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The Great Leveraging in the European crisis countries
Domestic credit and net foreign liabilities

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Abstract
Purpose – The Great Leveraging was an episode of rapid credit growth and booming housing markets leading up to the global financial crisis. It is important to identify the key drivers of the Great Leveraging and, to this end, the purpose of this paper is to model the relationship between domestic credit and net foreign liabilities in the EU countries most affected by the crisis.
Design/methodology/approach – The analyses show that domestic credit and net foreign liabilities were cointegrated one-to-one for Greece, Italy, Portugal and Spain, while there was no cointegration for Ireland. Estimation of vector error correction models (VECMs) shows that the adjustment to deviations from the cointegrating relationship took place through changes in domestic credit for Greece and Italy, while the adjustment was bidirectional for Spain and maybe also for Portugal.
Findings – These results suggest that external factors in the form of foreign capital inflows were important drivers of the pre-crisis leveraging in the southern crisis countries, although to varying degrees across the countries.
Originality/value – Key novelties include the use of stock variables instead of flow variables and the estimation of VECMs for the countries individually instead of in a panel.
Keywords Financial crisis, Leveraging, Cointegration, Capital flows
Paper type Research paper

1. Introduction
The GIIPS countries – Greece, Ireland, Italy, Portugal and Spain – were among the countries in Europe that were most adversely affected during the global financial crisis. The five crisis countries experienced problems in the banking sector, credit crunches, government debt crises and deep recessions (Moro, 2014). Four of the countries received financial support from the IMF and the European Union; only the Italian authorities managed to borrow at commercial terms throughout the crisis.

In the decade before the crisis, all five GIIPS countries experienced fast economic growth, subdued inflation and rapidly growing domestic credit. Domestic credit grew faster than GDP, meaning that the leverage ratio increased substantially, a phenomenon that has been labelled the Great Leveraging (Taylor, 2014). These developments were reversed after the outbreak of the global financial crisis as extensive deleveraging occurred and the countries were plunged into deep crises (Reinhart and Rogoff, 2014).

It is clearly pertinent to study the dynamics and interlinkages of domestic credit and current account developments. Numerous studies find that these variables provide valuable predictions on macroeconomic performance such as economic growth and asset prices (Dees, 2016). The variable may also provide signs of vulnerabilities to economic and financial crises in individual countries[1]. This paper investigates how the domestic credits and current account developments were connected in the GIIPS countries during the Great Leveraging before the global financial crisis.

It is important to note that domestic credit and the current account balance are very different concepts (Borio and Disyatat, 2015). The current account balance depicts the net transfer of resources to an economy in a given period, which can be broken down into

gross capital outflows minus gross capital inflows adjusted for changes in official reserves. Domestic credit represents the lending of financial institutions to non-financial institutions, and is as such a gross concept reflecting financial decisions by agents in the economy.

There are, in theory, several channels through which domestic credit and the current account balance can be tied together (Lane, 2013; Lane and Mcquade, 2014)[2]. A current account deficit or net inflow of foreign capital implies that additional resources are available domestically, and these resources may be channelled through the banking sector, causing an expansion of credit. Similarly, banks may finance domestic credit domestically or through foreign borrowing, and such borrowing leads *ceteris paribus* to a deterioration of the current account balance. It is clear that any linkage between domestic credit growth and the current account balance is unlikely to remain unchanged under all circumstances but will instead depend on developments in the economy or on financial markets determining the characteristics of the linkage[3]. In other words, the linkage between domestic credit growth and the current account balance is likely to be country and sample specific, and this is clearly important for the choice of empirical strategy.

Only a few empirical studies have analysed the relationship between domestic credit and international capital flows, and the studies have typically only considered causation in one direction. Avdjiev *et al.* (2012) find for emerging markets like Asia that capital inflows have allowed domestic credit booms to occur. This finding is supported by Magud *et al.* (2014) who assess the reaction of the domestic credit ratio to capital inflows, the exchange rate regime, money growth and other fundamentals. Amri *et al.* (2016) argue, however, that the linkage between surges in capital inflows and domestic credit is not very strong and, in large part, depends on how the variables are considered[4].

Lane and Mcquade (2014) consider domestic credit growth and various components of capital flows for a panel of European countries and a broader panel of 54 advanced and emerging economies before the global financial crisis. The main finding is that the current account balance helped explain domestic credit growth, largely driven by debt flows but not by equity flows. In the same vein, Davis (2015) finds, using vector autoregressive models, that debt-based capital inflows stimulate domestic credit growth while equity-based capital inflows do not. Calderón and Kubota (2012) also distinguish between different components of capital flows in a wide sample and find that increases in private gross capital inflows help explain credit booms. Carvalho (2014) finds in a broad data set a positive relationship between cross-border banking flows and domestic credit.

Focussing on Spain, Veld *et al.* (2014) find that a number of local factors such as the loosening of collateral requirements, and a reduction in the risk premium of the Spanish housing market facilitated the capital inflows that fuelled the housing market bubble. Gossé and Serranito (2014) model the current account balance in the OECD countries and find that domestic credit growth is associated with a deterioration of the current account in the long run.

Most of the empirical studies discussed conclude that the current account and domestic credit growth covary but the estimated effect is typically moderate. The studies, however, typically use panel data where data from many countries are pooled and common coefficients are estimated. Moreover, the time sample is often chosen without taking into account structural breaks or institutional changes. The upshot is that the relatively weak relationship between the current account and domestic credit growth may, to some extent, be the result of data being pooled across countries and structural breaks. Moreover, the studies typically use capital inflows and changes in the stock of credit. The use of first differenced variables reduces the risk of spurious correlation, but at the cost of information being omitted if cointegration is present.

