Work Project presented as part of the requirements for the Award of a Masters Degree in Finance from the NOVA School of Business and Economics.

BANKS AND SOVEREIGNS:

AN ECONOMETRIC ANALYSIS OF AN ENTANGLED RELATIONSHIP

ANA RITA SEMIÃO MENDES

(student number 685)

A Project carried out on the Financial Econometrics course, under the supervision of Prof. Paulo Manuel Marques Rodrigues

JANUARY 7, 2015

BANKS AND SOVEREIGNS:

AN ECONOMETRIC ANALYSIS OF AN ENTANGLED RELATIONSHIP

JANUARY 7, 2015

Abstract

In this discussion OLS regressions are used to study the factors that influence sovereign yield spreads and domestic bank indeces for a set of euro area countries. The results show that common factors explain changes in bank indeces better than in the yields. Moreover, although there is some country differentiation, a common pattern among all is visible. A contemporary spillover effect between banks and sovereigns emerged after bank bailouts and became stronger with the burst of the sovereign debt crisis. The vicious cycle between the two has contributed to the escalation of spreads and to painful austerity measures.

Keywords: Banking crisis; European debt crisis; financial turmoil; sovereign-bank feedback loop

1 INTRODUCTION

Since the inception of the euro in 1999, the euro area has never faced a bigger challenge than the one posed by the sovereign debt crisis. The increasing debt and fear of default has led to rising bond yields in several Euro countries, putting an end to the convergence that was in place since the introduction of the single currency. At the same time there has been a banking crisis characterized by liquidity shortage and the struggle to meet capital requirements. The two are interconnected in several ways. On the one hand, in case of a sovereign default, banks that hold a significant fraction of debt from that country become insolvent and potentially bankrupt, thereby reducing credit to the private sector and endangering economic growth. Usually national banks are the most affected due to a home bias effect. According to EBA, domestic banks accounted for 71% of all banks' holdings of Italian government debt in June 2013, the same percentage as Portugal, while for Spain it was 89%. On the other hand, an undercapitalization of the banking system and the increasing probability of banks default have a negative effect over the output as banks engage in de-leveraging and reduce lending. With the aim to avoid a credit crunch and spillover effects over other financial institutions and sovereign credit as well as to safeguard its citizen's deposits, governments may provide support to banks. However, the bailout decision usually comes at the cost of higher debt and often of higher taxes in the future. Therefore, the relationship between banks' and sovereigns' credit risk seems a vicious cycle. The recent past of Europe is the perfect illustration of this entanglement. A few examples are: the Irish decision to guarantee all debt of six of its biggest banks and the nationalization of Anglo Irish that pushed the budget deficit to 32 percent of GDP. As a result, the government had no other choice but to apply for a bailout fund from the IMF and

EU, which came at the cost of austerity measures; the downgrade of 28 Spanish banks due to concerns over the country's sovereign debt and souring real estate loans on June 2012; or, more recently, and shortly after Portugal exists bailout, the crisis in one of its biggest banks, BES, that pressured up Portuguese yields with contagion spreading to debt of other South Europe countries.

The present paper seeks to shed further light on these issues, studying the relationship between banks and sovereigns before, during and after the 2008 financial crisis. In order to do that, OLS regressions will be estimated using sovereign yield spreads and the national bank indeces as dependent variables. The US yield, the US bank index, the VIX and the Euribor - Eonia spread are used as common factors. The countries under analysis are Portugal, Spain, Italy, France, Austria, Belgium and the Netherlands. The following broad conclusions were reached: (i) there is some country differentiation but a similar pattern exists; (ii) common factors explain bank index returns better than changes in yield spreads; (iii) bank indeces and yield spreads are negatively correlated and only became statistically significant in explaining one another after bank bailouts; (iv) with the sovereign debt crisis, a contemporaneous association between bank indeces and sovereign yield spreads is verified for all countries with both variables explaining one another - this is known in the literature as the feedback loop; (v) countries with high public debt-to-GDP ratios are more vulnerable to financial shocks. The remainder of the paper is organized as follows: section 2 presents some studies related to the research topic; section 3 contains the data, the sub-sample selection procedure and the methodology; section 4 presents the results and section 5 concludes.

2 LITERATURE REVIEW

After the 2008 financial crisis, several academic papers have been written on the interdependence between banking and sovereign risk. Shambaugh (2012) discusses *the Euro's Three Crises* - banking, sovereign debt and growth – and their interconnectedness, as well as some policies that can be adopted to face one crisis without damaging another. Fabio Panetta for Bank For International Settlements (2011) draws attention to the channels through which higher sovereign credit risk negatively affects bank funding such as the direct holding of government bonds, the decrease in the value of collateral that banks can use to raise funding, the decline of the value of government guarantees and the domestic banks downgrade that usually follows a similar movement in sovereign credit. Gennaioli, Martin, and Rossi (2014) show that on average banks hold a significant share of their assets in government bonds. For that reason, sovereign defaults tend to lead to severe disruptions in domestic credit markets, working as an incentive for governments to repay their debt. Gorea and Radev (2014) find evidence that the joint default probabilities of the Euro area countries are affected by the size, economic strength and real economy connections among sovereigns and that these effects are stronger during crisis periods. Mody and Sandri (2012) demonstrate that sovereign credit risk reflects the fragilities of the financial sector. In particular, after the Anglo Irish rescue, the financial sector index became contemporaneously associated with sovereign spreads, constituting the sovereign-bank feedback loop, which had a more severe impact on countries with high debt-to-GDP ratios. Alter and Beyer (2014) constructed a Contagion Index, concluding that contagion from banks to sovereigns and from sovereigns to banks increased during the period October 2009 – July 2012, suggesting an escalation of the feedback loops. Constâncio (2012) defines

contagion as "a situation whereby instability in a specific market or institution is transmitted to one or several other markets or institutions." Eichengreen et al. (2012) show that banks' fortunes rise and fall together even in normal times. However, the importance of global factors reached unparalleled levels between the eruption of the Subprime Crisis and Lehman Brothers' failure, as a consequence of the direct spillovers from the CDS spreads of U.S. banks to those of European banks. Black et al. (2013) constructed a hypothetical distress insurance premium as a measure of each banks' systematic risk. Based on the measure created, the author concludes that there was an increasing systematic risk in Europe, first reflecting the spillover effects of the U.S. financial crisis, and later reaching its peak in November 2011 due to the increased sovereign default risk. Bedendo and Colla (2013) concluded that there was a contagion effect from sovereigns to firms, mainly due to the spillover of sovereigns to the financial sector, which consequently induced bank deleveraging affecting corporate lending.

