EXTERNAL STRESS EARLY WARNING INDICATORS

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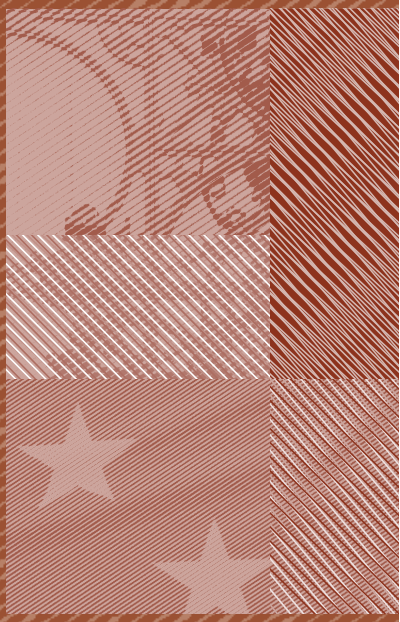

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BANCO DE ESPAÑA

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Abstract

We examine the determinants of external stress episodes through probit analysis, focusing on the role of foreign liabilities in order to build an external crisis early warning indicator for a set of selected EMU countries. We use a panel country data spanning 1970-2011 from External Wealth Dataset (Phillip Lane). Our results show that the ratio of net and gross foreign liabilities to GDP and current account balances — which measure external debt accumulation speed — are significant stress predictors, although (net) FDI liabilities seem an offset factor. Early warning indicators are based on a signalling approach and exploit panel dimension of the data to develop a country specific indicator. We find that EMU peripheral countries' external indebtedness remains higher than risk threshold, in spite of the external adjustment accumulated in the last years in some countries. This result highlights the necessity of going on structural reforms that reinforce competitiveness of these economies.

Keywords: International investment positions, external debt, external vulnerability, current account imbalances.

JEL Classification: E44, F32, F34, G15, H63.

Resumen

En este trabajo se analizan los determinantes de episodios de tensiones exteriores a través de un análisis *probit* enfocado en el impacto de los pasivos frente al resto del mundo, con la finalidad de construir un indicador de alerta temprana para un conjunto de economías seleccionadas de la zona del euro. Para ello se emplea un panel de datos de países para el período 1970-2011 procedente del External Wealth Dataset (Phillip Lane). Los resultados obtenidos señalan que las ratios de pasivos exteriores netos y brutos sobre el PIB y el déficit por cuenta corriente –que aproxima la velocidad de endeudamiento frente al resto del mundo– son predictores estadísticamente significativos de tensiones exteriores, si bien los pasivos (netos) materializados en forma de IED tienden a reducir dicho riesgo. Los indicadores de alerta temprana específicos para cada país que incorporan dichos determinantes estimados a través del enfoque de señalización muestran que el endeudamiento exterior de los países periféricos de la UEM continúa superando los umbrales de riesgo, a pesar del ajuste externo acumulado en los últimos años en alguna de estas economías. Este resultado subraya la necesidad de proseguir la senda de reformas estructurales conducentes a reforzar la competitividad de estos países.

Palabras clave: Posición de inversión internacional, deuda externa, vulnerabilidad exterior, desequilibrios por cuenta corriente.

Códigos JEL: E44, F32, F34, G15, H63.

1 Introduction

Large current account imbalances over the nineties and the first half of past decade gave rise to sizeable cross-country imbalances differences in net investment position (NIIP) not only across global economy, but also within euro zone. The vulnerability associated with high external liabilities in a context of financial turbulences was underscored by recent developments in the euro area, since EMU peripheral countries, including Spain, had net debtor international investment positions (IIP) GDP ratios higher than 70% GDP at the onset of the crisis (end-2008). In addition, when global data are employed, including emerging and advanced economies, external crisis are more likely when net debtor IIP was above 70% of GDP at the end of 2007 (Catao and Milessi-Ferreti, 2014). A high net debtor IIP often indicates a significant burden of refinancing that may increase the degree of macrofinancial vulnerability in case of tensions in capital markets. In fact, the net IIP is included in set of indicators of the EU macroeconomic imbalances procedure. So, establishing an external crisis early warning system may be a relevant tool for macroprudential policy.

The links between an economy's external vulnerability and its indebtedness vis-a-vis the rest of the world are complex, as they encompass various dimensions of external liabilities composition. External vulnerability may reflect, firstly, high external liabilities in net or gross terms. Some authors argue that the relevant indicator is the gross external liabilities (Shin, 2012), since it is a better indicator of the degree of international financial integration and of refinancing needs associated to external indebtedness. However, Catao and Milesi-Ferreti (2014) estimate that net external liabilities are also a robust predictor of external stresses. The aggregate behaviour of NIIP and external debt may mask very different patterns across the institutional sectors (public sector and private sector) and financial instruments (enforceable and non-enforceable), which are crucial to assess the external vulnerability. So, the implications of a certain level of external liabilities are conditioned by their composition by instruments, sectors, term and currencies. Thus, given a certain level of external liabilities, refinancing risks would be more pronounced when the proportion of enforceable instruments - such as fixed income or other investment -, is high, since this kind of investments imply the compulsory future realization of amortization and/or interest payments. The business cycle position and macro policies stance also influence in the level of external indebtedness compatible with macro-financial stability. It should also be borne in mind that it is not possible to extrapolate mechanically any increase in external liabilities valuation as an increase in vulnerability, since its evolution over time depends not only on the behavior of the current account (CA), but also on the called valuation effects (VE).

Against this background, our target is to build an early warning system of external turbulences, which consists of three main stages. In the first place, we must define what is meant as an episode of external turbulence. Next, we proceed to the selection of variables that significantly affect the probability of such episodes. These variables are chosen through the results of panel data probit regressions. Finally, we estimate a composite alert indicator and the so-called risk thresholds for each variable, focusing attention on those that quantify external indebtedness.

The contribution of this paper to the literature is to combine the two predominant approaches in the literature (probit regressions and signalling system) in a two-step procedure in order to get a more robust early warning system, since in the first step probit regressions identifies external stress determinants. In addition, the regressions allow estimating the contribution of each regressor to crisis probability. In the second step, we implement an early warning system

We use an updated version of the Lane and Milesi-Ferretti (2007) dataset, spanning the period 1970–2011. The definition of external stress not only include defaults and rescheduling events as well as recourse to sizable multilateral financial support in the form of programs with the International Monetary Fund (IMF) or European Union, both also sharp and substantial accumulation of external imbalances. Distinguishing among the components of a country's external balance stocks allows us to test through probit analysis whether countries with high debt liabilities are more vulnerable to external stress than those with non-debt liabilities, particularly FDI. Also we include the speed of external indebtedness accumulation, proxied by current account balance and other control variables, such as real GDP growth, public balance, per capita relative GDP, interest rates. Probit analysis allows identify potential interactions among variables.

Once established the main variables which affect external crisis probability, we apply a signalling approach to build up an external stress early warning system for a set of selected EMU countries and thus identify thresholds beyond which a further buildup of net/gross external liabilities sharply raises stress risk. Thresholds are country specific, in order to take into account heterogeneity across economies.

The main findings of this paper show that higher (net) foreign liabilities increase the risk of external tensions even after controlling for other factors. Second, risk rises as the composition of external liabilities is biased toward debt instruments (mainly portfolio or other investment), whereas higher FDI liabilities tend to reduce crisis risk. Third, current account deficits have, in general, a high impact on external stress probability. Also, advanced economies can face higher levels of external indebtedness than emerging countries. These findings are consistent with standard sovereign debt models, which have long focused on the ratio of external debt liabilities to GDP as a key variable of default risk (Catão et al., 2009; Panizza et al., 2009; Mendoza and Yue, 2012). Early warning estimates show that external indebtedness in EMU peripheral countries remain higher than risk thresholds and stress probability increased sharply during euro crisis.