In this paper, we investigate the relationship between the stock of credit and the stock of net foreign liabilities for each of the five GIIPS countries. The analysis is based on a comprehensive cointegration analysis comprising several steps. The time series properties of the two variables are analysed and the period in which both variables are integrated of order of 1 is identified for each country. If tests confirm the presence of cointegration, the cointegrating vector is estimated. Finally, a full vector error correction model (VECM) is estimated to ascertain the dynamics of the adjustment to deviations from the cointegrating relationship.

The paper contributes in several respects to the incipient literature on the linkages between domestic leveraging and foreign capital flows. First, the analyses are carried out for the sample countries individually. Second, the estimation of a VECM with equations for domestic credit and net foreign liabilities means that equations for the two variables are estimated simultaneously. Third, the use of VECM makes it possible to study the dynamic adjustment following shocks in either domestic credit or the net foreign liability.

In conclusion, the VECM methodology proposed in this paper opens up new ways of establishing the relationship between domestic credit growth and the current account balance. It allows for country-specific modelling and makes it possible for the direction of causality to be assessed, and it provides insights into the dynamic adjustment. The findings are important for understanding the pre-crisis leveraging in the GIIPS countries and potentially also if the authorities seek to implement measures to head off similar developments in the future.

The rest of the paper is organised as follows. Section 2 documents the data and provides a graphical analysis of the relationship between domestic credit and net foreign liabilities. Section 3 contains the empirical analysis between the two variables. Finally, Section 4 concludes.

2. Data

The analyses for the five GIIPS countries are initially carried out with three variables, these being the net international investment position, domestic credit and GDP. The data are quarterly and cover the period 1998:4-2013:3, except for the data for Ireland, where data on net international investment position are only available from 2000:4.

Quarterly data for domestic credit in the form of credit to the private non-financial sector from domestic banks are from the Bank for International Settlements (BIS, 2015; code: *Q:XX:B:P:U*, where *XX* indicates the country). Data are available for the entire sample period. The series have been converted into shares of GDP by dividing by GDP at current prices taken from Eurostat (2015) (code: *namq_gdp_c*). To make it comparable with the annual data, the quarterly GDP series has been annualised by multiplying them by four. Seasonality was removed using the multiplicative ×12 procedure. The resulting variable, seasonally adjusted domestic credit as a share of GDP, is labelled CR.

Quarterly data for the net international investment position in per cent of GDP at the end of the period are published by Eurostat (2015) (code: *tipsii40*). The availability of quarterly data back in time varies across the five sample countries. Quarterly data for Greece are available from 2007:4 and annual data from 1998, so for the period 1999:1-2007:3 data for the first, second and third quarters have been interpolated[5]. Quarterly data for Ireland for the first, second and third quarters have been interpolated for the period 2000:4-2003:3. Semi-annual data are available for Italy for the period 1998:4-2003:3, so data for the first and third quarters have been interpolated for this period. Data for Portugal for the first, second and third quarters have been interpolated for the period 1998:4-2003:3. Finally, quarterly data for Spain are available throughout the sample period. For ease of interpretation, we consider net foreign liabilities instead of the net international investment position. Net foreign liabilities as a share of GDP (NFL) are simply minus the net international investment position.

To ensure that extreme observations do not affect the results unduly, we have in all cases used the logarithmic approximation $\log(1+x) \approx x$. The approximate leverage ratio, domestic

credit as a share of GDP, is thus computed as L1CR = log(1+CR), while approximate net foreign liabilities as a share of GDP are L1NFL = log(1+NFL). The econometric analyses are carried out using a model with only two variables, L1CR and L1NFL.