Other papers focused on the consequence of bank bailouts. Acharya et al. (2013), Ejsing and Lemke (2011) and Alter and Schüler (2012) find empirical evidence that bailouts triggered the rise of sovereign credit risk and that, post-bailout, there is a co-movement between sovereign and financial CDS, with the former explaining the latter. Gerlach, Schulz and Wolff (2010) show that sovereign risk premia increase with the size of the banking sector during periods of financial turmoil, especially after the implementation of government guarantees. Demirgüç-Kunt and Huizing (2010) concluded that the "too big to fail" theory can turn into a "too big to save", especially in countries with already stressed public finances.

3 DATA DESCRIPTION AND ECONOMETRIC APPROACH

The focus of the present study is on the evolution of the European interdependence between the sovereign and financial sector. The majority of the literature on the theme uses CDS spreads as input. However, due to restriction of data before 2008, government bond yield spreads were used. In theory the results should be similar as the n-year CDS spread is equal to the yield on an n-year par yield bond minus the n-year risk-free rate. According to Hull et al (2004) this relationship usually holds. The sovereign spread for country "j" at time "t", S_{jt}, in the context of this paper, is the difference between the sovereign yield of a 5-year maturity bond and the yield on the 5-year German Bund. The spread is, therefore, the premium paid for the risk of default. Moreover, in order to capture spillovers from sovereigns to banks and from banks to sovereigns, domestic bank stock market indeces, B_{jt}, were used as a proxy for the financial sector stress. The two main variables in study are inversely related as **graphic 1** shows. The countries included in the analysis are Austria, Belgium, the Netherlands, France, Spain, Italy and Portugal. Germany is excluded because its yield is the benchmark risk-free. Ireland and Greece were also excluded due to restrictions on data for the yields. All data were collected from Bloomberg except the bank indeces that were retrieved from Datastream.

The sample starts on the first week of January 2003 and ends on the last week of June 2014. It is divided into four distinct periods. The first period runs from the first week of January 2003 until the end of May 2007 and contains 228 observations after adjustments. This period is characterized by calm financial markets, convergence in yields and an upward trend in bank indeces. The second period begins in the first week of June 2007 and

ends in September 2008 consisting of 70 observations. It is characterized by turmoil in financial markets and by Lehman's bankruptcy. Soon, financial stress was transmitted to European banks, and bank indeces plumped right after. The third period lasts from October 2008 until the last week of November 2009, consisting of a total of 61 observations. This period is considered to investigate the immediate following effects of banks bailouts that took place in Europe. It started on 30 September 2008 with the Irish announcement to guarantee all debt of its six largest banks, followed by the Eurozone leaders' draft declaration, on 13 October, that governments would guarantee bank loans and take stake in lenders. The fourth period starts in the first week of December 2009 and goes to the last week of June 2014 consisting of 239 observations. This last stage is regarded as the European sovereign debt crisis.

To study the possible association between sovereign risk premium and the financial sector stress of each country, first consider the following OLS regressions:

$$(1) \quad S_{jt} = h + \Phi_j S_{j,t-1} + \sum_{s=0}^{1} \rho_{js} B_{j,t-s} + \psi_{js} F_{jt} + \epsilon_{jt}$$

$$(2) \quad B_{jt} = \ell + \phi_j B_{j,t-1} + \sum_{b=0}^{1} \gamma_{jb} S_{j,t-b} + \varphi_{jb} F_{jt} + \mu_{jt}$$

where S_{jt} and B_{jt} are the sovereign spread and the national bank index of country j at time t, respectively. The first lags of the dependent variables are considered to account for the possibility of persistence in the data. The F_t regressors include other factors that are expected to affect both yield spreads and bank indeces, such as the 5-year US yield, which in the model is used as a proxy for the assessment of global economic conditions. Slower economic growth, high unemployment or public debt levels are linked with lower US

treasury yields since US treasury bonds are considered safe assets; the US bank index, that works as a proxy for global financial conditions; the VIX, which is an indicator of investors' risk aversion; and the spread between the 3-month EURIBOR and the 3-month EONIA which is an indicator of the credit risk banks perceive in one another. If the spread is widening, as in mid 2007 and 2008, credit risk increases and if it is shrinking the opposite applies. The relationship of key interest is considered by regressing sovereign yield spreads on bank indeces and the reverse.

Some econometric considerations should be made when estimating the regressions. First, estimation is made using weekly data to smooth measurement error of daily frequencies. Secondly, market indeces are very volatile and in order to reduce the volatility of these series and the impact of outliers, estimation should be made using natural logarithms. Thirdly, unit root tests suggest that all variables considered in the regression are not stationary if considered in levels, but that they are difference-stationary. Taking these considerations into account, the specification to be estimated is:

$$(3) \quad \Delta S_{jt} = \alpha + \delta_j \Delta S_{j,t-1} + \sum_{s=0}^{1} \beta_{js} \Delta logB_{j,t-s} + \theta_{js} \Delta F_{jt} + \varepsilon_{jt}$$

$$(4) \quad \Delta logB_{jt} = \partial + \omega_j \Delta logB_{j,t-1} + \sum_{b=0}^{1} \vartheta_{jb} \Delta S_{j,t-b} + \tau_{jb} \Delta F_{jt} + \upsilon_{jt}$$

Regarding the two dependent variables, ΔS_{jt} represents the change in the sovereign yield spread of country j, and $\Delta logB_{jt}$ is the change in the natural logarithm of country j bank index.