The paper is organized as follows. Section 2 describes the dataset, the external stress episode definition employed in this work and summarizes the stylized facts that characterize such events. Section 3 discusses the variables that affect turbulences probability through probit regressions. Using the determinants chosen in section 3, section 4 describes the implementation of an external stress early warning system for a set of selected EMU countries, which allows compute thresholds above which crisis risk increases rapidly and estimates an aggregate early warning indicator. Section 5 discusses briefly some concerns on endogeneity bias and the potential incidence of VE for thresholds estimates. Finally, section 6 draws the main conclusions from the analysis.

2 Data, external stress definition and stylized facts

In order to build up an early warning indicator we employ as main database the updated and extended External Wealth of Nations Dataset (Lane and Milessi-Ferretti, 2007), with data on external stocks (assets and liabilities) of 72 countries (42 emerging) for the period 1970-2011. Specifically the database reports, when available, the split of external stocks between non-gold foreign reserves, FDI securities, equity and debt portfolio instruments and other investments[1]. So, from this data can be built up net external positions on total and debt instruments. In the analysis carried out in this paper, lower income countries are eliminated, since external borrowing is mainly official and/or on a concessional basis rather than market driven and also data on NFA or its breakdown into equity and debt are problematic[2]. Among advanced countries, we drop Ireland, because its debt/equity disaggregation is heavily distorted by its sizable mutual fund industry[3], and Iceland after 2007 due to the huge jump in NFL between 2007 and 2008 (from 110% to 700% of GDP), which could biases our results.

The former data are complemented, as control variables, by GDP per capita, real GDP growth extracted from the UN National Accounts database, and public balance, real exchange rate and long term public interest rates come from IMF International Financial Statistics database. Data used in this paper raise some concerns related with the lacking of data on financial flows vis-à-vis the rest of the world and the sample period, which finish in 2011. Both limitations do not allow to catch all the EMU crisis and their impact on capital flows in peripheral Eurozone countries.

Our definition of external stress is based on a set of criteria. First, it encompasses defaults and rescheduling events[4] as well as events associated with large IMF support[5] or EC support program. This first criterion focuses on major events (Kraay and Nehru, 2006). External tensions can also be manifested through currency crises. For this reason it is added as second criterion that real exchange rate (REER) depreciates by no less than 20% in a year and real GDP growth is negative. This criterion is based on currency crisis literature (Laeven and Valencia (2012) and Frankel and Rose (1996)). Last, we also contemplate other episodes of external turbulence associated with a very abrupt pre-accumulation of external imbalances, a mechanism that raised the external fragility of some EMU peripheral economies during the previous expansionary phase[6]. For this purpose, we add as a third criterion a current account deficit accumulated in the previous three years of at least 25% of GDP, provided that the net debtor IIP in t-3 was above 50% of GDP. We exclude from our sample episodes that are ramifications of major crisis outbreak, until market re-entry[7]. Although this reduces the number of episodes, it is consistent with the conception that external stress episodes have long-lasting consequences. In addition, this strategy mitigates estimation biases from feedback effects of the crisis onto the explanatory variables, as discussed in Bussière and Fratzscher (2006), and makes episodes more

1. Data coverage fall significantly with disaggregated external stock positions: for example, we have 2602 observations of NIIP data, but only 1460 observations for net portfolio position.

2. There are two main advantages of excluding low-income countries. The first is that causal mechanisms in the theoretical literature on country borrowing require a reasonable degree of international capital market integration. The second is that we circumvent data limitations more prevalent in poorer countries.

3. Liabilities are recorded as equity instruments, but assets include both equity and debt

4. Compiled by Catao and Milessi-Ferreti (2014).

5. IMF loans at least twice as large as the country's quota in this institution.

6. The caveats aforementioned do not allow us using financial flows to detect capital flights in the case of balance of payment crisis after a sharp accumulation of CA imbalances. The impact of a possible endogeneity of CA as a risk indicator variable may be reduced, as it is shown in the next section.

7. Market re-entry as either the year after S&P classifies the default to have ended or when the country's liabilities vis-à-vis the IMF decline for two consecutive years or fall below 200% of quota.

comparable to each other. Applying this definition to our data generates 74 episodes of external tension for the period 1970-2011, of which 13 are located in advanced economies (8 EMU countries) (Chart 1). It should be noted that the bulk of episodes are defined by only the first criterion (specifically 62).

Data show that countries that suffer external turbulences show higher both net debtor IIP (particularly in debt instruments) and CA and public deficits, while real GDP growth is lower (Chart 2). In average, real effective exchange rates are more appreciated[8]. If we employ a stress definition without CA accumulation criterion, we obtain qualitatively similar results. Deviations in case of external stress remain significant when we regress these variables against an external stress episode dummy, especially in the case of NIIP and net external debt (Table 1).

The nature of external tensions episodes can be better understood if we look at the behavior of some economic variables around such events. For that purpose, we compute pre-stress and post-stress averages of external indebtedness, CA and public balances, real GDP growth and REER. Such averages are computed over an 11-year window centered on the crisis year (t = 0) and spanning 5 years prior and after the external turbulences. As can be seen in Chart 3, these variables deteriorate with the onset of a crisis. NIIP and external debt averages deteriorates around a 40% at the onset of stress events. This development mostly reflects a worsening net external debt position. Regarding CA balance, countries start off with large current account deficits and, after stress, CA adjusts significantly (in average, CA deficit before external stress is around -7% GDP, and after the tensions the adjustment is around 5 pp GDP). Real GDP growth behavior shows a similar pattern. Our data also point that external stress episodes crises are preceded by a real exchange rate appreciation, followed by a depreciation.

8. In stress year, REER is a 5% more appreciated than average (13% in the year immediately before an episode).

3 External stress determinants

We now examine how net IIP and their composition affect external stress probabilities in the context of a multivariate probit model, which constitutes the first step of our methodology for building an early warning system. The choice of the possible determinants of an external turbulence episodes is made through a regression analysis in which the variable to be explained takes the value 1 in each episode of external stress and 0 in another case. Specifically, we run a probit regression such that:

$$C_{i,t} = \beta_0 + \beta_{1,t} + X_{i,t}\mathrm{B} + \nu_{i,t}$$

Where i denotes the country, t the year, $C_{i,t}$ is the external tension dummy, β_0 is a constant, $\beta_{1,t}$ is a year fixed effect, $X_{i,t}$ is the matrix of explanatory variables and B is its coefficient vector and $\nu_{i,t}$ is the error. Within $X_{i,t}$ matrix are included - depending on the specification chosen - explanatory variables such as NIIP, foreign liabilities, relative per capita income, CA balance, public balance, long term interest rates, REER, real GDP growth.

We report the margin effects at mean in Table 2. The results indicate that total external indebtedness to the rest of the world, both in gross terms and, particularly, in net terms, anticipates the probability of external tensions occurring. The composition of this indebtedness is also relevant, since the probability of turbulence increases when it materializes through enforceable liabilities, while debit positions in foreign direct investment (FDI) would not increase the external vulnerability. Another key factor that raises the probability of external turbulence is the magnitude of the current account deficit, which is a proxy for speed external debt accumulation. The macroeconomic environment also matters for external stress risk: a lower real GDP growth increases stress probability, as occurs when REER appreciates. Risk stemming from weak economic activity appears related to net external liabilities. On the other hand, REER significance is consistent with EMU experience: peripheral Eurozone countries accumulated a significant price-competitiveness misalignment through REER appreciation that contributed to external imbalances. Finally, as the degree of development of an economy is higher, it usually presents smaller episodes of financial turbulence, for the same level of external indebtedness. Also, there is some evidence, although not very robust, that public deficit and long term interest rates increases external stress probability.

Marginal effects are generally low, because stress episodes are infrequent events and are computed at the sample mean, but the non-linearity of the probit implies that these elasticities can be larger when are computed immediately before a turbulence event, when explanatory variables differ significantly from average as has been previously explained. In Chart 4, we compute marginal effects in the year before an external stress episode versus at mean: NIIP and, specially, CA marginal impacts are very much larger immediately before an event, signaling the substantial deterioration of external vulnerability that precedes an external stress episode.