Figure 1 shows cross-plots of the domestic credit variable L1CR and the net foreign liabilities variable L1NFL for each of the five GIIPS countries. For Greece, the Great Leveraging went hand in hand with increased net foreign liabilities until the end of 2007, from which time the relationship between the two variables became less pronounced. Towards the very end of the sample, private credit stagnated as a share of GDP, while net foreign liabilities exhibited sizeable gyrations. These gyrations were in part due to the IMF and EU bailout packages, which typically increased net foreign liabilities, and in part due to the private sector debt write-down at the end of 2011, which reduced net foreign liabilities.
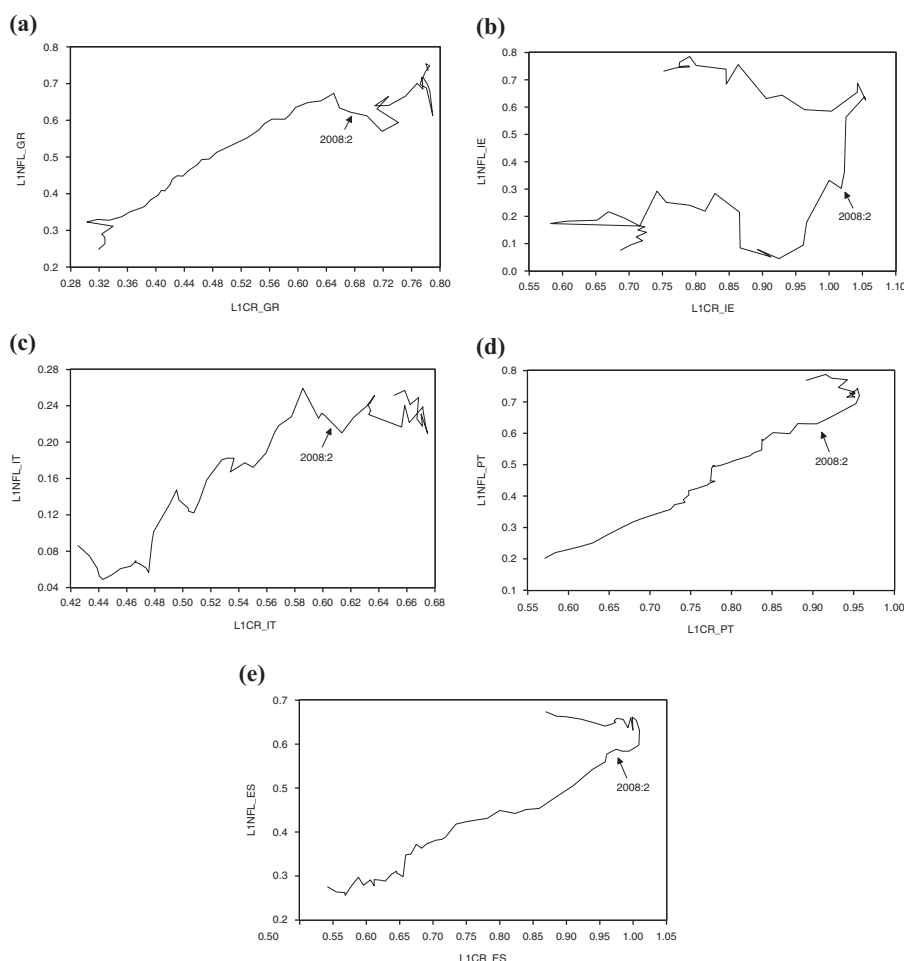
Figure 1.
Cross-plots of private credit and net foreign liabilities, shares of GDP

Notes: (a) Greece; (b) Ireland; (c) Italy; (d) Portugal; (e) Spain. The sample is 2000:4-2013:3 for Ireland and 1998:4-2013:3 for the other countries. Private credit is denoted L1CR and net foreign liabilities L1NFL, both shown with adjacent country identifiers

For Ireland, the pre-crisis leveraging of the domestic private sector occurred while net foreign liabilities remained broadly constant. A bailout was agreed with the IMF and the EU in November 2010 after substantial problems in the banking sector. The Irish economy subsequently experienced extreme deleveraging, with the private credit variable L1CR declining from more than 100 per cent of GDP to around 75 per cent of GDP in a few years.

For Italy, the pre-crisis growth of domestic credit was accompanied by a corresponding accumulation of net foreign liabilities. The net foreign liabilities remained relatively small, however, compared to those in the other sample countries. After the outbreak of the crisis, the deleveraging started late and was relatively modest, while net foreign liabilities stayed largely constant.

Developments for Portugal and Spain followed the same broad pattern, although the global financial crisis afflicted the countries differently. The pre-crisis period was characterised by rapid leveraging and corresponding growth in net foreign liabilities. The process of deleveraging started towards the end of 2008, but net foreign liabilities continued to increase. Portugal received a bailout after facing government financing problems in May 2011, while Spain received support for the banking sector in June 2012 after problems in several savings banks.

The cross-plots in Figure 1 show many similarities across the five GIIPS countries, but also notable differences. Before the global financial crisis, the countries all underwent a process of rapid leveraging accompanied in all cases except that of Ireland by a rapid increase in net foreign liabilities. After the outbreak of the crisis, a process of deleveraging took place, but it was most pronounced in Ireland and, to a lesser extent, in Spain. The deleveraging was however not accompanied by a corresponding decline in net foreign liabilities in any of the GIIPS countries. Instead, any sign of a stable relationship between the two variables disappeared.

3. Empirical analysis

As a first step in the empirical analysis, we test for the order of integration of the variables L1CR and L1NFL. We apply the unit root test of Leybourne *et al.* (2007), which not only estimates the order of integration but also changes in the order of integration from I(1) to I(0) and vice versa. This is particularly important in our context as the financial crisis and other developments may have affected the time series properties of the variables. The estimation of a VECM model requires both variables to be I(1).

The test of Leybourne *et al.* (2007) is based on the Dickey-Fuller unit root test, with the modification proposed by Elliot *et al.* (1996) to detrend the series. The test statistic for the null of unit root against the alternative that the series is I(0) in some continuous subsample is:

$$M = \inf_{\lambda \in (0,1)} \inf_{\tau \in (\lambda,1)} DF_G(\lambda, \tau) \tag{1}$$

where a subsample between λT and τT with $0 \leqslant \lambda < \tau \leqslant 1$ is used to compute $DF_G(\lambda, \tau)$, which is the *t*-ratio for the estimated autoregressive coefficient in the basic Dickey-Fuller regression. Table I shows the results of the computations of M, where a constant term has been included and a lag length of 4 has been used in all cases.

It follows from Table I that the L1CR variable is I(1) in all of the available time samples for Greece, Italy, Portugal and Spain, while it appears to be I(0) for Ireland for a short period around the outbreak of the global financial crisis. The L1NFL variable exhibits a structural break for all of the countries except Spain; a change from I(1) to I(0) happens around 2008 in Greece, Italy and Portugal, while the change had already happened in 2004 for Ireland.

The results would justify running the cointegration analyses for most of the countries until around 2008:2, just before the bankruptcy of Lehman Brothers. The case of Ireland is interesting as the variables seem to be stationary around the middle of the sample.