After defining the model, two econometric concerns arise: heteroskedasticity and autocorrelation. Under heteroskedasticity the variance of the errors is not constant. It does

not result in biased parameters estimates but, if ignored, the standard errors can be biased and, consequently, any inferences made can be misleading. Regarding autocorrelation, it means that errors are correlated with one another. The consequence of ignoring it is similar to the one of heteroskedasticity, that is, it does not affect the unbiasedness or consistency of coefficient estimates but it does affect their efficiency. Under both concerns, the OLS estimates are no longer BLUE. When testing for heteroscedasticty and autocorrelation up to four lags, it was verified that the majority of the regressions often suffered from such problems. Therefore, when estimating the previous specification in the software E-views, if regressions exhibited heteroskedasticity and/or autocorrelation, estimation was made using heteroskedasticity and autocorrelation consistent (HAC) covariance matrix of the parameters. If that was not the case, then estimation default was applied. With all these considerations into account, the results are presented next.

4 RESULTS

This section intends to analyze the results of the OLS regressions mentioned in section 3 (**tables 1 to 8**). First, the regressions where the dependent variable is the sovereign yield spread will be discussed and later, the regressions where the explained variable is the domestic bank index.

In the first period considered, that is, before the onset of the financial crisis, the changes in sovereign spreads are not predicted by the variables considered, except for Portugal and for the Netherlands, and R-squares are small (**table 1**). This result is consistent with the literature that argues that before the crisis yield spreads are difficult to explain. According to Klepsch and Wollmershäuser (2011), investors generally ignored fundamental

countries' risks such as debt levels, being this the reason for the convergence in yield spreads verified at the time. Regarding the exceptions, persistency in yield spreads occurs in the case of the Netherlands and Portugal, meaning that for these two countries and considering the interactions with the other explanatory variables, it was possible to predict changes in the yield spread through the use of its first lag. This contradicts the efficient market hypothesis that past returns do not explain current returns as prices follow a random pattern. However, the coefficient sign is negative, meaning that the spread tended first to overshoot and then to wince a bit. Moreover, the change in US yield spread significantly explains, at a 10% level, the changes in Portuguese spreads over the German Bund. Once again, the coefficient is negative which indicates that if global economic conditions are favorable the premium paid for the risk of Portugal's default is lower.

In the second period, which goes from June 2007 until late September 2008 which corresponds to the beginning of the financial crisis, yield spreads began to rise as investors started to evaluate more countries' credit risk. During this stage, it would be expected that the US bank index would be a significant variable representing the financial turmoil that took place in that country and that soon was transmitted to Europe; however, that happens only for Belgium (**table 2**). Nevertheless, the significance of the Euribor-Eonia spread increased for all countries, reflecting the escalation of risk that European banks perceived in one another. In order to test that this latter variable was not absorbing the effect of the former, a regression that does not include the Euribor-Eonia spread was estimated and the results still hold. Comparing with period one, the R-squares increased for six of the seven countries under analysis, reflecting a higher explanatory power during this period than in the previous one. Once again, the yield spread is persistent in the case of the Netherlands.

The change in US yield is significant for Italy. Similarly to Portugal in the previous phase, the sign is negative, meaning that if the global economic environment worsens, the Italian spread will increase. Although at this stage Portugal and Spain do not have any statistically significant variables, the significance of the change in US bank index, the VIX and the Euribor-Eonia spread increased, reflecting the growing importance of financial global factors at this point.

In the third period, which lasts from October 2008 until November 2009, the Euribor-Eonia spread lost its significance (except for Italy) while the first lag and lag zero of domestic bank indeces had the opposite behavior for the majority of countries (**table 3**). This result is consistent with the literature that argues that bailouts achieved their main goal of bringing stability to the financial sector, but at the cost of a risk transfer to the government balance sheet. The contemporaneous lag of domestic bank indeces for Italy and France became statistically significant. This result can be explained by the specific measures that these two countries took to help national banks. In October 2008, the French President Nicolas Sarkozy announced that the state would set up a fund of 40 billion euros to help recapitalise banks in difficulty and guarantee 320 billion euros of bank debt. At the same time, the Italian Finance Minister Guido Tremonti announced that the government would guarantee some bank debt and buy preferred stocks if needed. Moreover, the US yield increased its significance for all countries, meaning that external economic news were particularly relevant during this fragile phase for Europe. It is interesting to notice that for Italy, the significance of all variables increased, probably translating the risk of this specific country due to its high level of public debt. Furthermore, it was during this stage that yield spread differentials across European countries started to widen.

Finally the last period which starts in December 2009 and goes until the end of June 2014 concerns the European sovereign debt crisis. This period of turbulence in the euro area sovereign bond markets was mainly triggered by Greece's unhealthy public finance situation. The concerns over a Greek default soon spilled over to other euro area countries with poor economic performance such as Portugal, Spain, Italy and Ireland. Consequently, sovereign spreads differentials were very large at this point in time. Looking at the regressions (**table 4**), the most visible effect of this period is the fact that domestic bank indeces became highly significant in explaining yield spread changes for all countries - except the Netherlands for which it is almost significant at 10%. In other words, for all countries, sovereign yield spreads reflected equity losses in their national stock market bank indeces. However, and despite the fact that EU governments took actions based on the same policy of bailing out their national banking system, while equity losses for six of the countries under analysis are reflected on a sovereign yield spread increase, for France it was translated in a lower spread. Furthermore, the coefficients are quite big in absolute value and especially for countries with high debt-to-GDP, suggesting that they are more vulnerable to financial shocks. For instance, if the Portuguese bank index increases by one point, the yield spread will decrease by 0.11%. In addition, it is also interesting to notice that the domestic bank index and its first lag often have opposite signs, not only during this particular stage, but also in the previous ones. This pattern can be explained by the own volatility of bank indeces or because the market is still trying to understand how the financial sector stress affects public debt levels and sovereign yields. Besides, Spain, France and Belgium show some persistence in the change in yields, while the volatility index still remains significant in explaining variations in the spreads for Italy, but now with

a positive sign. R-squares at this stage are quite high, except for the Netherlands, for which the only statistically variable is the change in US bank index.

As for the regressions where the regressand is the domestic bank index (**tables 5 to 8**), it is clear, when comparing to the previous ones, that common factors are more important in explaining changes in domestic bank indeces than sovereign yield spreads for the four different periods. The next paragraphs will analyze each different phase, similarly to what was done before.