4 Early warning system based on a country-specific signalling approach

Once the variables that significantly rise external stress probability have been identified, we use these results to estimate an early warning system, which is a particularly useful tool for the implementation of macro-prudential policy. Policy-oriented research on early warning has relied especially on the signalling approach, thus European Commission use this approach for surveillance tasks. Our purpose in this section is to estimate an early warning indicator for a group of selected EMU countries[9]

Signalling approach can integrate a large number of variables and can deal with data availability problems in unbalanced panels, as is the case of the data employed in this work. Also, this approach can be implemented relatively easily, since the thresholds derived for the indicator variables can directly be used for policy surveillance and analysis. International empirical evidence suggests that early signaling warning systems have a higher predictive power than multivariate probit models in out-of-sample forecasts (see Cos et al., 2014). All of this might outweigh the major disadvantage of signalling approach: neither correlations between different variables nor individual variables conditional statistical significance cannot be tested. On the other hand, early warning estimates should be taken with caution, given the methodological difficulties arisen by this methodology. In particular, it should be borne in mind that threshold estimates depend of a very small number of event episodes, which reduces their robustness and their predictive power outside the sample used for their estimation. In addition, such predictive power also decreases as the signalling window is more dilated over time (i.e. variables lags are longer).

On the basis of probits estimated in the former section, the variables chosen to develop the early warning system we choose as signaling variables NIIP, net external debt, CA balance, public balance, relative per capita GDP, long term interest rate, real GDP growth and REER. Also, we add as signaling variables the three-year averages for NIIP, gross and net external debt and total external liabilities in order to soften possible significant valuation effects, which may be very substantial in a given year[10]. We exclude more disaggregated stock data because data availability is minor and the harmonization between different countries face more difficulties.

The next two steps to construct an early warning system are to calculate thresholds for each variable and, after, aggregate these variables into a composite index for signalling external stress. In this paper, warning forward signalling is of one year (i.e. we evaluate how well external turbulence stress in t is predicted based on data for t-1), following a widespread option in international literature (see Cos et al., 2014). Thresholds are chosen to maximize signaling power of a given window with respect to past stress episodes.

The determination of the thresholds requires a choice of several methodological alternatives about the criterion of error prediction minimization and the common or specific country nature of such thresholds.

Regarding the first issue, there are two type of forecasting errors that may arise when we anticipate a stress episode. Type I error is a false positive signal, also called false alarm, while type II error is a false negative signal, also called missed crises. Any threshold criterion should take into account that there is a tradeoff between the two types of error. Thus, for variables where

9. The countries are Austria, Belgium, France, Finland, Germany, Italy, Netherlands, Greece, Portugal and Spain.
10. For example, in Spain negative valuation effects in 2007 amounted 7 pp GDP.

a value above the threshold indicates external stress (i.e. the threshold is a minimum, like in the case of gross external liabilities), the type II error increases with the threshold value (more crises tend to missed), while the type I error (false alarms) decreases (because the system sends less often a crisis signal, if no crisis occurs). When the threshold is a maximum (like in the case of net IIP), the tradeoff is reversed. Consequently, the determination of the critical thresholds is a balance between minimizing the number of false alarms and of missed crisis. There are different methodologies to implement this balance. One is the maximization of the signal-to-noise ratio, based on the sum of true over the sum of false signals. Another one is the total misspecification error (TME), which is defined as TME=1- type I error- type II error. Signal-to-noise-ratio criterion assigns the same weight to false positive and false negative signals, while TME approach assigns a higher weight to false negative signals, as stress episodes are rare events.

In Chart 5 we plot predictive powers of the early warning index using TME or signal-to-noise ratio as alternative minimization criterion. The first methodology reach a consistently higher predictive power. In addition, since, we want to avoid especially false negative signals, which are likely to be far costlier than false positive signals, we apply TME criterion.

Another methodological relevant decision concerns about applying common or country specific thresholds. In the first case, all country-year pairs are treated as independent observations and the panel dimension of the data is ignored. This data pooling across countries increases the number of crises observations for the threshold identification, which should augment its robustness. However, critical levels for the thresholds of the variables signalling external stress might vary strongly in different countries (Reinhart et al., 2003), and, on the other hand, the estimated common thresholds might be driven by outliers. As a result, common thresholds may lead to a lower predictive power when country heterogeneity in the sample is high.

In the sample, country heterogeneity is high, since external indebtedness EMU countries varies from creditor positions until very large debtor positions, and the sample applies for CA balance. One way to asses this heterogeneity is comparing country specific and common thresholds. As it is shown in Chart 5, gross and net external indebtedness thresholds vary significantly across EMU countries. For that reason we finally choose a country-specific criterion, which, in addition, allow us to estimate a composite index for each economy. Predictive powers of common and country-specific approaches are relatively similar.

Concerning individual variables predictive power, all variables have positive signalling[11] power and thereby contribute to the predictive power of the early warning system (Chart 6). The variables that have the highest predictive power are REER, CA balance and (net) external indebtedness measures, both total liabilities and only enforceable instruments. REER predictive power is more volatile across different alternatives than those corresponding to CA balance and external liabilities[12].

Results shown correspond to a signalling window of one year (stress predictions are based on data for t-1). However, data are often only available with a considerable time-lag and policy actions often need time to be implemented. Against this background, a longer signalling window would be necessary to detect ex ante external stress risks and have enough time to react. By way of illustration, we plot in Chart 7 the predictive power of TME country specific composite index across different signalling windows, which decrease continuously as window

11. The predictive power of the three-year averages of each variable tends to be slightly lower.

12. Under the signalling approach interactions between the variables are not modelled, there are no distortions by variable interactions.

enlarges. So, results are less reliable when lags are longer and, so, signals should be interpreted with more caution.

Thresholds for composite indexes also reflect country-heterogeneity, since their levels and time evolution differ strongly across countries. The first lies between 0.2 and 1, while the evolution in time show a split between core and EMU periphery (Chart 5), that reflects country-specific developments (Chart 8). We elaborate two aggregate composite GDP- weighted indexes, the first one, for all selected EMU countries and the second one only for EMU peripheral countries of the sample (Greece, Portugal and Spain). In the last group, the aggregate composite index rebounded sharply in the years immediately preceding the last crisis, as external imbalances accumulated in the expansive phase. Risk indicator reached its peak in coincidence with the turmoil in the sovereign markets of the EMU from 2010. This behavior reflect the individual index path for these peripheral economies.

Concerning the country specific thresholds, it should be noted that the actual and current external indebtedness of peripheral EMU economies is above of such thresholds, with gaps between 20% and 40% of net IIP or gross external debt (Chart 9). Thus, according to these estimates, EMU peripheral countries, including Spain, still maintain a significant degree of vulnerability in the face of a hypothetical deterioration of the international capital markets, due to its high external financial dependence. On the other hand, given any NIIP debtor level, external vulnerability also is influenced by external liabilities structure by currency, term, instruments and institutional sectors. For example, external vulnerability softens when a sizable portion of these are not fixed income, deposits or loans; and, consequently, are not subject to sudden withdrawal. Concerning term, when the bulk of external liabilities are long term securities refinancing risks are lower and without any significant currency mismatch between external assets and liabilities also the impact of negative shocks on wealth derived from sharp depreciations is lower.

Related with the former, EMU integration would also mitigate macro financial vulnerability, since currency crisis are eliminated. But, in any case, external indebtedness still eventually matter within a currency union, especially because stock adjustment tends to be protracted[13]. The euro area financial crisis highlighted that countries with high external imbalances accumulated in the past are not immune to solvency and liquidity concerns, since in the absence of intra-euro area fiscal transfers, they are subject to the inter-temporal budget constraint. So, accumulated liabilities are expected to be matched by expected future surpluses, and a realignment of expectations would cause turbulences in financial markets. In addition, competiveness adjustments within EMU are protracted due to nominal wage rigidities and the relatively low level of inflation across the euro area.