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Variable	M-statistic	I(0) start-end
Greece		
L1CR	−1.72	
L1NFL	−8.88***	2007:3-2010:3
Ireland		
L1CR	−7.09***	2006:1-2008:4
L1NFL	−4.92**	2004:1-2008:1
Italy		
L1CR	−3.26	
L1NFL	−4.42**	2008:1-2011:1
Portugal		
L1CR	−2.57	
L1NFL	−4.54**	2008:4-2011:4
Spain		
L1CR	−3.06	
L1NFL	−2.07	

Notes: The sample is 2000:4-2013:3 for Ireland and 1998:4-2013:3 for the other countries. The critical values at the 1, 5 and 10 per cent levels of significance are −3.88, −4.24 and −5.13, respectively. These have been obtained from Leybourne *et al.* (2007, p. 13). *,**,***Denote rejection of the null hypothesis at the 10, 5 and 1 per cent levels, respectively

This would rule this country out from the analysis and indeed the results confirm the lack of a relationship between the two variables for Ireland.

The next step is the estimation of VECMs using the methodology developed by Johansen (1988, 1991). The literature discussed in Section 1 typically uses panel data estimations, which means that many observation points are available and so a number of variables can be included. Since we estimate the relationship for each country separately, we have fewer observations available and therefore opt for a parsimonious specification with two variables. The income level appears however implicitly in the specification because domestic credit and net foreign liabilities are both divided by the income level. More importantly, if there is a cointegrating relationship between two variables as we find for the south European GIIPS countries, the addition of other variables would not change that relationship since the stochastic trends cancel out in the cointegrating space (Juselius and McDonald, 2004; Juselius and Toro, 2005)[6].

The Johansen approach is based on estimation of the following equation:

$$\Delta X_t = \alpha\beta'X_{t-1} + \sum_{i=1}^{p}\gamma_i\Delta X_{t-i} + \mu + \varepsilon_t \quad (2)$$

The vector X_t contains the non-deterministic variables of the model, α represents the loading or adjustment matrix, β is a matrix with the long-run coefficients, γ_i are the short-run coefficients, μ is a constant term and ε_t is the vector of errors. The assumption behind this model is that at least two of the variables are I(1), and it is possible to find one or more cointegrating relationships among the variables in the form of a linear combination that cancels out the overall stochastic trend.

The time sample covers both a boom and a bust. The global financial markets came under increasing strain in 2007-2008 as witnessed by the bailout of Bear Sterns in June 2007 and the bankruptcy of Lehman Brothers in September 2008. The cross-plots in Figure 1 also suggest that the dynamics of domestic credit and foreign liabilities differ in the periods

before and after the outbreak of the global financial crisis. This finding was also
corroborated by the unit root tests applied in the previous section. We will therefore
consider the period from the introduction of the euro to 2008:2 which is the last quarter
before the bankruptcy of Lehman Brothers and the beginning of the global financial crisis.

We test for the presence of a cointegrating relationship between private credit and net
foreign liabilities for each of the five crisis countries. The models use four lags and a non-
restricted constant, except for Portugal where seven lags were included in the model, and
Spain where five lags were used. The choice of lag length is based on the misspecification
test of the models. Tests for autocorrelation reveal that the models do not exhibit auto-
correlated residuals.

Table II reports the results of the trace test and λ-maximum for the number of
cointegrated vectors in the pre-crisis sample until 2008:2. For Ireland, the hypothesis of no
cointegration cannot be rejected for the full sample and the pre-crisis sample, results that
appear consistent with the cross-plot in Figure 1.

For each of the other countries, there is at least one cointegrating vector. In some cases,
the tests indicate more than one cointegrating vector, but the tests may overestimate the
number of cointegrated vectors in short samples (Cheung and Lai, 1993). In addition, a full
rank would imply that both variables are stationary, which is not the case; cf. Table I. It is
also worth noting that Portugal is a borderline case as one test indicates one cointegrating
relationship, whereas the other rejects cointegration. Taken together, the results in Table II
provide strong support for the hypothesis that private credit and net foreign liabilities are
cointegrated for the four mediterranean GIIPS countries, but not for Ireland.

Table III reports the estimated cointegrated vectors for the full sample for the four
countries for which the hypothesis of one cointegrating vector cannot be rejected.
The hypothesis of cointegration was rejected for Ireland. For the four other countries, the
estimated long-run coefficient of L1NFL(−1) is negative and, in numerical terms, very close
to 1. This implies a positive and a roughly one-to-one relationship between net foreign
liabilities L1NFL and domestic credit L1CR. These results corroborate the initial hypothesis
of a positive relationship between the two variables.

No. of CE(s)	Trace statistic	5% critical value	p-value[a]	Max-eigenvalue	5% critical value	p-value[a]
Greece						
None	36.398	15.494	0.000	30.334	14.264	0.000
At most 1	6.064	3.841	0.014	6.064	3.841	0.014
Ireland						
None	9.218	15.494	0.346	9.100	14.264	0.278
At most 1	0.118	3.841	0.730	0.118	3.841	0.730
Italy						
None	19.277	15.494	0.013	13.832	14.264	0.058
At most 1	5.445	3.841	0.020	5.445	3.841	0.020
Portugal						
None	15.747	15.494	0.046	10.043	14.264	0.210
At most 1	5.703	3.841	0.017	5.703	3.841	0.017
Spain						
None	18.442	15.494	0.018	17.582	14.264	0.014
At most 1	0.859	3.841	0.354	0.859	3.841	0.354

Note: The sample is 2000:4-2008:2 for Ireland and 1998:4-2008:2 for the other countries
Source: [a]MacKinnon-Haug-Michelis (1999) p-values

Table II.
Cointegration tests

As the final step in the cointegration analysis, Table IV shows the results of the adjustment specifications for the four southern GIIPS countries. The error correction term, containing the deviations from the cointegration relationships shown in Table III, is labelled ECT. The change in a variable from quarter to quarter is indicated by a prefixed Δ. The models in Table IV have all passed the usual autocorrelation tests.