Prior to the financial crisis, investors' risk aversion significantly explained returns of European bank indeces (**table 5**), except for Portugal since it is the country under analysis that has lowest correlation between the VIX and the domestic bank index. The coefficients' signs are negative as during volatile periods investors often pull out of the market and invest in safer assets. The changes in the US bank index and in US yield are significant for five of the seven countries - Portugal and Austria excluded - and the sign of both regressors are positive for all. Regarding the first case, if the American bank index exhibits a positive or negative trend it is likely that this behavior spills over to the European banking markets. In what concerns the second variable, investing in the banking sector was considered quite safe before the financial crisis, and so it is likely that bank indeces were trending upwards if global economy was not showing signs of slowdown. Moreover, the national factors considered often had influence on bank indeces before the crisis. First, because the first lag of the Portuguese bank index explains the contemporaneous one. This result does not contradict the financial theory as it is possible to obtain some predictive power for stock returns based on previous returns, when stocks are considered in aggregate. Secondly, because the first lag of the yield spread significantly explains changes in the Spanish,

Belgian and Dutch bank stock returns. It is interesting to notice that while in period one of the previous set of regressions, changes in bank indeces do not significantly explain the dependent variable, which is the change in sovereign spread (**table 1**), here the opposite holds for the three countries mentioned. While Spain and Belgium suffered a sovereign credit rating upgrade during this period, the Netherlands maintained its AAA rating, according to Fitch. The negative signs of the coefficients confirm the usual negative relationship between the two variables. The considerable lower R-squares of Portugal and Austria, when compared to the rest of the countries, can be explained by the fact that other factors outside the model better account for the change in the domestic bank index at the time. In the case of Portugal, one possible reason is the importance of domestic effects such as the 2003 economic recession, low productivity growth, the large current account deficit or bank concentration. As for Austria, its banks experienced a very rapid expansion in Western Europe between 2003 and 2007 through the acquisition of local banks that were privatized. According to the IMF, by 2007 the foreign claims of Austrian banks on Central, Eastern and Southeastern Europe had increased from 10 percent of GDP in 2003 to 70 percent of GDP. The R-squares of the first stage are much higher when the responding variable is bank indeces rather than sovereign yield spreads.

With the outbreak of the financial crisis, investors' risk aversion became significant for all countries (**table 6**). As it is common during periods of financial turbulence, the volatility index jumped while bank indeces dropped sharply. Changes in US bank index are now significant for all countries except for Portugal. Contrary to the previous phase, US yield does not significantly influence bank indeces returns, with the exception of Austria. Note that, although the coefficient sign is positive for Austria, it starts to be negative for some

countries and is negative for all of them in the next phase. This means that as the crisis evolved, investing in bank stocks was not considered safe anymore. Moreover, the fact that US yield lost part of its importance after the crisis indicates that financial factors had a much greater impact on bank indeces and that pure economic issues fell behind. Persistency still remains significant for Portugal. In addition, the first lag of changes in domestic yield spread is significant for France. One common characteristic of this period is that for all countries, and not only for France, sovereign spreads rose as a consequence of the financial turbulence that hit Europe. Excluding the period right after Bear Stearns' rescue, they exhibit an upward trend, while bank indexes show the opposite behavior. Similarly to what happened in the previous estimations, the predictive power at this phase is higher than the first one.

After bailouts, and identically to what happened at this point in time when the regressand was the change in spreads but on the opposite direction, change in yield spreads contemporaneously affects variation in the domestic bank index for Italy and France (**table 7**). This is consistent with the economic view that after bailouts yield spreads were influenced by the financial sector stress, since proving state help to banks increased public debt levels. On the reverse side, bank indeces started to be affected by sovereign credit risk due to both the direct holding of domestic sovereign bonds and the dependence on state guarantees. Note also that in the previous period it was the past lag that was significant for France, meaning that as the crisis evolved, the French bank index started to incorporate the information of the public finances sooner. For the remaining countries, the relationship between changes in yield spreads and bank indeces became stronger after bailouts, although not statistically significant yet. Concerning the common factors, in general, international

financial conditions and investors' risk aversion still influence bank stock returns, while the credit risk that Euro zone banks perceive in one another significantly explains bank stock returns for Portugal and Austria. This later result shows that despite bailouts had transfer some risk from the banking sector to the government, the market was still afraid of a negative spillover effect among banks and, more broadly, of the risk of a bank default. Also, the first lag of domestic bank index is significant for Belgium.

Regarding the period of the debt crisis, the persistence of the dependent variable is significant for Portugal instead of Belgium and the variations in US bank index and the VIX still remain as variables that explain the changes in domestic bank indeces (**table 8**). However, the main difference to the previous stages is that, for all countries, yield spread changes contemporaneously affect the variations in the domestic bank indeces. The fact that countries such as Portugal, Spain and Italy have the smallest coefficients in absolute values might be explained by the high volatily of domestic yields during this period when compared to the other countries. Additionally, this result do not necessarily imply that bailouts had a greater impact on countries such as France, Austria and Belgium, otherwise the feedback loop theory does not perfectly hold since in **table 4** the countries for which bank indeces mostly affect sovereign spreads are the first set of countries and not the second ones. The Netherlands, the country that in the last three years has had the lowest government debt among the seven, is the one that tends to show less evidence of the relationship between banks and sovereigns. The R-squares at this stage are considerably high, with the exception of the Netherlands, although lower than in the previous stage.

5 CONCLUSION

The 2008 financial crisis had its origins in the US and soon spread its tentacles over Europe. Today, more than six years later, we are still daily bombarded by news of banks in trouble and the social consequences of austerity measures. The present work aimed at studying the factors that affect the behavior of sovereigns' and banks' returns and the feedback loop between the two. With this end in mind, two different OLS regressions were estimated for seven Euro area countries: regressions where the explained variable is the sovereign yield spread and regressions where the dependent variable is the domestic bank index. Both have as regressors the first lag of the explained variable, the dependent variable of the other regression, and a set of common factors that are likely to influence both sovereign yield spreads and domestic bank indexes, namely global economic environment, global financial conditions, investors' risk aversion and the perceived lending risk among Euro area banks. These two regressions were then estimated for four different periods of study: the first one, before the financial turmoil; the second, during the outburst of the crisis; the third, when the influence of bank bailouts started being felt; and the fourth, the persistence of the sovereign debt crisis.