13. For example, in the Spanish case Net IIP long term scenarios consistent with international macroeconomic forecasts project a gradual decline of net foreign liabilities (Banco de España, 2017). Under baseline scenario, net IIP would decrease gradually over the medium term, but this is subject to risks, since net IIP will still maintain a high level by 2026.

5 Robustness checks

The methodology used and the limitations of data, raise concerns about endogeneity bias, related mainly to the inclusion of the criterion of CA deficits accumulation. This criterion could bias the significance of NIIP and CA balance coefficients in probit regressions. In order to asses this potential bias, CA accumulation is excluded as a stress criterion definition. First of all, in Graph 2 green bars show that deviations from average of selected variables do not change qualitatively when stress episodes are defined without including CA criterion. Also, Table 3 reports probit regressions results with different specifications excluding CA criterion as a part of external stress definition. Again the significance and sign of NIIP and CA balance are robust to stress definition changes.

Other potential caveat concerning the results of the early warning system is that NIIP data include VE, which do not imply automatically changes in external vulnerability. From the point of view of external vulnerability, it is not the same that an increase in the debtor NIIP comes from a higher net inflow of resources (transactions), which will generate future payment obligations (interest or principal repayment), that it comes from changes in the prices of financial instruments or in the exchange rates of the currency in which they are denominated. In this last case, the variation of the NIIP does not have an effect on future financing requirements, and, even, it may be caused, like in Spain since 2012, by better economic prospects of the country in relation to others economies, which in fact implies an external vulnerability decrease[14].

In that sense, external indebtedness thresholds may be biased when NIIP official data, which implicitly includes VE, are used. NIIP computed as CA accumulation[15] from the first NIIP data. In some countries differences are substantial[16], including sign reversals on average (Austria and France). Evolution along time of both NIIP measures is plotted in Chart A1: path are qualitatively similar, although there are significant differences in France and in some years in Greece and Germany. In EMU peripheral countries, CA accumulation would give a worse NIIP for Greece and Portugal at end 2011, although during the expansive phase in years 2000 NIIP by accumulation was above NIIP data in both countries. In Spain negative VE since euro adoption implies a consistent in time improvement of net external liabilities when they are computed by CA accumulation. After computing accumulated CA NIIP we estimate the country specific threshold levels for NIIP variable. We obtain that the results are sensitive to the method of computing NIIP (Chart 10). In the case of EMU peripheral countries, debtor NIIP risk levels are of a minor magnitude when they are estimated through NIIP by CA accumulation. Again external indebtedness (calculated by CA accumulation) would be significantly higher than the estimated thresholds[17]. Concerning predictive power, both NIIP measures have a similar performance (Chart 11), and, in addition, country specific composite index evolution along time are virtually the same. So, the main difference lies in NIIP country-specific thresholds levels, which move in line with the path along time of the chosen NIIP measure.

14. Indeed, in the case of equities, revaluations are frequently driven by changes in expectations about future income, and in the case of debt securities by changes in market yields and in the perceived solvency of debtors.

15. We do not accumulate by lending/borrowing capacity because capital account balance coverage is worse than those of CA balance.

16. We drop Belgium, since the deviations between the two measures is enormous.

17. In Spain, the threshold derived from NIIP base on CA accumulation is 30 GDP pp higher (the positive gap between actual NIIP and NIIP by accumulated CA amounts 20 GDP pp in 2016).

6 Concluding remarks

Since the mid-1990, issues about external vulnerability has been attracting attention from policy makers and economist, first due to the emergence of global imbalances reflecting a CA deficit in USA matched by surpluses run notably by Japan, China, Germany and oil exporting countries. Alongside global imbalances, imbalances within EMU between core surplus and peripheral deficit countries started widening shortly after euro introduction. These large current account gave rise to sizeable net debtor IIP in deficit countries, especially in the case of peripheral EMU countries. These imbalances are held to be one of the major causes both of international financial crisis and euro crisis, since global imbalances decreased long-term interest rates encouraging housing prices bubbles (Bernanke, 2009) and inflows of easy foreign borrowing allowed deficit countries postpone necessary structural reforms to restores competitiveness and fiscal consolidation (Obstfeld and Rogoff, 2009). A high net debtor IIP often indicates a significant burden of refinancing that may increase the degree of macrofinancial vulnerability in any event of financial markets stress which hamper access to foreign financing. Although CA deficit usually adjust sharply after an external turbulence episode, stocks correction is more protracted, which imply that external vulnerability may remain relatively high over time. Thus, it is still interesting for policy making to build external stress early warning systems to identify risk thresholds for external liabilities that, if surpassed, would be indicators of a significant increase in the vulnerability of the economy to turbulences in international markets.

Results obtained in this paper corroborates that large external debt liabilities increases the probability of external stress episodes. Decomposition of (net) external liabilities shows that (net) debt liabilities are the most important determinant of crisis risk and that their contribution is highly statistically significant. Second, the speed at which external indebtedness accumulates, proxied by CA deficits, is also a key factor. On the other hand, there is no evidence that higher net FDI liabilities increase crisis risk. Actual external indebtedness of EMU peripheral countries, including Spain, remain above risk thresholds obtained by the early warning system implemented in this paper. Thresholds are sensitive to the way of computing NIIP: when we drop VE effects through CA accumulation, thresholds for EMU peripheral countries are above those corresponding to NIIP official data, which include VE effects.

The previous results indicate that a system of early warning indicators based on a country-specific signalling approach can generally help to detect external tensions. However, it is necessary to take into account the general caveats that surround this methodology. Firstly, early warning indicators are based on historical crises observations, but triggers of future crises events may differ from past episodes. In addition, the data used to build a system of early warning indicators are ex post, which are usually available with a lag and are subject to revisions. As shown in the paper, predictive power falls with out-sample predictions or when the signaling window is longer. Therefore, data availability and their quality can reduce the usefulness as a policy tool of an early warning system when we try to detect future external stress episodes, especially when it is necessary to adopt structural reforms which take time in their implementation and for having a favorable impact on the economy.

External indebtedness correction is usually a gradual process and requires to consolidate a sustained path of external surpluses, whose achievement would be fostered with further advances in structural reforms oriented to reinforce the structural consolidation of public accounts in EMU peripheral countries – against a background of population aging in

advanced economies - and the external competitiveness of highly external indebted economies. These reforms could so promote genuine gains in productivity, cost moderation and the factors reallocation to sectors and firms with greater potential growth, for which it is necessary to remove the rigidities in factor and product markets and institutional constraints that limit the expansion of size firms.

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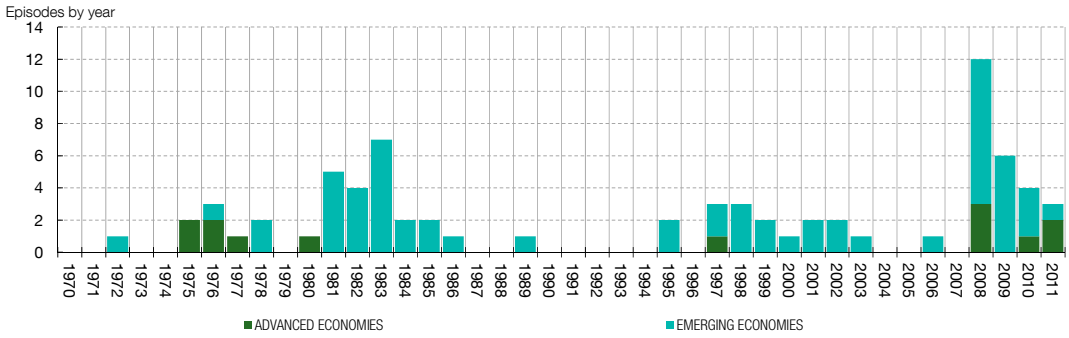
FIGURES AND TABLES