For Greece, Italy and Portugal, the estimated coefficient of the error correction term ECT(−1) is negative and statistically significant in each of the ΔL1CR equations, but it is not statistically significant in the ΔL1NFL equations. In other words, only credit growth reacts to deviations from the cointegrating relationship while net foreign liabilities do not, and therefore liabilities can be taken to be weakly exogenous. This suggests that the pre-crisis leveraging in these countries was, in large part, driven by capital inflows factors. A different finding emerges for Spain as the estimated coefficients of ECT(−1) are statistically significant in both the ΔL1CR equation and the ΔL1NFL equation. There is a bidirectional relationship as domestic credit and net foreign liabilities react to each other, suggesting that both domestic and external factors were behind the pre-crisis leveraging in Spain.

The size of the estimated coefficients of ECT(−1) and the lagged values of ΔL1CR and ΔL1NFL vary across the countries. To gain further insights into the dynamics, Figure 2 shows the responses of domestic credit and the net foreign liabilities to a one unit impulse in each of the variables. The impulse responses are based on the moving average representation of the VAR representation of the VECM models in Table IV, so the contemporary cross effects are zero by definition. The upper right and lower left panels are of particular interest. The upper right panels show the effect on L1CR of a one unit increase in L1NFL, while the lower left panels show the effect on L1NFL of a one unit increase in L1CR. The dotted lines represent the 95 per cent confidence intervals based on a bootstrap with 10,000 replications using the method of Hall (1992)[7].

The impulse responses in Figure 2 generally confirm the results from Table IV. Foreign capital flows affect domestic credit in Greece and Italy, while there is no evidence of statistically significant relationships in the opposite direction. The same holds for Portugal, but the effect on domestic credit of the accumulation of net foreign liabilities is relatively subdued and occurs with a notable lag. The effect of an increase in net foreign liabilities on domestic credit seems to have been sizeable for Greece and, to some extent, Spain, while the effects are smaller for Italy and Portugal. This goes hand in hand with changes in net foreign liabilities being more persistent for Greece and Spain than for the other two countries. In other words, increases in capital inflows appear to have set in motion a sequence of increases in domestic credit and net foreign liabilities in Greece and, to a lesser extent, Spain, while this is not the case for Italy and Portugal.

The bidirectional relationship for Spain which was found in Table IV is confirmed by the impulse responses in Figure 2, panel (d). As discussed above, the effect of a change in net foreign liabilities on domestic credit builds up gradually and only becomes statistically significant after about two years. The effect of a change in domestic credit on net foreign liabilities is similarly gradual, though the effect is statistically significant after one year.

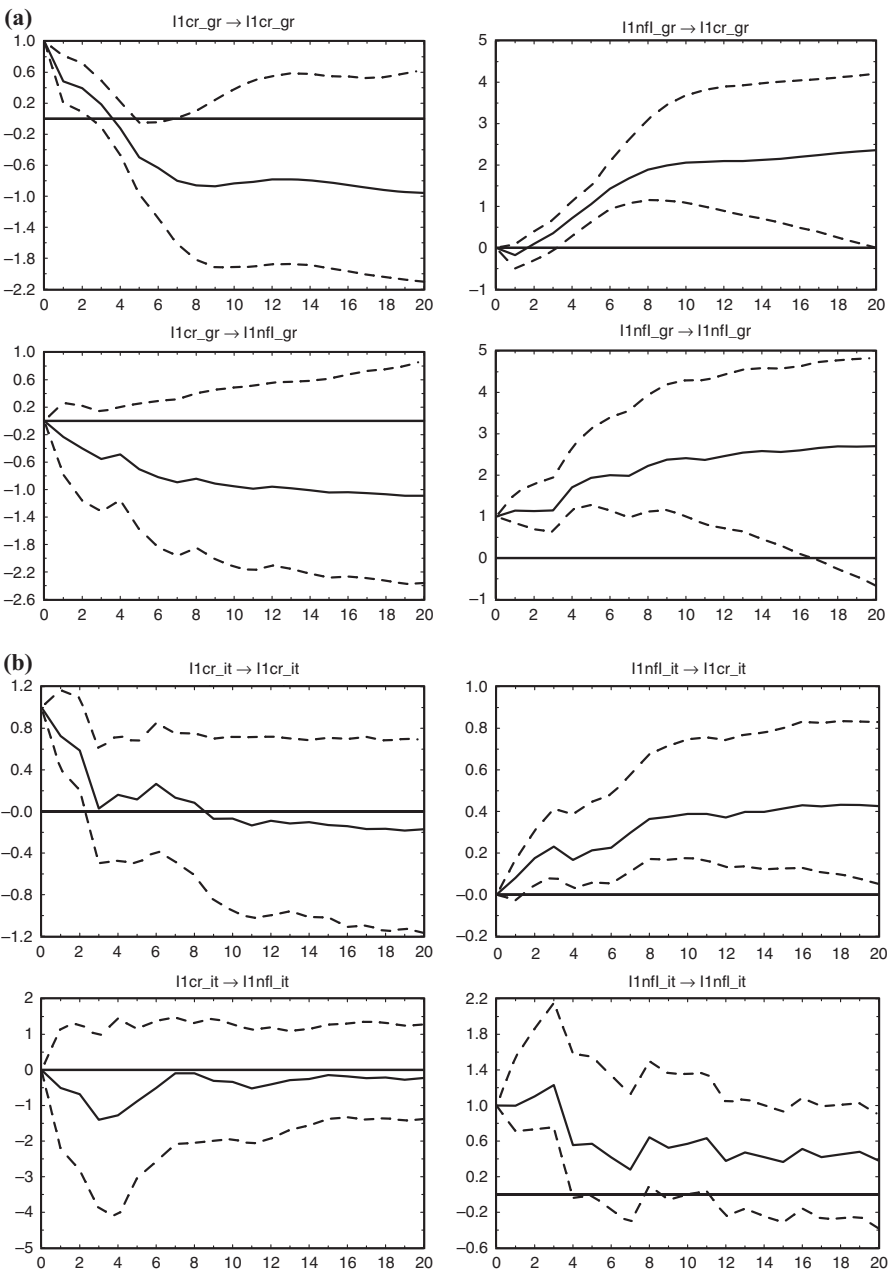|	Greece	Italy	Portugal	Spain
L1CR(−1)	1.000	1.000	1.000	1.000
L1NFL(−1)	−0.877*** (0.019)	−1.058*** (0.105)	−0.844** (0.073)	−1.155*** (0.109)
Constant	−0.047	−0.366	−0.382	−0.285