Results show that sovereign yield spreads are particularly difficult to predict, although the explanatory power increased after the eruption of the financial crisis, as the credit risk that banks perceive in one another became a significant factor. All other common factors considered did not have a clear effect over sovereign spreads across countries and across the four different time periods, contrary to when the regressand is the bank index. The two key variables of study are negatively correlated, but only after bank bailouts they became statistically associated, especially after the eruption of the sovereign debt crisis. Countries

with high debt-to-GDP ratios are more vulnerable to financial shocks. The contemporaneous relationship between the banking and the public sectors during the sovereign debt crisis can be explained by the higher debt burden for governments, which resulted directly from the guarantees provided to banks. This, in turn, feeds back to banks since a negative shock decreases sovereigns' credit worthiness and affects banks through the direct holding of sovereign bonds or through the guarantees provided by governments. Therefore, any fear about a sovereign default is translated into the banking sector. This loop has greatly contributed to the rise of sovereign yield spreads and yield differentials among Euro area countries, a burden which was especially felt between 2011 and 2013, but that still persists.

Policy makers are taking actions in order to break the link between banks and sovereigns given the threat that it represents to the European project. In an effort to prevent the boat from sinking, EU institutions designed a banking union that consists of a common banking supervisor (the ECB), a financial mechanism to directly recapitalize banks in Europe, and a common deposit guarantee up to a limit of 100,000 euros. However, whether the Banking Union will be able to achieve this or not depends on the ability of the Asset Quality Review and of stress tests to evaluate banks' assets and collateral and to force corrective measures if needed. Moreover, it also seems crucial that European authorities take steps towards promoting growth in order to diminish debt-to-GDP and, consequently, improve the quality of banks' portfolio.

6 REFERENCES

Acharya, Viral, Drechsler, Itamar and Schnabl, Philipp. 2013. "A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk." *Journal of Finance,* forthcoming.

Alter, Adrian and Beyer, Andreas. 2014. "The dynamics of spillover effects during the European sovereign debt turmoil." *Journal of Banking & Finance,* 42 (2014): 134-153.

Alter, Adrian and Schüler, Yves. 2012. "Credit spread interdependences of European states and banks during the financial crisis." *Journal of Banking & Finance,* 36 (2012): 3444-3468.

Bedendo, Mascia and Colla, Paolo. 2013. "Sovereign and corporate credit risk: Spillover effects in the Eurozone." Working Paper.

Black et al. 2013. "The Systemic Risk of European Banks during the Financial and Sovereign Debt Crises." Board of Governors of the Federal Reserve System, International Finance Discussion Papers No. 1083.

Brooks, Chris. 2008. *Introductory Econometrics for Finance.* New York: Cambridge University Press.

Constancio, Vítor. 2012. "Contagion and the European debt crisis." Banque de France, Financial Stability Review No. 16, 109–121.

Demirgüç-Kunt, Asli and Huizinga, Harry. 2010. "Are Banks Too Big to Fail or Too Big to Save? International Evidence from Equity Prices and CDS Spreads." World Bank Policy Research Working Paper 5360.

Eichengreen, Barry, Mody, Ashoka, Nedeljkovic, Milan, and Sarno,Lucio. 2012. "How the Subprime Crisis went global: Evidence from bank credit default swap spreads" *Journal of International Money and Finance,* 31 (2012): 1299-1318.

Ejsing, Jacob and Lemke, Wolfgang. 2011. "The Janus-headed salvation: Sovereign and bank risk premia during 2008-2009." *Elsevier Economic Letters,*110 (2011): 28-31.

Gennaioli, Nicola, Alberto Martin and Stefano Rossi. 2014. "Sovereign Default, Domestic Banks, and Financial Institutions." *Journal of Finance,* 69: 819-866.

Gerlach, Stefan, Schulz, Alexander and Wolff, Guntram B. 2010. "Banking and Sovereign Risk in the Euro Area", Discussion Paper Series 1, Economic Studies No 09/2010.

Gorea, Denis and Radev, Deyan. 2014. "The euro area sovereign debt crisis: Can Contagion spread from the periphery to the core?" *International Review of Economics and Finance,* 30 (2014): 78-100.

Hull, John, Predescu, Mirela, White, Alan. 2004. "The relationship between credit default swap spreads, bond yields, and credit rating announcements" *Journal of Banking & Finance,* 28 (2004): 2789-2811.

Klepsch, Catharina and Wollmershäuser, Timo. 2011. "Yield Spreads on EMU Government Bonds – How the Financial Crisis Has Helped Investors to Rediscover Risk", *Intereconomics,* 46 : 169-176.

