing relative to their total assets, i.e. their bank debt leverage ratio is high. Firms' dependence on bank finance varies considerably across size classes and across industries. The average bank debt leverage ratio measured in the data is 19.7% with a standard deviation of 10 percentage points.

To investigate the role of bank credit during the financial crisis, we regress investment on profit and demand determinants (sales growth and cash flow) and bank debt leverage. First, we test whether bank debt mattered “more” – i.e. had more negative effects on investment – during the financial crisis than in earlier downturns and also compared with earlier boom years. Only if bank debt mattered more during the financial crisis we can claim that bank credit was hard to substitute during the crisis. In other words, earlier booms and downturns provide a benchmark indicating the usual relationship between bank debt leverage and investment. Comparing investment sensitivity to bank debt leverage in those earlier periods and in the financial crisis can help to identify bank debt effects during the crisis.

Second, in order to identify which alternative model of the credit channel is operating, one needs to control for possible net worth effects of firms. Total leverage is a reasonable proxy for net worth, or rather its inverse. Total leverage measures the total of all debt of the firm, i.e. bank debt and other debt (such as inter-firm loans, market debt, etc.) relative to total assets. If investment is low owing to low

net worth, total leverage should matter during the crisis. However, if bank debt is difficult to substitute, investment sensitivity should be in relation to bank debt leverage and not total leverage.

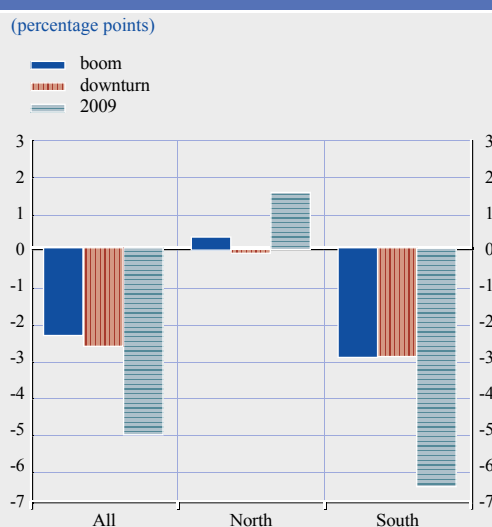
We investigate the role of bank debt in the total sample pooling the data for all countries and we look for asymmetric effects between the north (Belgium, Germany and France) and the south (Spain, Italy and Portugal). Typically, southern European firms are more bank dependent than northern firms.

Highlighting the main results, Chart 2 shows

the estimated reduction in the investment rate for a 10 percentage point increase in bank debt leverage. It is clear that during the financial crisis investment became rather sensitive to bank debt leverage. This contrasts with a much lower sensitivity during earlier periods, for both booms and downturns. The results in the pooled data are driven by the southern European firms. Firms in the south show higher sensitivity to dependence on bank credit supply.

The financial crisis appears to have had asymmetric affects across Europe. This is consistent with earlier findings in the literature.

Chart 2 Estimated effect on investment of a 10 percentage point increase in bank debt



Sources: Buca and Vermeulen (2012).
Note: Data refer to the period 2001-2009.





Policy interventions to recapitalise banks have been found to positively and disproportionately support the growth of firms that depend on external finance (Laeven and Valencia (2011)). It is possible that policy measures taken in the north were more elaborate, faster and more effective than in the south. For instance, Laeven and Valencia (2010) show that especially interventions in Belgium and France covered a larger fraction of total banking assets. This, combined with a general lower dependence in the north on bank financing, might have protected firms from credit supply effects.

Conclusion

The financial crisis caused an unprecedented drop in economic activity, especially in investment. The evidence clearly indicates that bank-dependent firms were more affected. Considering the large shocks in the banking sector, this should not come as a surprise. Taking policy measures in order to shorten the banking crisis and restore credit flows can be expected to have first order effects on investment spending, an important part of aggregate demand.

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Box I

THE SEVENTH ECB WORKSHOP ON FORECASTING TECHNIQUES – NEW DIRECTIONS FOR FORECASTING

On 4 and 5 May 2012 the European Central Bank hosted its seventh workshop on forecasting techniques. The goal of this biennial workshop is to provide an overview of the most promising recent developments in the field of economic and financial forecasting. The 2007-08 global financial crisis and the ensuing economic recession and European sovereign debt crisis have created many challenges, also for forecasters. Against this background, this year the workshop focused on new directions for forecasting.

The workshop was divided into four sessions during which invited speakers presented their papers (14 in total). The main topics covered were:

1. non-linear forecasting models;
2. forecasting with dynamic stochastic general equilibrium (DSGE) models;
3. optimal combination of forecasts;
4. the use of regularisation techniques for forecasting;
5. new features and uses of surveys of professional forecasters.

According to a common perception, the recent crisis should have proved once and for all that non-linear models are needed to forecast macroeconomic variables well. In line with this, Graham Elliott (University of California, San Diego) argued that the potential gains from modelling non-linearities are substantial. The available samples are today sufficiently large to estimate non-linear models successfully, although we still need to investigate which non-linear functional forms will allow us to reap clear gains in terms of forecasting ability. The workshop discussions nonetheless highlighted that non-linear forecasting remains a very controversial topic. In particular, the currently available non-linear models do not systematically “beat” linear models in terms of point forecasting. Some currently available non-linear models have substantial advantages in density forecasting compared with linear models. Andrew Harvey (University of Cambridge) presented some recent advances in the methods for inference with a prominent class of such non-linear models (time-varying volatility models).

Another theme widely debated at the workshop was the performance of the currently available DSGE models in macroeconomic forecasting. A growing number of studies (some of which were presented at the workshop) show that DSGE models provide macroeconomic forecasts that are as least as reliable as other common benchmarks. John Geweke (University of Technology, Sydney), discussed optimal forecast combinations and showed that DSGE models always have a non-negligible weight in such optimal combinations of models, also in the presence of other popular models such as factor models and vector auto regressions. The main point of the evidence that he presented, based on post-war quarterly US data until the end of 2011, was that model combination is extremely useful only if it is based on techniques allowing for pervasive model uncertainty.

An interesting debate revolved around the importance of regularisation techniques that allow the use of a large number of predictors or of non-linear functions of predictors by imposing flexible





restrictions on the model estimation. Besides being very well suited for linear forecasting, such techniques may yet provide a way forward for non-linear forecasting.

A final stream of discussion involved the surveys of professional forecasters. Kenneth Wallis (University of Warwick) spoke about some novel features of these surveys, in particular the persistence of relative forecast uncertainty at the individual level. Other papers also examined the benefits of including such surveyed forecasts as proxies for expectations in structural macroeconomic models.

The programme, papers and the presentations/discussions are available on the ECB's website at http://www.ecb.europa.eu/events/conferences/html/ft_workshop2011.en.html

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