Table III. Cointegrating vectors

Notes: The sample is 1998:4-2008:2. Standard errors are given in parentheses. *,**,***Denote rejection of the null hypothesis at the 10, 5 and 1 per cent levels, respectively

	Greece		Italy		Portugal		Spain	
	ΔL1CR	ΔL1NFL	ΔL1CR	ΔL1NFL	ΔL1CR	ΔL1NFL	ΔL1CR	ΔL1NFL
ECT(−1)	−0.761*** (0.142)	−0.306 (0.242)	−0.122*** (0.035)	−0.054 (0.158)	−0.234*** (0.086)	−0.119 (0.096)	−0.174** (0.083)	0.409*** (0.171)
ΔL1CR(−1)	0.244 (0.153)	0.074 (0.261)	−0.151 (0.178)	−0.451 (0.799)	0.162 (0.221)	0.282 (0.247)	0.408** (0.199)	0.532 (0.408)
ΔL1CR(−2)	0.362*** (0.140)	0.051 (0.238)	−0.050 (0.165)	−0.260 (0.739)	0.580*** (0.227)	0.248 (0.253)	0.307 (0.212)	−0.604 (0.434)
ΔL1CR(−3)	0.319** (0.138)	0.007 (0.236)	−0.449** (0.198)	−0.746 (0.889)	0.174 (0.258)	0.389 (0.289)	0.434* (0.253)	−0.195 (0.520)
ΔL1CR(−4)	0.156 (0.145)	0.167 (0.247)	0.045 (0.191)	−0.242 (0.857)	−0.107 (0.268)	−0.270 (0.300)	0.022 (0.250)	−0.901* (0.512)
ΔL1NFL(−1)	−0.844*** (0.173)	−0.124 (0.295)	−0.048 (0.048)	−0.059 (0.215)	−0.470* (0.243)	−0.791*** (0.272)	−0.060 (0.098)	0.001 (0.202)
ΔL1NFL(−2)	−0.460* (0.254)	−0.339 (0.434)	−0.013 (0.044)	0.086 (0.200)	−0.454** (0.227)	−0.575** (0.254)	−0.160* (0.096)	0.091 (0.198)
ΔL1NFL(−3)	−0.373* (0.207)	−0.224 (0.354)	−0.043 (0.060)	0.144 (0.271)	−0.186 (0.206)	−0.713*** (0.230)	−0.055 (0.089)	0.110 (0.183)
ΔL1NFL(−4)	−0.177 (0.227)	0.352 (0.388)	−0.138** (0.064)	−0.623** (0.290)	−0.320 (0.201)	−0.371* (0.225)	−0.140 (0.087)	0.106 (0.179)
Constant	0.020*** (0.006)	0.010 (0.011)	0.008*** (0.002)	0.014* (0.009)	0.007 (0.005)	0.024*** (0.006)	−0.002 (0.003)	0.014* (0.007)
R^2	0.592	0.164	0.453	0.256	0.538	0.749	0.568	0.460