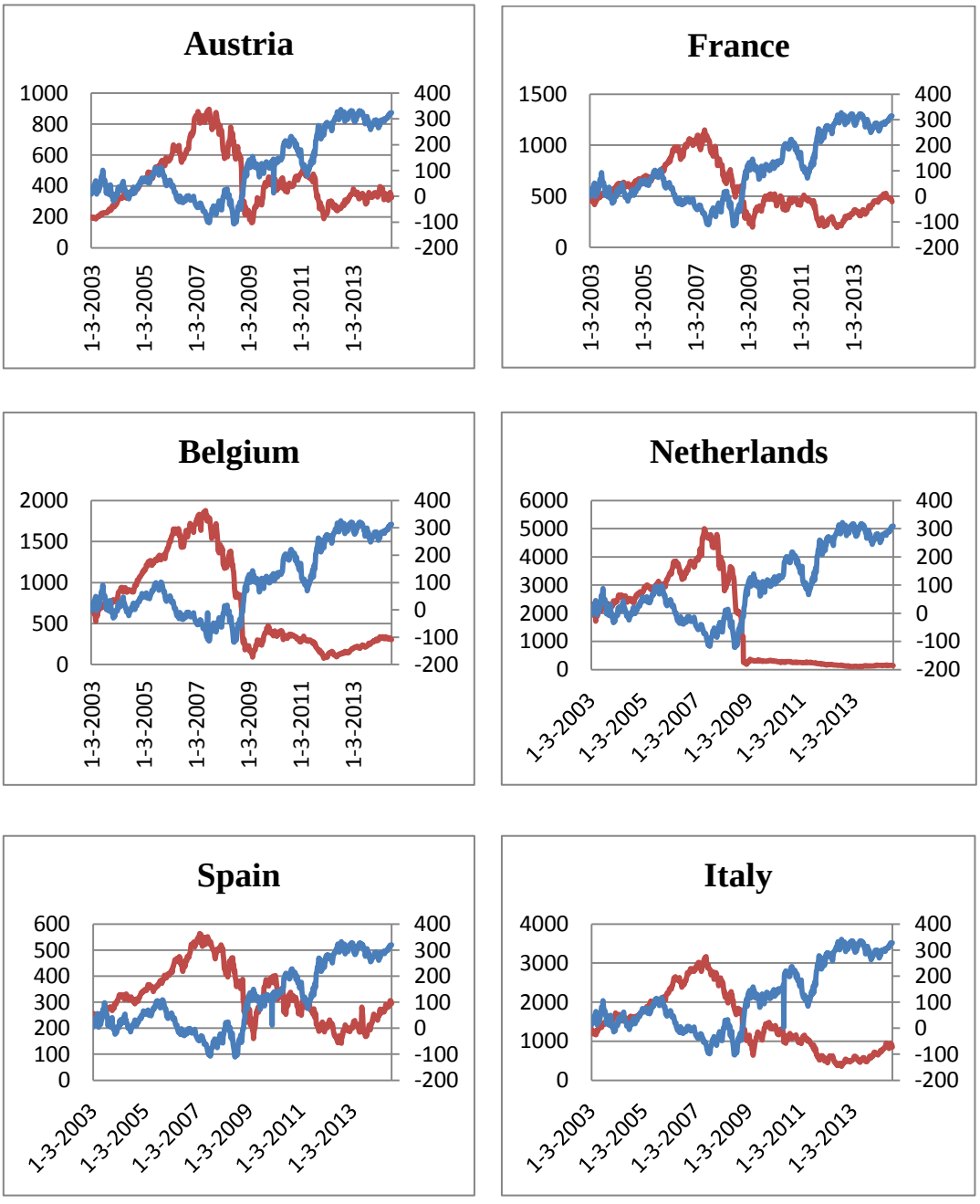
Mody, Ashoka and Sandri, Damiano. 2012. "The eurozone crisis: how banks and sovereigns came to be joined at the hip", *Economic Policy,* 27 (70): 199-230.

Panetta, Fabio et al. 2011. "The impact of sovereign credit risk on bank funding conditions", Bank for International Settlements.

Shambaugh, Jay. 2012. "The Euro's Three Crises." Brookings papers on Economic Activity, Spring 2012.

7 APPENDICES

Graphic 1 – The negative relationship between the 5-year yield spread over the German Bund and the domestic bank index stock market



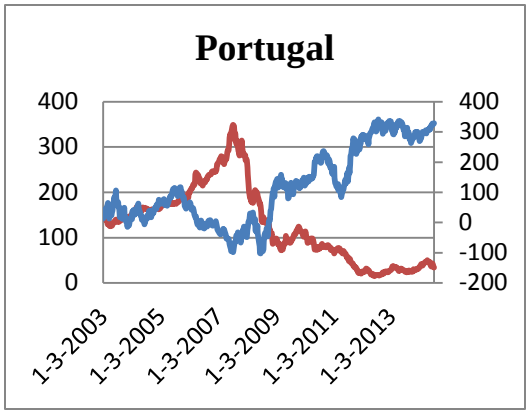


Table 1 – Change in sovereign yield spreads: January 2003 - May 2007

Period 1

dependent variable	ΔS						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	0.001	0.000	0.000	0.000	-0.001	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LΔS	-0.093**	-0.030	-0.030	0.045	0.035	-0.144	-0.257*
	(0.044)	(0.068)	(0.061)	(0.063)	(0.022)	(0.105)	(0.144)
ΔlogB	-0.124	-0.228	-0.250	0.023	-0.037	0.017	-0.150
	(0.171)	(0.248)	(0.242)	(0.203)	(0.138)	(0.132)	(0.153)
LΔlogB	-0.558	0.032	0.035	0.092	0.130	-0.156	-0.187
	(0.338)	(0.192)	(0.141)	(0.126)	(0.086)	(0.215)	(0.200)
ΔUS yield	-0.030*	0.002	0.005	0.003	0.010	0.003	0.011
	(0.016)	(0.016)	(0.020)	(0.011)	(0.014)	(0.013)	(0.012)
Δlog US bank index	0.025	0.205	-0.367	-0.139	0.144	-0.053	0.744
	(0.268)	(0.323)	(0.271)	(0.293)	(0.178)	(0.209)	(0.485)
ΔEuribor - EONIA	-0.104	-0.062	-0.096	0.080	-0.078	-0.100	-0.005
	(0.129)	(0.106)	(0.067)	(0.065)	(0.065)	(0.064)	(0.102)
Δlog VIX	-0.001	-0.019	-0.018	-0.022	0.038	0.069	0.056
	(0.029)	(0.052)	(0.040)	(0.026)	(0.063)	(0.046)	(0.059)
R-square	0.046	0.007	0.029	0.007	0.011	0.045	0.092
Observations	228	228	228	228	228	228	228

