BANCO DE ESPAÑA
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RESEARCH ON MACROECONOMICS, MONETARY ECONOMICS, FINANCE AND BANKING

.

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Part A - SUMMARY OF THE PROPOSAL

TOPIC: RESEARCH ON MACROECONOMICS, MONETARY ECONOMICS, FINANCE AND BANKING

Project Title: IDENTIFICATION AND PREDICTION OF SYSTEMIC SHOCKS: ANALYSIS OF THE MACROECONOMIC DETERMINANTS OF FINANCIAL RISKS AND THEIR CROSS-SECTIONAL IMPLICATIONS

SUMMARY

A systemic shock is an idiosyncratic shock whose effects spread throughout the entire financial sector generating financial instability that ultimately affects real activity. In this project we will address the identification of systemic shocks and, therefore, systemic risk, at THREE levels.

In the first level the main objective is to identify systemic shocks and analyse their transmission from the financial sector to the real economy. To this end, our objective is: a) to identify different types of shocks (persistent versus non-persistent, or systemic versus idiosyncratic) by combining different econometric techniques. Some classic, such as structural VAR models, and some not so common, such as methods for signal extraction and the identification of unobservable components; b) to develop general equilibrium models to determine not only how transitory shocks in asset valuation become persistent, but also how idiosyncratic shocks can become systemic.

In the second level we focus on the first transmission channel (the risk of contagion between banks) and study the impact of a large increase in credit risk for one bank on the other banks in the system. The study takes as its starting point several measures of individual credit risk (CDS market, Value at Risk (VaR) and Expected Shortfall (ES) measures) and analyses the transmission of risk in the financial sector in the most appropriate way given the risk measurement used in each case.

And, finally, in the third level we will study which systemic shocks and macroeconomic disturbances most affect the behaviour over time and cross-sectional behaviour of the beta values of financial assets. There are banks that have a high degree of correlation with macroeconomic conditions. If, moreover, they are highly leveraged, these banks have a high probability of being systemic. Therefore, understanding the macroeconomic determinants of the correlations of the returns of these banks with aggregate economic activity is a key step in identifying the origin of systemic banks. Furthermore, in the same vein, we want to study the simultaneous determinants of the risk premiums of asset returns and the risk premiums of volatility. Here, simultaneous treatment will allow us to analyse the determinants of the risk premiums explicitly using expected returns and not, as is normal, historical average returns. The explicit introduction of expected returns into the analyses is possible through the options trading carried out by our sample of banks.

KEYWORDS: Unobservable components, systemic shocks, credit risk, general equilibrium models, risk transmission, market betas, risk and volatility premiums, capital structure.

Part B. Research report

1. Starting hypothesis

This research report is based on the belief that the real economy, the prices of financial assets and corporate finances must be analysed together, since the interrelationship between the three areas is critical if we are to understand each of them.

2. General objectives

The general objectives of the project are:

- To improve the procedures for the identification of systemic shocks and the methods for the estimation and assessment of the consequences of those shocks on the financial sector and the real economy as a whole.
- To improve the techniques for quantifying the credit risk of banks and analyse the transmission of such risk to the banking sector.
- To study the macroeconomic determinants of the betas of financial assets, their cross-sectional consequences on the expected returns from these and analyse their relationship with the capital structure of industrial and financial companies.

The results of the proposed analysis are important because they should allow society to move in the right direction given that:

- An improvement to the techniques to quantify the effect of financial shocks on the real economy and to the understanding of the transmission mechanisms will result in better economic policy decision-making designed to anticipate, alleviate or overcome a financial crisis.
- A better understanding of the credit risk of banks and the contagion effect will lead to advances in one of the fundamental elements in banking regulation and supervision, which will provide the necessary stability for the financial system and prevent future financial crises.
- In view of the effects of the recent economic crisis, accurate and prompt diagnosis of a crisis and its consequences is a necessity for any economy that wants to continue to be part of the developed economies.

2. Theoretical approach

The relationship between the real and financial economy is widely documented. Both Stock and Watson (1989, 2003) and Backus, Routledge and Zin (2009) show that lead and lag correlations exist between macroeconomic variables and financial variables. In addition, Malkhozov and Tamoni (2015) show the important role played by “news shocks” in explaining the trend in financial variables that "anticipate" fluctuations in the real economy. Nieto, Novales and Rubio (2014a and 2014b) relate macroeconomic and financial factors in determining the risks and volatilities of bond and swap yields.

The starting point for the method to measure and anticipate systemic shocks that we intend to develop in the project is a model where agents gradually learn which part of the observed shock is noise and which part corresponds to a significant change in the state of the economy. Therefore, the inclusion of variables that act as leading indicators of future events will determine which part of the shock has information content and a lasting effect on the fluctuations observed in the data. Several members of the project's research team have already made significant contributions to this type of technique

(Lafuente, Pérez and Ruiz, 2014 and 2015), which is expected to be used both to identify and assess more or less frequent events, as well as to analyse the impact of the systemic risk factor on financial markets once it has been estimated.