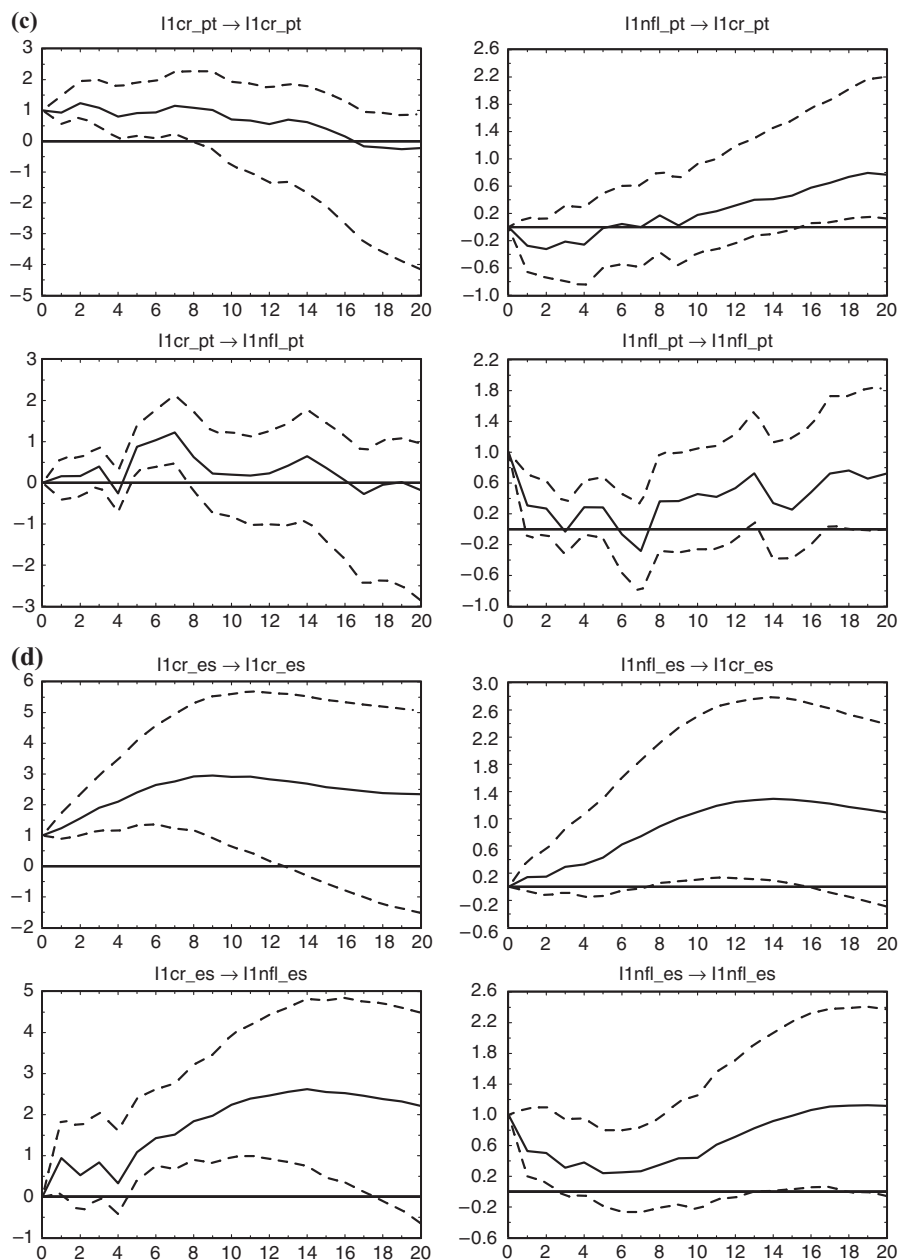**Notes:** The sample is 1998:4–2008:2. Standard errors are given in parentheses. *,**,***Denote rejection of the null hypothesis at the 10, 5 and 1 per cent levels, respectively. To save space, only the first four lags are reported for Portugal and Spain

Table IV.
Vector error
correction models

Figure 2.
Impulse-response
functions of
VECM models

(*continued*)

(c)

l1cr_pt → l1cr_pt

l1nfl_pt → l1cr_pt

l1cr_pt → l1nfl_pt

l1nfl_pt → l1nfl_pt

(d)

l1cr_es → l1cr_es

l1nfl_es → l1cr_es

l1cr_es → l1nfl_es

l1nfl_es → l1nfl_es

Notes: (a) Greece; (b) Italy; (c) Portugal; (d) Spain

Figure 2.

The magnitude of the effect on net foreign liabilities of a change in domestic credit is considerable and again results from the series of increases in both variables.

Spain stands out for its bidirectional relationship between domestic credit and net foreign liabilities. The domestic factor in the leveraging uniquely found for Spain might relate to the very dynamic developments in the Spanish banking sector before the crisis (Carballo-Cruz, 2011; Veld *et al.*, 2014). Spain has been dominated by a large number of small banks, with high levels of competition and low levels of concentration. The competition-fragility hypothesis view (Marcus, 1984) posits that banks may compete aggressively for market share in such a situation. The Spanish banks may thus have sought to compete aggressively to lend to the booming housing market and this credit growth appears in part to have been financed through the accumulation of net foreign liabilities.

The impulse responses in Figure 2 are computed for shocks in the variables of the reduced-form VECM. Table AI shows the residual variance-covariance matrix for each of the VECM estimations, while Table AII shows the corresponding residual correlation matrix. The contemporaneous residual correlation coefficients are all relatively small, though there are some differences in sign and magnitude across the four countries[8].

We have carried out several robustness checks of the results presented in Tables II-IV (available upon request). The results are in all cases unchanged in qualitative terms if the time sample is shortened by several quarters from either the beginning of the sample or from the end. This suggests that the small sample size of around 40 observations is not a critical issue. We have also tried to use the variables CR and NFL instead of the logarithmic transformations L1CR and L1NFL, and the results are again qualitatively unchanged, although the point estimates change somewhat. Finally, extending the sample to include the crisis period typically changes the results in Tables II-IV, reflecting the importance of the structural break associated with the start of the global financial crisis.