EXTERNAL STRESS EPISODES

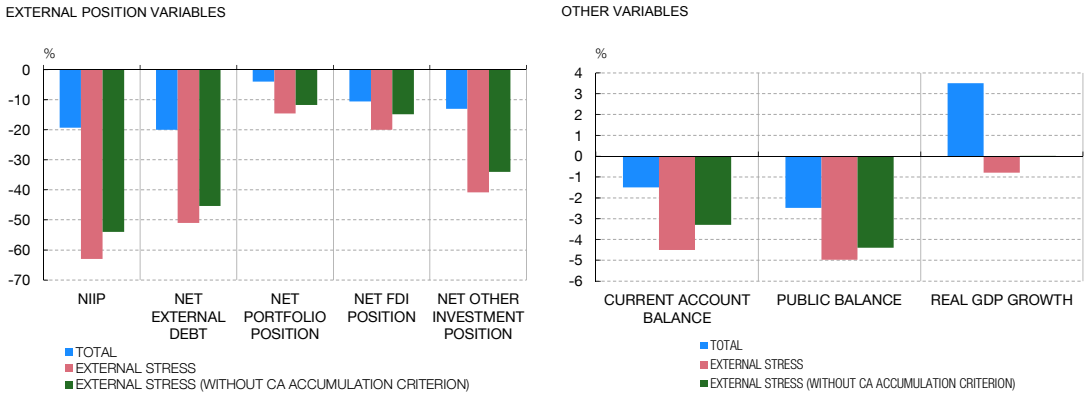
CHART 1



SOURCES: Lane and Milesi-Ferreti (2007) and own calculations.

SELECTED VARIABLES AVERAGES AND DEVIATIONS WHEN THERE ARE EXTERNAL STRESS EPISODES

CHART 2

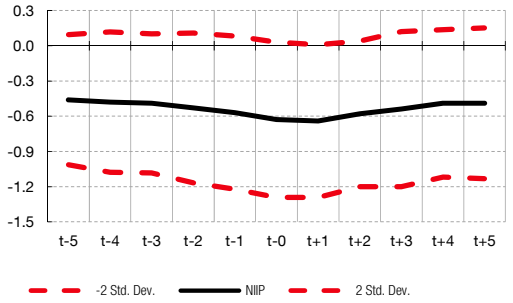


SOURCE: Lane and Milessi-Ferreti (2007) and own calculations.

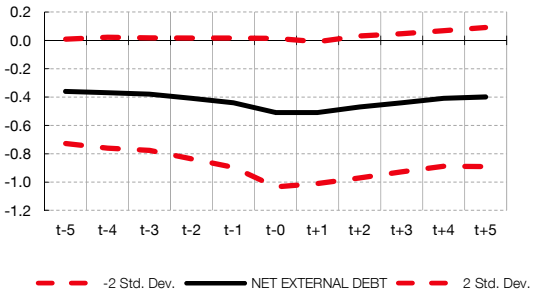
SELECTED VARIABLES AROUND EXTERNAL STRESS EPISODES

CHART 3

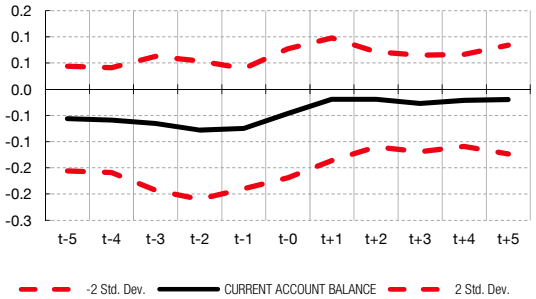
1 NET INVESTMENT POSITION



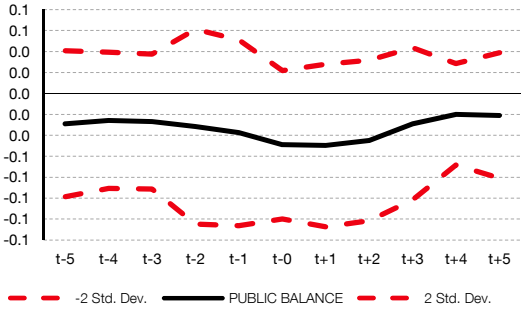
2 NET EXTERNAL DEBT



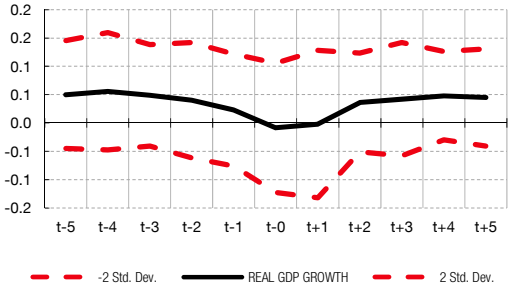
3 CURRENT ACCOUNT BALANCE



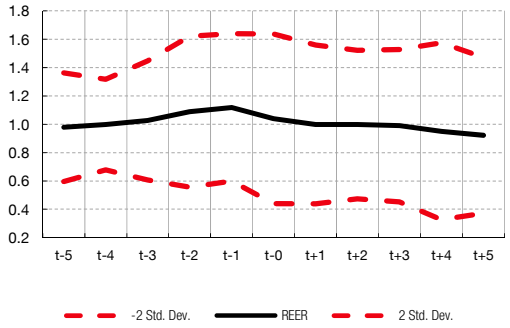
4 PUBLIC BALANCE



5 REAL GDP GROWTH



6 REAL EFFECTIVE EXCHANGE RATE

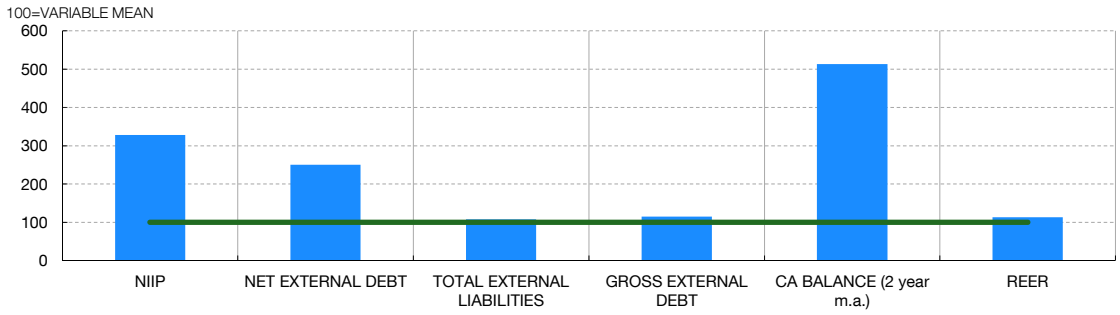


SOURCES: own calculations.

MARGINAL IMPACT OF SELECTED VARIABLES ON EXTERNAL STRESS PROBABILITY

CHART 4

MARGINAL IMPACT AT A YEAR PRIOR TO EXTERNAL STRESS EPISODE



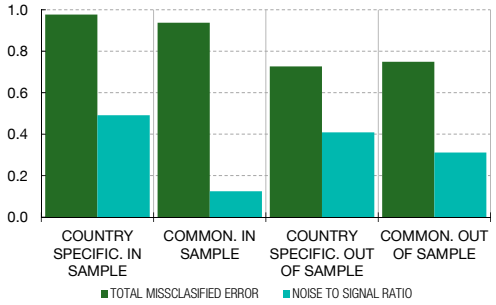
SOURCE: own calculations.