Table 2 – Change in sovereign yield spreads: June 2007 - September 2008

Period 2

dependent variable	ΔS						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	0.006	0.004	0.000	-0.001	0.002	0.004	0.003
	(0.005)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
LΔS	-0.177	0.081	-0.110	-0.109	0.118	0.012	-0.264*
	(0.152)	(0.130)	(0.082)	(0.140)	(0.157)	(0.128)	0.143
ΔlogB	0.059	-0.222	-0.698	0.015	-0.152	-0.130	0.040
	(0.188)	(0.296)	(0.503)	(0.203)	(0.223)	(0.179)	0.073
LΔlogB	0.347	0.163	-0.351	0.082	0.061	0.115	0.004
	(0.218)	(0.242)	(0.413)	(0.143)	(0.187)	(0.155)	0.081
ΔUS yield	-0.042	-0.005	-0.063*	-0.006	0.002	-0.019	0.004
	(0.028)	(0.022)	(0.037)	(0.019)	(0.021)	(0.019)	0.016
Δlog US bank index	-0.068	0.209	-0.199	-0.003	0.077	0.262*	0.016
	(0.268)	(0.155)	(0.380)	(0.141)	(0.174)	(0.147)	0.218
ΔEuribor - EONIA	0.079	0.045	0.138*	-0.077*	0.067*	0.080*	0.050*
	(0.062)	(0.048)	(0.077)	(0.041)	(0.038)	(0.042)	0.030
Δlog VIX	0.051	0.110	0.068	-0.095	0.034	0.066	0.068
	(0.070)	(0.067)	(0.131)	(0.060)	(0.055)	(0.059)	0.059
R-square	0.172	0.127	0.234	0.114	0.113	0.171	0.089
Observations	70	70	70	70	70	70	70

Table 3 – Change in sovereign yield spreads: October 2008 – November 2009

Period 3

dependent variable	ΔS						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	-0.004	-0.001	-0.006	0.004	-0.003	-0.004	-0.002
	(0.012)	(0.011)	(0.006)	(0.007)	(0.010)	(0.010)	(0.009)
LΔS	-0.026	0.051	-0.255***	-0.156	-0.074	-0.122	-0.128
	(0.115)	(0.132)	(0.075)	(0.139)	(0.146)	(0.132)	(0.148)
ΔlogB	-0.868	-0.729	-1.611***	0.415*	-0.574	-0.219	0.010
	(0.849)	(0.563)	(0.443)	(0.247)	(0.384)	(0.341)	(0.047)
LΔlogB	-0.633	-0.476	-0.744*	0.212	-0.214	-0.099	0.061
	(0.425)	(0.361)	(0.404)	(0.181)	(0.233)	(0.208)	(0.060)
ΔUS yield	-0.110	-0.096	-0.145***	0.064	-0.048	-0.109	-0.051
	(0.068)	(0.070)	(0.045)	(0.045)	(0.071)	(0.080)	(0.066)
Δlog US bank index	-0.430	-0.230	-0.173	0.093	-0.295	-0.494	-0.367
	(0.416)	(0.372)	(0.268)	(0.234)	(0.291)	(0.478)	(0.256)
ΔEuribor - EONIA	0.043	0.127	0.159**	-0.062	0.083	0.073	0.070
	(0.144)	(0.112)	(0.080)	(0.072)	(0.144)	(0.132)	(0.098)
Δlog VIX	-0.224	-0.155	-0.397**	0.154	-0.509	-0.431	-0.324
	(0.387)	(0.298)	(0.184)	(0.188)	(0.490)	(0.284)	(0.305)
R-square	0.150	0.244	0.343	0.195	0.151	0.166	0.081
Observations	61	61	61	61	61	61	61

Table 4 – Change in sovereign yield spreads: December 2009 – June 2014

Period 4

dependent variable	ΔS						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	-0.005	0.000	-0.004	0.000	-0.002	-0.003	0.000
	(0.040)	(0.016)	(0.013)	(0.005)	(0.006)	(0.008)	(0.003)
LΔS	0.088	-0.276***	-0.060	-0.121*	-0.165	-0.250***	-0.023
	(0.063)	(0.063)	(0.069)	(0.070)	(0.083)	(0.070)	(0.064)
ΔlogB	-11.148***	-6.498***	-7.737***	2.190***	-2.390***	-4.302***	-0.448
	(2.541)	(1.676)	(0.972)	(0.515)	(0.695)	(0.800)	(0.278)
LΔlogB	6.371***	-0.814	0.414	-0.084	-0.107	0.069	0.061
	(1.954)	(1.003)	(1.161)	(0.317)	(0.382)	(0.573)	(0.249)
ΔUS yield	-0.114	-0.076	-0.050	-0.008	0.031	0.025	-0.022
	(0.510)	(0.191)	(0.145)	(0.045)	(0.081)	(0.096)	(0.033)
Δlog US bank index	1.617	-0.727	1.480	-0.518	0.111	0.130	-0.912*
	(5.142)	(2.333)	(1.784)	(0.853)	(1.256)	(1.524)	(0.531)
ΔEuribor - EONIA	0.911	0.678	0.534	0.096	0.203	0.389	-0.038
	(1.979)	(0.645)	(0.513)	(0.162)	(0.287)	(0.388)	(0.135)
Δlog VIX	0.811	0.397	0.564*	0.060	-0.073	-0.115	-0.066
	(1.103)	(0.361)	(0.294)	0.116	(0.125)	(0.223)	(0.072)
R-square	0.211	0.418	0.510	0.232	0.207	0.403	0.061
Observations	239	239	239	239	239	239	239

Table 5 – Change in domestic bank indeces: January 2003 - May 2007

Period 1

dependent variable	ΔB						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	0.001**	0.001	0.001**	0.001**	0.003***	0.001**	0.001
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
LΔlogB	0.148**	0.046	-0.001	-0.002	-0.042	-0.068	-0.055
	(0.070)	(0.052)	(0.084)	(0.059)	(0.060)	(0.096)	(0.067)
ΔS	-0.008	-0.017	-0.022	0.002	-0.005	0.002	-0.017
	(0.012)	(0.018)	(0.019)	(0.019)	(0.018)	(0.016)	(0.015)
LΔS	-0.005	-0.030*	0.009	0.017	-0.016	-0.035**	-0.057***
	(0.015)	(0.018)	(0.017)	(0.012)	(0.016)	(0.017)	(0.020)
ΔUS yield	0.002	0.013***	0.014***	0.015***	0.002	0.017**	0.016**
	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.008)	(0.008)
Δlog US bank index	0.160	0.503***	0.341***	0.488***	0.060	0.465***	0.542***
	(0.121)	(0.081)	(0.074)	(0.092)	(0.120)	(0.105)	(0.128)
ΔEuribor - EONIA	-0.064	0.004	0.030	0.006	0.024	-0.045	-0.052
	(0.043)	(0.029)	(0.041)	(0.029)	(0.029)	(0.050)	(0.049)
Δlog VIX	-0.022	-0.056***	-0.044***	-0.061***	-0.092***	-0.067***	-0.068***
	(0.015)	(0.013)	(0.011)	(0.015)	(0.020)	(0.018)	(0.019)
R-square	0.113	0.413	0.296	0.401	0.173	0.338	0.348
Observations	228	228	228	228	228	228	228