4. Conclusion and policy insights

The paper examines the Great Leveraging in the GIIPS countries before the outbreak of the global financial crisis. Cointegration analysis and VECM estimations for each of the countries aim to ascertain possible linkages between domestic credit and net foreign liabilities and the adjustment processes over time.

The econometric analysis is carried out for the period until 2008:2 and thus shed light on the relationship between domestic credit and net foreign liabilities during the Great Leveraging prior to the global financial crisis. Tests for cointegration show cointegration between domestic credit and net foreign liabilities for Greece, Italy, Portugal and Spain, but not for Ireland. Ireland experienced rapid leveraging without the accumulation of substantial net foreign liabilities. For the first four countries, the long-run coefficient is in all cases close to 1, suggesting a roughly one-to-one relationship between domestic credit and net foreign liabilities over time.

Estimations of VECMs show that the adjustment to deviations from the cointegrating relationship differs somewhat across the four southern European crisis countries. For Greece and Italy, the adjustment takes place only through changes in domestic credit, while net foreign liabilities are weakly exogenous. For Portugal, domestic credit adjusts, while there may or may not be adjustment in the other direction. For Spain, the estimations reveal a bidirectional relationship where domestic credit and net foreign liabilities adjust when there are deviations from the cointegrating relationship.

The conclusion is that Ireland followed a unique pattern before the crisis and showed rapid leveraging without a corresponding accumulation of net foreign liabilities. The south European GIIPS countries, meanwhile, exhibited many similarities. Their pre-crisis leveraging was accompanied by an accumulation of net foreign liabilities, and foreign capital inflows appear to have contributed to the pre-crisis leveraging for all four southern European crisis countries. The liberalisation of capital flows in Europe in the 1980s, the

introduction of the euro in the late 1990s and the global savings glut in the 2000s facilitated capital inflows to countries in the European periphery. Foreign capital inflows to the southern GIIPS countries appear to have contributed to the Great Leveraging in these countries in the decade before the outbreak of the global financial crisis.

Several policy implications follow from the analyses in this paper. One key message is that surveillance seeking to pre-empt excessive credit growth should also include surveillance of external balance measures such as the current account balance. Large current account deficits and growing net foreign liabilities might indeed be a sign of rapid and possibly unstainable credit growth. Internal and external imbalances are tied closely together in many countries.

The interlinkages between capital flows and domestic credit growth suggest that policies aiming to hinder or slow down the accumulation of excessive domestic credit levels should include measures targeting international capital flows such as exchange rate policies and macro-prudential rules. Measures to trim current account deficits may thus also be conducive to financial stability.

A final policy implication is that there appears to be substantial heterogeneity across European countries, even countries that all experienced financial crises after the Great Leveraging. The differences between the countries pertains both to the causes of the Great Leveraging and to the estimated relationships between domestic credit and net foreign liabilities. This heterogeneity suggests that surveillance measures and policies aiming to ensure financial stability should be tailored specifically to the individual countries.

Acknowledgments

Notes

1. Rapid domestic credit growth may help predict financial crises (Gourinchas and Obstfeld, 2012; Taylor, 2013; Jordá *et al.*, 2013; Jordá *et al.*, 2015). Large current account deficits may similarly be a predictor of financial instability in the future (Obstfeld, 2012a, b; Reinhart and Reinhart, 2008; Lane and Milesi-Ferretti, 2010, 2012). Finally, Davis *et al.* (2016) find that banking crises are more prevalent in a situation with high rates of credit growth and large current account deficits.

2. Carvalho (2014) discusses the definitional links between capital flows, the money stock and domestic credit. The linkages between external capital flows, domestic credit and money are indeed at the core of the IMF monetary model (Polak, 1998).

3. Bruno and Song (2014) link the two variables through the risk-taking behaviour of commercial banks at different stages of the business cycle.

4. Samarina and Bezemer (2016) observe that capital inflows lead to increased domestic credit and increased lenging to the household sector, especially in countries with few investment opportunities.

5. The interpolation entails adding the current account balance to the net international investment position quarter-by-quarter. Since there is typically a discrepancy between the fourth quarter value of the interpolated net international investment position and the published data, the discrepancy is spread proportionately over the interpolated data of the first, second and third quarters.

6. Test of the time series properties of variables such as interest rates and inflation rates suggest that these variables typically are stationary in the time period considered and they would thus not belong to any cointegrating vector.

7. The impulse responses have been computed using the software JMulti, ver. 4. A similar pattern for the confidence intervals was found using the method of Efron and Tibshirani (1993).

8. We have also computed impulse responses using simple Cholesky decomposition, but the results are qualitatively in line with those in Figure 2. This finding is consistent with the correlation coefficients reported in Table AII, being small.

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Appendix

	Greece		Italy		Portugal		Spain	
	L1CR	L1NFL	L1CR	L1NFL	L1CR	L1NFL	L1CR	L1NFL
L1CR	5.209	−1.878	8.379	5.549	4.489	−1.741	3.689	2.438
L1NFL	−1.878	15.124	5.549	16.829	−1.741	5.608	2.438	15.496

Note: All values in the table must be divided by 100,000

Table AI.
Residual variance-covariance matrix

	Greece		Italy		Portugal		Spain	
	L1CR	L1NFL	L1CR	L1NFL	L1CR	L1NFL	L1CR	L1NFL
L1CR	1.000	−0.212	1.000	0.148	1.000	−0.347	1.000	0.322
L1NFL	−0.212	1.000	0.148	1.000	−0.347	1.000	0.322	1.000

Table AII.
Residual correlation matrix

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