EXTERNAL STRESS EARLY WARNING SYSTEM

CHART 5

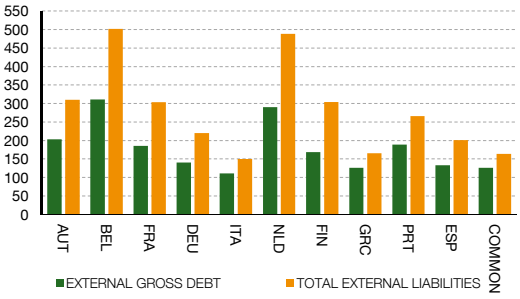
1 AGGREGATE INDEX PREDICTIVE POWER

Signalling window: 1 year. Out of sample last year: 2005



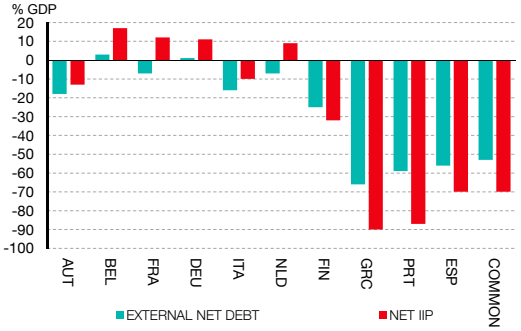
2 THRESHOLDS. EXTERNAL LIABILITIES

% GDP



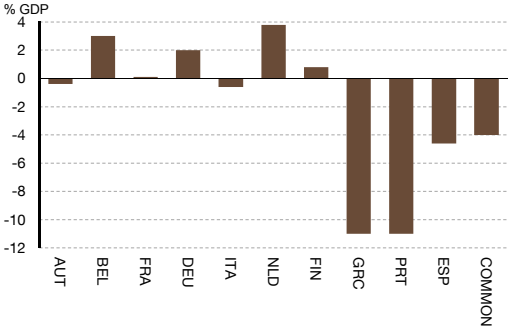
3 THRESHOLDS. NET POSITIONS

% GDP

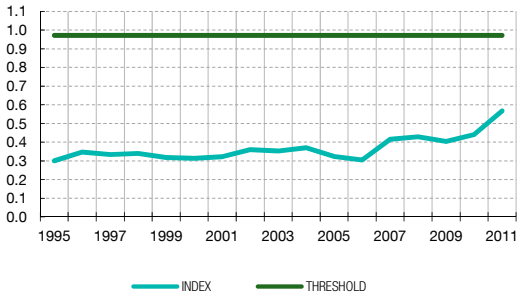


4 THRESHOLDS. CA BALANCE

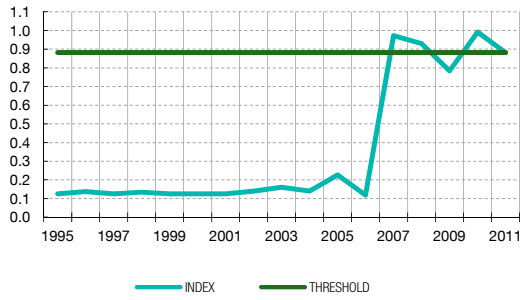
% GDP



5 AGGREGATE GDP-WEIGHTED EARLY WARNING INDEX FOR SELECTED EMU COUNTRIES



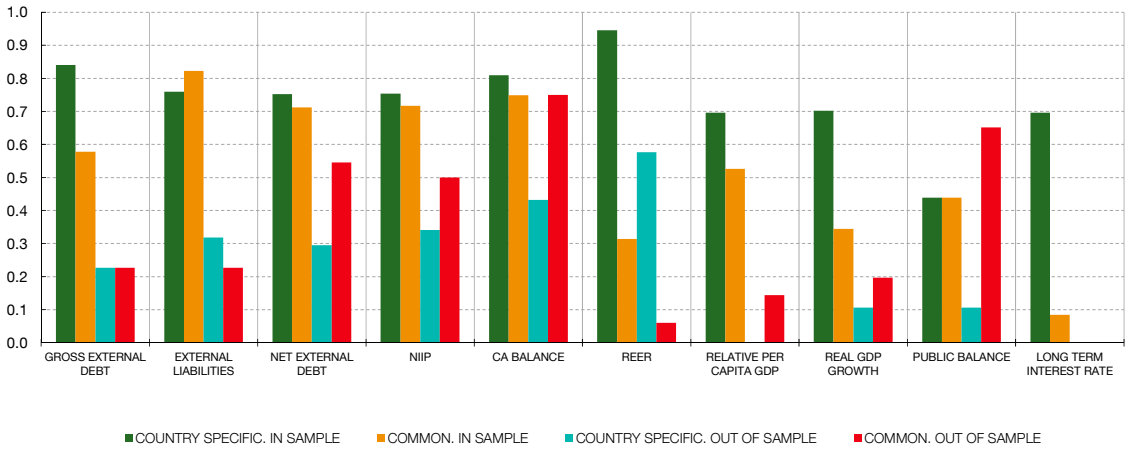
6 AGGREGATE GDP-WEIGHTED EARLY WARNING INDEX FOR PERIPHERAL EMU COUNTRIES



VARIABLES PREDICTIVE POWER

TME criterion. Signalling window: 1 year. Out of sample last year: 2005

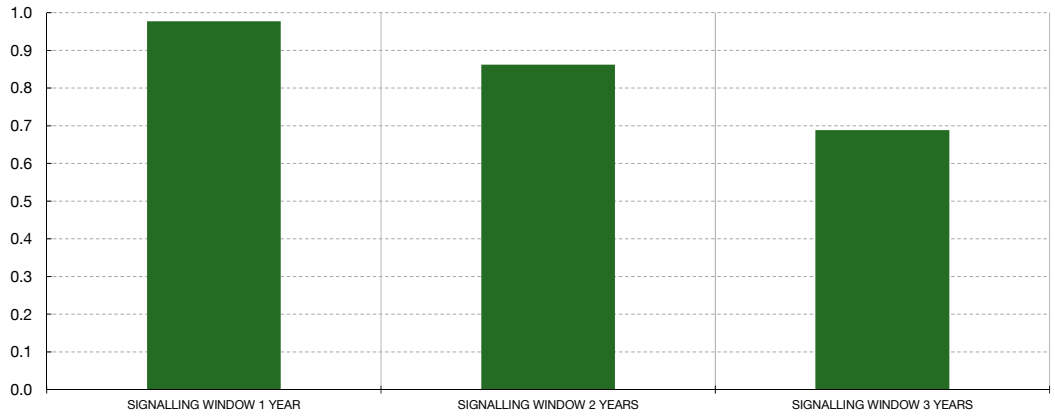
CHART 6



SOURCES: own calculations.

TME IN SAMPLE COUNTRY-SPECIFIC. COMPOSITE INDEX PREDICTIVE POWER ACROSS SIGNALLING WINDOWS

CHART 7

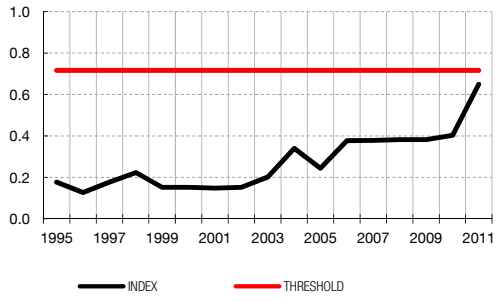


SOURCES: own calculations.