Table 6 – Change in domestic bank indeces: June 2007 - September 2008

Period 2

dependent variable	ΔB						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	-0.003*	-0.002	-0.003*	-0.003**	-0.001	-0.003*	-0.003
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
LΔlogB	0.235*	-0.028	-0.070	0.007	-0.032	0.148	0.498**
	(0.136)	(0.098)	(0.109)	(0.077)	(0.102)	(0.104)	(0.234)
ΔS	0.015	-0.040	-0.044	0.006	-0.078	-0.065	0.064
	(0.048)	(0.054)	(0.031)	(0.052)	(0.091)	(0.086)	(0.107)
LΔS	-0.052	0.035	-0.001	-0.212***	-0.004	-0.096	-0.018
	(0.048)	(0.060)	(0.030)	(0.069)	(0.093)	(0.143)	(0.214)
ΔUS yield	0.008	0.011	0.001	-0.001	0.037***	-0.004	-0.031
	(0.015)	(0.009)	(0.010)	(0.011)	(0.013)	(0.011)	(0.022)
Δlog US bank index	0.118	0.193***	0.121*	0.353***	0.215**	0.396***	0.362**
	(0.111)	(0.045)	(0.063)	(0.091)	(0.090)	(0.093)	(0.161)
ΔEuribor - EONIA	-0.002	0.035	0.029	0.01	0.005	0.007	-0.096
	(0.024)	(0.024)	(0.020)	(0.021)	(0.030)	(0.035)	(0.090)
Δlog VIX	-0.083**	-0.050*	-0.091***	-0.121***	-0.075*	-0.092***	-0.214***
	(0.035)	(0.029)	(0.028)	(0.03)	(0.041)	(0.032)	(0.075)
R-square	0.228	0.401	0.408	0.555	0.418	0.433	0.374
Observations	70	70	70	70	70	70	70

Table 7 – Change in domestic bank indeces: October 2008 – November 2009

Period 3

dependent variable	ΔB						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	-0.001	0.001	-0.002	0.000	-0.002	-0.001	-0.009
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)	(0.012)
LΔlogB	-0.063	-0.009	0.01	-0.041	-0.019	0.272***	0.000
	(0.102)	(0.073)	(0.074)	(0.090)	(0.121)	(0.087)	(0.050)
ΔS	-0.022	-0.042	-0.078***	0.122**	-0.075	-0.037	0.015
	(0.020)	(0.033)	(0.026)	(0.059)	(0.047)	(0.056)	(0.075)
LΔS	-0.018	0.003	-0.024	0.014	-0.003	0.083	0.091
	(0.021)	(0.032)	(0.028)	(0.051)	(0.036)	(0.056)	(0.078)
ΔUS yield	-0.005	-0.010	-0.019	-0.006	-0.008	-0.010	-0.047
	(0.013)	(0.021)	(0.016)	(0.029)	(0.035)	(0.034)	(0.057)
Δlog US bank index	0.259***	0.416***	0.334***	0.555***	0.358***	0.836***	-0.150
	(0.067)	(0.071)	(0.113)	(0.086)	(0.098)	(0.137)	(0.275)
ΔEuribor - EONIA	-0.064***	-0.037	-0.028	-0.043	-0.097**	-0.005	0.249
	(0.015)	(0.026)	(0.019)	(0.045)	(0.042)	(0.054)	(0.224)
Δlog VIX	-0.014	-0.109*	-0.191***	0.006	-0.226*	-0.179	-0.594
	(0.045)	(0.063)	(0.070)	(0.116)	(0.126)	(0.140)	(0.471)
R-square	0.569	0.688	0.726	0.588	0.616	0.647	0.103
Observations	61	61	61	61	61	61	61

Table 8 – Change in domestic bank indeces: December 2009 – June 2014

Period 4

dependent variable	ΔB						
independent variables\countries	Portugal	Spain	Italy	France	Austria	Belgium	Netherlands
Constant	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LΔlogB	0.132**	-0.015	0.034	0.018	0.059	0.049	-0.008
	(0.063)	(0.042)	(0.063)	(0.063)	(0.064)	(0.067)	(0.088)
ΔS	-0.012***	-0.037***	-0.045***	0.068***	-0.053***	-0.060***	-0.028*
	(0.003)	(0.006)	(0.005)	(0.015)	(0.009)	(0.009)	(0.017)
LΔS	-0.002	-0.010***	-0.003	0.022**	-0.002	-0.019**	-0.004
	(0.002)	(0.004)	(0.005)	(0.011)	(0.009)	(0.009)	(0.014)
ΔUS yield	0.020	0.011	0.015	0.012	0.007	0.003	0.004
	(0.016)	(0.010)	(0.010)	(0.009)	(0.011)	(0.011)	(0.008)
Δlog US bank index	0.588***	0.311**	0.506***	0.795***	0.516***	0.654***	0.155*
	(0.134)	(0.125)	(0.096)	(0.096)	(0.093)	(0.132)	(0.087)
ΔEuribor - EONIA	-0.030	-0.007	-0.013	-0.038	-0.054	-0.012	-0.012
	(0.043)	(0.030)	(0.029)	(0.033)	(0.040)	(0.042)	(0.027)
Δlog VIX	-0.017	-0.069**	-0.014	-0.067***	-0.068***	-0.070**	0.010
	(0.030)	(0.027)	(0.022)	(0.024)	(0.020)	(0.028)	(0.022)
R-square	0.335	0.463	0.603	0.627	0.474	0.566	0.046
Observations	239	239	239	239	239	239	239

significance levels: ***p<0.01. **p<0.05.*p<0.1

L is the lag operator and Δ is the difference operator

Note: results were rounded to tree decimals and significance levels are according to original values