Once these systemic shocks have been identified and estimated, we want to use them to test whether such shocks, along with other financial and macroeconomic disturbances, can to some extent affect the behaviour of the risks of the financial assets over time. As a result, we will study the macroeconomic determinants of the systematic risk (market beta) of shares, jointly analysing the estimation of the betas and their determinants. We propose to break down the beta into a high frequency component and a low frequency one. Both components, which are modelled additively, will follow the MIDAS processes (mixed data sampling regression). The betas estimated in this way will be called mixed frequency conditional betas. To the best of our knowledge, the econometric methodology proposed is new for the estimation of beta risk, although it has its origins in the literature on the volatility of components from Engel and Rangel (2008) and Engel, Ghysels and Sohn (2013). The relationship with macroeconomic factors and systemic shocks will be generated through the long-term beta risk component. Considering also that beta has a component associated with the economic risk of the assets themselves and another with financial risk, we can relate the real economy to the prices of financial assets and corporate finances as part of the same phenomenon. In particular, we want to analyse the relationships between the economic and financial components of market betas and the borrowing decisions of both industrial and financial companies.

3. Specific objectives

The research project has three clear objectives:

The first of these is to develop econometric techniques, using signal extraction methods, to identify which part of the observed noise corresponds to persistent shocks and which part corresponds to transitory shocks. To this end:

i) We will develop a general procedure for dealing with models affected by lasting shocks observed with noise. From the representation of an observable signal with two (persistent and transient) components, we will establish assumptions for identifying them separately. State-space representation ensures good statistical and computational properties for the estimators. It also makes it possible to work at the component level in the theoretical models used to study the transmission of effects from the financial economy to the real economy [Lafuente, Pérez, Ruiz, 2014, 2015];

ii) We will empirically identify persistent shocks and assess their impact on economic fluctuations. To do this, we must integrate the structural VAR methodology with the signal extraction procedure designed in i). We will study the countries of the European Union (EU) and the United States and relate variables that measure economic activity (growth of GDP, consumption or investment) to variables that summarise financial activity, such as credit, financial asset prices, yields and house prices [Barsky and Sims, 2012; Beaudry and Portier, 2014; Forni, Gambetti, Lippi and Sala, 2014; Blanchard, L'Huillier and Lorenzoni, 2012; Fernández-Villaverde, Rubio-Ramirez, Sargent and Watson, 2007; Leeper, Walker and Yang, 2009];

iii) We will develop dynamic and stochastic general equilibrium models that allow us to identify not only how transitory shocks become persistent, but also how systemic shocks can become systemic in the valuation of assets. In a model with friction, even noisy signals - which provide less information - may have an impact on the real economy, albeit a transitory one. Incorporating a stylised financial sector will allow us to deal with the dispersion of expectations of

unlikely risk events, and the fact that agents learn about the economy from signals relating to the dividend policy of companies and/or the monetary policy of the Central Bank [Acemoglu, 2015; Piatti, 2014; Burashi, Trojani and Vedolin, 2013].

The second objective is to test whether the shocks identified and estimated as part of the first objective, along with other financial and macroeconomic disturbances, to some extent affect the behaviour over time of the risks of financial assets. In particular:

i) We will study the macroeconomic determinants of the market betas of shares, jointly analysing these betas and their determinants. In this way we can relate the real economy to financial asset prices and corporate finances as part of a single phenomenon;

ii) We will study the simultaneous macroeconomic determinants of risk premiums for the returns on assets and the risk premiums of volatility, following the approach initiated by González-Urteaga and Rubio, *Journal of Financial Economics* (2015). This simultaneous approach will allow us to analyse the determinants of the risk premiums explicitly using expected returns and not, as is normal, historical average returns. This analysis will be performed in different environments: i) under restrictions on borrowing, ii) under disturbances in the rate of time preference, and iii) considering changes in risk aversion and/or the intertemporal elasticity of substitution of consumption, focusing on market illiquidity, illiquidity in the provision of funds and high-frequency trading;

iii) We will study corporate capital structure decisions in this new scenario, given that the analysis of the risks will affect the cost of financing and this can determine corporate capital structure decisions.

The third objective addresses the study of systemic risk from an individual point of view. The literature on the transmission of systemic risk in the financial sector from an individual point of view is at a very early stage (Brewer III and Jagtiani, 2013; Helwege and Zhang, 2013, Mink and de Haan, 2015). The aim is to identify shocks in the idiosyncratic component of the credit risk of important banks in the system and analyse their spread or contagion to the rest of the banking sector. We will attempt to analyse this issue using market risk measures that will enable us to identify significant increases in the credit risk of each bank and determine when that signal causes an increase in the risk level of the system. We will focus on the systemic banks (G-SIBs) identified by the Financial Stability Board from both the Eurozone and the US. Our objectives are:

i. to estimate the idiosyncratic shocks in the default risk by using the CDS market and to characterise the main attributes of those shocks that spread to the rest of the system;
ii. to estimate the transmission of credit risk between pairs of banks using the CoVaR; we will study the sensitivity of the results to the method used for calculating the VaR of each bank, and propose an alternative measure to the CoVaR, i.e. conditional ES (CoES), comparing the results obtained with both indicators;
iii. to analyse whether the classification of a bank as systemic is justified from the point of view of our analysis;
iv. to identify common credit risk factors in the financial system from the individual risks, in order to build an indicator of systemic risk. Subsequently, we will study the determinant factors of this indicator and its relationship with different variables measuring economic and financial activity. We will analyse its relationship with the systemic risk indicator obtained from the structural analysis proposed as the first objective of the project;

v. to analyse to what extent it is possible to cover this risk using the CDS indices listed in the market.

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PART 3. ACTIVITY REPORT

The research proposal presented in the report requires the completion of a set of activities which are to be carried out within the framework of this agreement.
Below we have listed the specific actions to be carried out, grouped into: (1) activities for the completion of the research, (2) complementary activities to improve the research, and (3) the dissemination of the results.

1. Activities necessary for the completion of the proposed research:

This section includes the activities designed to facilitate interaction between the members of the working team. Some of the tasks that we intend to carry out to achieve the stated objectives involve researchers assigned to different centres. The different geographic locations are not an obstacle for working together and knowing exactly what is going on given the current available communication technologies. However, we consider physical interaction between the researchers in the team to be absolutely necessary. Consequently, we propose payment for any travel (and stays, if necessary) for the team members needed in order to hold:

- An organisational meeting at the start of the research. The purpose of this meeting will be the discussion and evaluation of the current state of the topic associated with each of the tasks to be performed, the determination of the specific objective to be met, clearly identifying our contribution, as well as the organisation and distribution of tasks between the researchers in the team in order to achieve the objective.
- A follow-up meeting at the end of the first year. In this case, the meeting will be structured in the format of seminars run over one or more days, where the person responsible for each task will present the progress in the research to the rest of the team members. The purpose of these seminars is twofold. First, there will be a presentation of the progress made in meeting the objectives, any possible deviations from the initial objective, any problems that have arisen and, if so, whether it is necessary to make any adjustments to the objective. Second, the preliminary results will be presented, commented on and discussed in order to analyse their reliability and the possible avenues for additional research that they may suggest.
- A meeting prior to the completion of the research. We will again use the format of seminars to present the results obtained in each of the areas of work included in the report, thus encouraging all members of the team to contribute to the evaluation of results and proposals for future research.

2. Complementary activities to improve the research:

The research that we propose in our report links macroeconomics and finance through the concept of risk. Its completion therefore requires knowledge and research experience in these two areas of economics, and the curricula of the members of the research team demonstrate this. However, i) it is not an easy task to work on both sides in a theoretical context of dynamic general equilibrium models that include financial and real assets together, in order to understand the transmission of risk between them; and ii) in addition, the importance of the potential results of the research we are proposing is clear in terms of decision-making in economic policy in general and especially in the banking sector. To deal with these two points, we consider that funds will be necessary to:

- Organise an intensive and advanced course given by an international expert in macro-finance.
- Run at least three seminars given by renowned national or international researchers in topics closely linked to the objectives of our research.
- Hold at least two meetings with banking professionals in order to present and discuss both the objectives of our research and the results that we are obtaining.

3. Dissemination of the results:

Finally, we consider it necessary to include in the agreement the possibility of funding a series of activities aimed at disseminating the research results, such as:

- Participation in national and international conferences to interact with other members of the research community.
- The development of a research group website where the achievements of the projects are published in a timely manner and that also includes a blog to discuss them.
- The publication of research papers in journals of high international impact.

PART 4. BUDGET

The Complutense University will provide the computing equipment and rooms necessary to hold the organisational meeting at the beginning of the research, the follow-up meeting at the end of the first year and the meeting prior to the completion of the research, as well as the courses, seminars and meetings with professionals mentioned in the activity report. No funding is requested to directly pay the researchers involved in the research, but there is a request for funds for food and travel expenses, organisational meetings and conferences. Specifically, the budget would be broken down as follows:

Consumables/travel and expenses/other expenses		
Item	**Cost (€)**	**Breakdown**
Consumables-Computer equipment	1300	Computer consumables (Printer toner/Printer maintenance/Repair of Computers, tablets and laptops, pen drives)
Travel and expenses:	15700	A.- 3 organisational meetings (1500 euros per meeting)=4500 B - 2 External guest speakers at the intensive training course (1000 euros per guest)=2000 C - Invitation for three prestigious speakers to give seminars (400 euros per guest): 1200 D - 4 international conferences (1400 per conference) = 5600 E - 4 national (€600 per conference)= 2400
Other expenses	3000	A - Expenses for publication in scientific journals. 5*100 = 500 B - Improvement and development of group's website = 2500€
SUBTOTAL	**20000**	