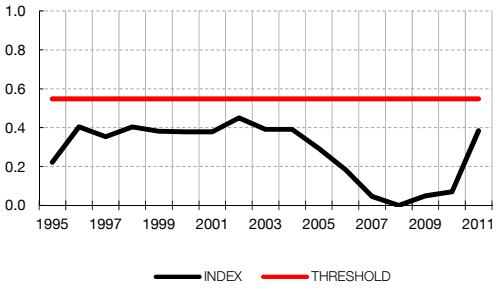
EARLY WARNING COUNTRY SPECIFIC INDEXES

CHART 8

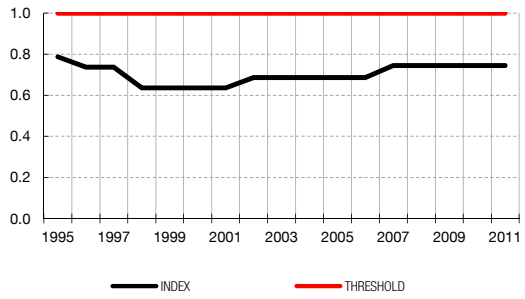
1 FRANCE



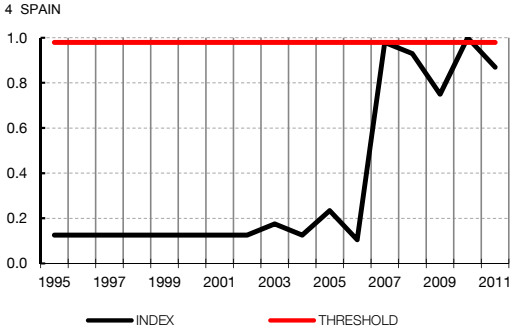
2 GERMANY



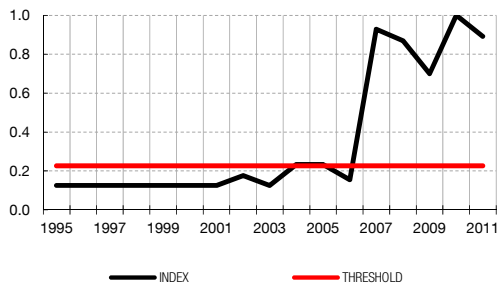
3 ITALY



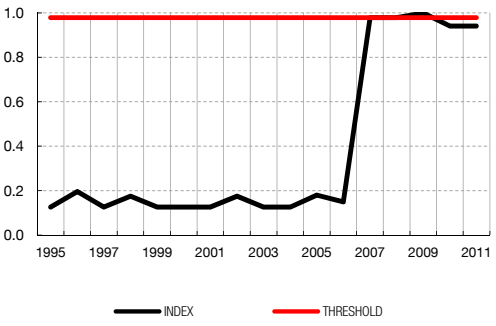
4 SPAIN



5 PORTUGAL



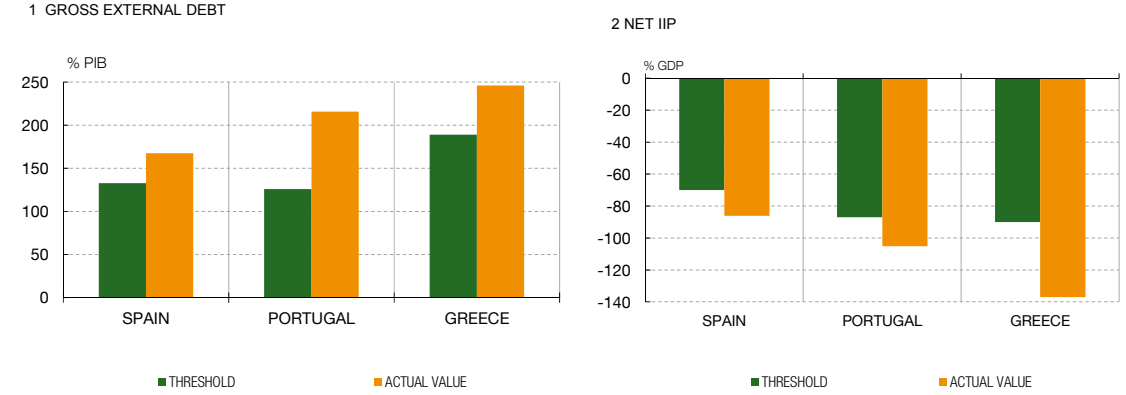
6 GREECE



SOURCES: own calculations.

EXTERNAL INDEBTEDNESS THRESHOLDS AND ACTUAL VALUES.
COMPARISON FOR EMU PERIPHERAL COUNTRIES

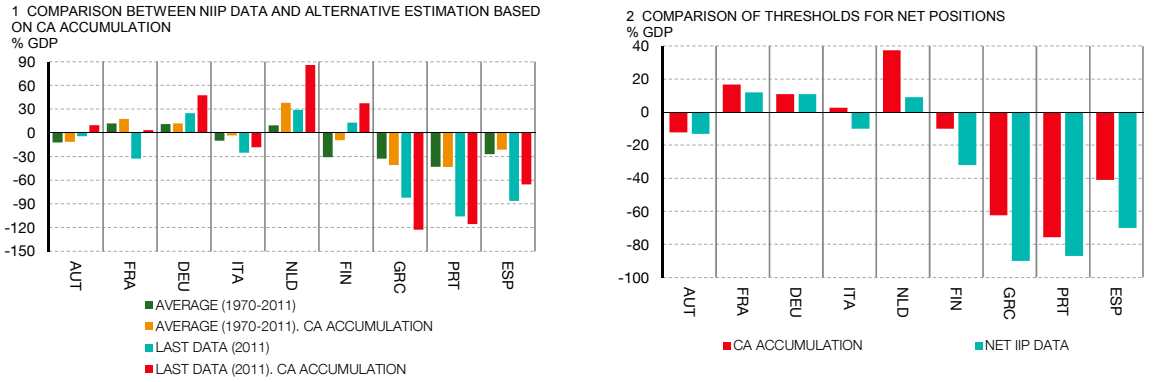
CHART 9



SOURCES: Banco de España, national sources and own calculations.

ALTERNATIVE NIIP (BY CA ACCUMULATION)

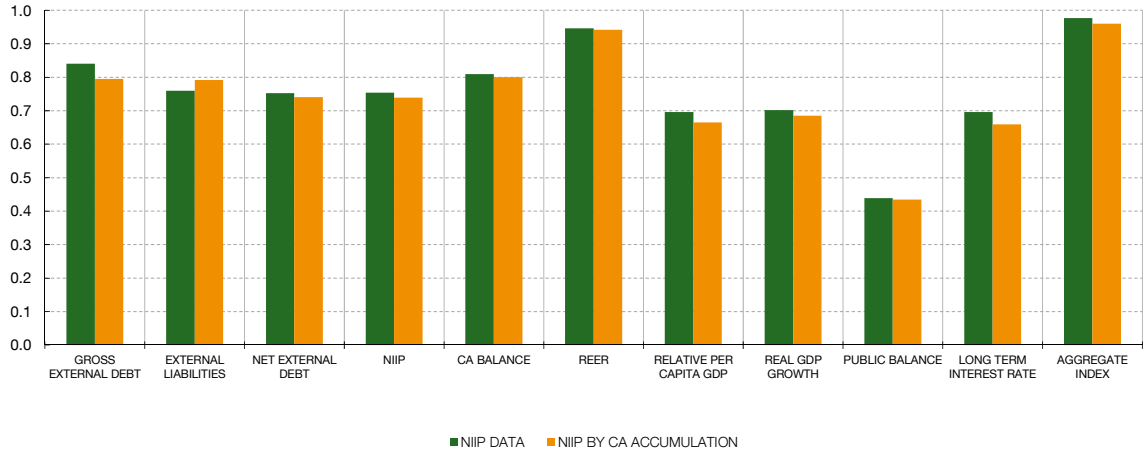
CHART 10



SOURCES: Lane and Milessi-Ferreti (2007) and own calculations.

VARIABLES PREDICTIVE POWER (TME COUNTRY SPECIFIC THRESHOLDS)
TME criterion. Signalling window: 1 year

CHART 11



SOURCES: own calculations.

CRISIS IMPACT ON EXTERNAL STOCKS VARIABLES AND CURRENT ACCOUNT (measured as GDP ratios)
MCO coefficients of a dummy variable that takes 1 if there is a crisis or 0 if not.
Controlled by country dummies

TABLE 1

	1970-2011
NIIP	-0.25***
	(0.03)
Net External debt	-0.19***
	(0.03)
Net FDI assets	-0.04**
	(0.02)
Current account balance	-0.01**
	(0.007)
Real GDP growth	-0.05***
	(0.007)
Real Exchange Rate	0.1**
	(0.04)

SOURCE: own calculations.

a. Robust standard errors in brackets. *, **, *** impliy statistical significativity 10%, 5% y 1%, respectively.

TABLE 2

PROBIT ESTIMATES. CRISIS PROBABILITY
(variables are GDP ratios and are lagged one year. Coefficients reported are the marginal impact on average)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(9)	(10)	(11)	(12)
Net foreign assets	-0.09***	-0.04***	-0.12***	-0.06***	-0.05***								
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)								
Total external liabilities										0.01**		0.01**	
										(0.003)		(0.006)	
Net debt assets						-0.07***	-0.15***	-0.07***	-0.05**				-0.06**
						(0.02)	(0.03)	(0.24)	(0.03)				(0.03)
Debt liabilities											0.01*		
											(0.007)		
Net FDI assets						0.09***			0.11**				0.07**
						(0.03)			(0.05)				(0.04)
FDI liabilities											-0.09**		
											(0.04)		
Current account balance (2 year moving average)		-0.6***		-0.9***	-0.7***	-0.71***		-0.7***	-0.8***		-0.9***		-0.9***
		(0.11)		(0.17)	(0.14)	(0.11)		(0.1)	(0.14)		(0.12)		(0.17)
Relative per capita GDP	-0.07***	-0.07***	-0.1***	-0.06**	-0.1***	-0.1***	-0.13***	-0.1***	-0.13	-0.11***	-0.09***	-0.14***	-0.13***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.04)	(0.05)
Public balance				-0.37*									0.3
				(0.21)									(0.26)
Long term public interest rates												0.03***	0.03***
												(0.01)	(0.01)
Real GDP growth			-0.26**		-0.4***		-0.27**	-0.4***	-0.4***				
			(0.1)		(0.1)		(0.13)	(0.1)	(0.13)				
Real Effective Exchange Rate			0.06**		0.06***		0.06***	0.07***	0.06***				
			(0.02)		(0.02)		(0.03)	(0.03)	(0.03)				
Number observations	1547	1508	773	762	761	1498	773	761		1548	1507	1102	619
Wald chi2	130	148	90.1	73.7	110.3	142	96.7	110.0		98.2	131.3	98.3	80
Pseudo R2	0.19	0.24	0.29	0.34	0.35	0.26	0.29	0.35		0.13	0.24	0.18	0.35

SOURCE: own calculations.

Regressions controlled by year dummies.

a. Robust standard errors in brackets. *, **, *** impliy statistical significativity 10%, 5% y 1%, respectively

PROBIT ESTIMATES. CRISIS PROBABILITY (ALTERNATIVE EXTERNAL STRESS DEFINITION WITHOUT CA ACCUMULATION CRITERION)

TABLE 3

(variables are GDP ratios and are lagged one year. Coefficients reported are the marginal impact on average)

	(1)	(2)	(3)	(4)	(5)	(6)
Net foreign assets	-0.03**	-0.04**				
	(0.01)	(0.02)				
Total external liabilities						
Net debt assets			-0.05**	-0.08***	-0.06***	
			(0.03)	(0.02)	(0.02)	
Debt liabilities						0.01*
						(0.01)
Net FDI assets					0.08***	
					(0.03)	
FDI liabilities						
Current account balance (2 year moving average)	-0.4***	-0.3**	-0.4***	-0.3***	-0.4***	
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	
Relative per capita GDP	-0.07***	-0.07***	-0.1***	-0.09***	-0.09***	-0.1***
	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Public balance		-0.5**		-0.41**		-0.6***
		(0.2)		(0.2)		(0.2)
Long term public interest rates						
Real GDP growth	-0.15*		-0.4***		-0.15*	
	(0.09)		(0.1)		(0.1)	
Real Effective Exchange Rate			0.06**			
			(0.02)			
Number observations	1544	762	773	762	1544	762
Wald chi2	125	147	87.2	72.5	108.6	129.7
Pseudo R2	0.17	0.22	0.28	0.32	0.31	0.21

SOURCE: own calculations.

Regressions controlled by year dummies.

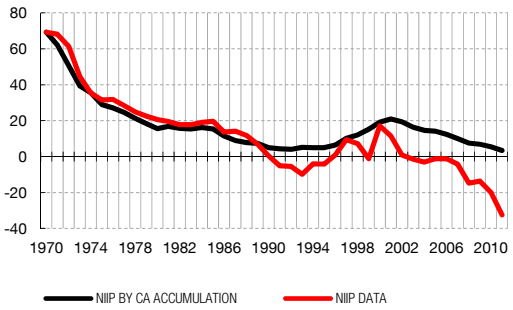
a. Robust standard errors in brackets. *, **, *** impliy statistical significativity 10%, 5% y 1%, respectively

ANNEX

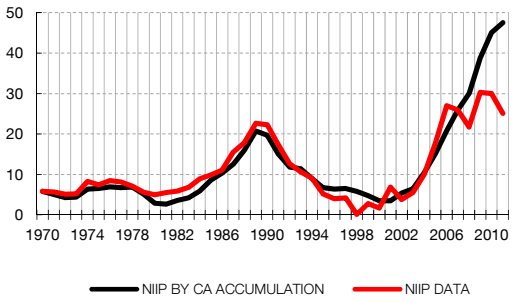
COMPARISON BETWEEN NIIP DATA AND NIIP BY CA ACCUMULATION FOR SELECTED EMU COUNTRIES (% GDP)

CHART A1

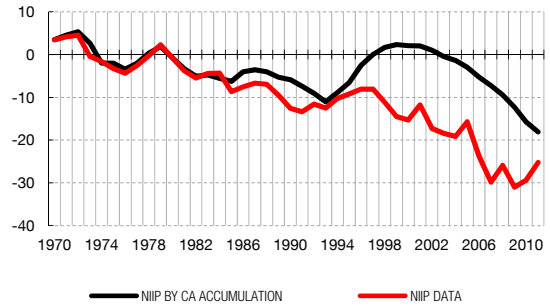
1 FRANCE



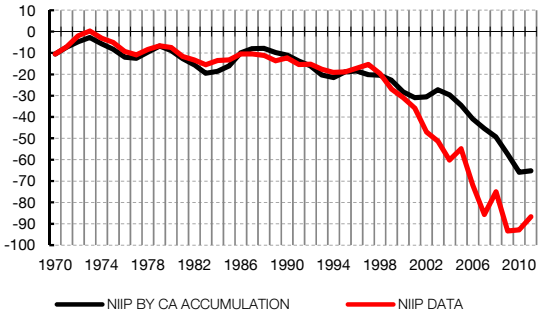
2 GERMANY



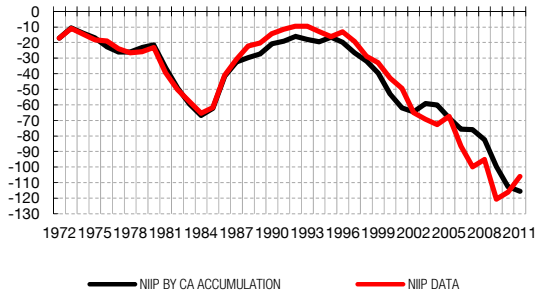
3 ITALY



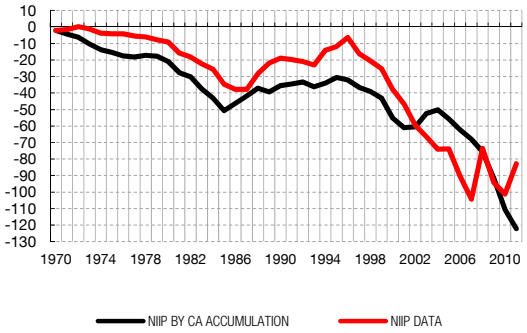
4 SPAIN



5 PORTUGAL



6 GREECE



SOURCES: Lane and Milessi-Ferreti (2007) and own calculations.

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