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Sovereign exposures in the Portuguese banking system: determinants and dynamics

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Abstract
This paper studies the dynamics of the exposure of the Portuguese banking system to the domestic public sector over 2008-2016 and assesses possible underlying motivations. The analysis relies on a new dataset built from granular information that provides full coverage of the Portuguese banking sector and the public sector. The results suggest that moral suasion was an important driver of the evolution of sovereign exposures during the euro area crisis: domestic banks provided financing to the sovereign when the Treasury needed to issue debt amidst rising yields and, although to a smaller extent, when State-Owned Enterprises faced funding shortages in international markets. Moreover, increases in central bank funding are also related to increases in holdings of sovereign debt securities. These findings mainly hold for medium-sized and large banks. In contrast, we find no evidence of gambling for resurrection behaviour by banks with lower prudential capital or depressed profitability.

JEL: C23, G01, G21, H63

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1. Introduction

The bank-sovereign nexus played a pivotal role in the euro area sovereign debt crisis and has remained in the spotlight of policy and academic fora ever since. In 2010, when sovereign spreads started to soar in some vulnerable countries, tensions were swiftly transmitted to the respective banking sectors. Facing a sudden stop in market funding, banks in these countries became increasingly reliant on Eurosystem liquidity, while sovereigns became more dependent on domestic banks as purchasers of public debt. Against a backdrop of already fragile fiscal positions, public finances in some countries were hampered by government support to banking institutions in order to avoid further systemic stress.

These adverse feedbacks were clear in the case of Portugal. In the run-up to the country´s Financial Assistance Programme (requested in May 2011; henceforth the Programme), bank holdings of domestic public debt recorded one of the steepest rises in the euro area and, over the past decade, support to the financial sector has heavily weighed on the general government accounts. Mirroring these developments, the creditworthiness of the Portuguese sovereign and banks have been closely intertwined. Figures A.1 to A.3 in the Appendix provide graphical evidence for these developments.

Benefiting from very detailed data sources, we have assembled an original dataset which provides full coverage of banking sector bond and loan exposures to the domestic public sector, as well as to debt securities issued by other European Union sovereigns. Focusing on banks operating in Portugal, this new dataset is used to document the evolution of those exposures over the last decade and to assess their underlying motivations on the basis of the main channels pointed out in the literature: moral suasion, liquidity and carry-trade. For instance, the contrasting behaviour of domestic and foreign banks provides strong motivation for assessing the role of moral suasion as a driver of exposures to the public sector. The prospect of high returns on sovereign bonds of countries under market pressure could also be an incentive for holdings, especially if the concomitant high risk is not fully internalised by banks and if there are few other profitable business opportunities.

Our main results can be summarised as follows. Over 2008-2016, we find strong evidence of moral suasion mechanisms in driving the evolution of sovereign exposures, particularly in the most acute phases of the euro area crisis: when the Treasury needed to issue debt amidst rising yields, domestic banks bought Portuguese sovereign debt securities to a greater extent than foreign banks. Additionally, when yields fell and thus bond prices recovered, foreign banks decreased their holdings of government bonds relative to domestic banks. We also find that periods of increases in central bank funding seem to be associated with increases in bank holdings of sovereign debt securities, particularly as regards medium-sized and large banks. This suggests an appetite for investing in an asset that could offer an attractive yield and be pledged as collateral, thus enabling banks to obtain liquidity in times of trouble. We find no evidence that weakly capitalised or less profitable banks were more likely to be driven by carry-trade incentives in

adjusting their exposures to sovereign debt securities. When it comes to exposures to State-Owned Enterprises (SOEs), evidence suggesting moral suasion mechanisms is not as strong, but it is still significant: we find that domestic banks have contributed more than their foreign-owned counterparts to finance those firms in months characterised by a sharper reduction in external funding to SOEs.

The next section presents a review of the literature. Section 3 describes the dataset. Section 4 presents the results of the econometric modelling of exposures to general government, and Section 5 does similarly for exposures to SOEs. Section 6 concludes.

2. An overview of the literature

Since the outset of the sovereign debt crisis, a vast literature on the interactions between banks and governments, with both theoretical and empirical approaches, has emerged.

Uhlig (2014) and Farhi and Tirole (2018) developed models for the relationship between banks, governments and regulators. In both set-ups, national regulators in riskier countries face incentives to be more lenient regarding domestic sovereign holdings by banks. Banks also face incentives to increase their holdings as the losses from a potential sovereign default are expected to be shared with other countries (or the monetary authority, as in Uhlig (2014)). According to the model presented by Gennaioli *et al.* (2014), increasing sovereign exposure is an optimal decision from banks' viewpoint, as it is a way to store liquidity. Ari (2018) develops a model showing that undercapitalised banks have an incentive to increase exposures as a form of carry-trade, in an attempt to "gamble for resurrection".

Our analysis is more closely related to the empirical literature on the bank-sovereign nexus. An important contribution was made by Erce (2015), who analysed CDS data for euro area countries and found evidence of a strong feedback relationship between sovereign and bank risk, especially in countries with higher public debt and a financial sector with a stronger home bias. Battistini *et al.* (2013) use a vector error-correction model to assess the relationship between sovereign yields and home bias in the balance sheets of banks in ten euro area countries. Their results point to a positive relationship, particularly in the case of periphery countries. Moreover, the authors find evidence that, in both core and periphery, banks increase exposures to the domestic sovereign in response to an increase in the systemic component of sovereign yield differentials. Increases in the country-specific risk component, in contrast, result in higher domestic exposures only in the case of periphery countries. This is consistent with evidence provided by, among others, Becker and Ivashina (2018), Horváth *et al.* (2015), Altavilla *et al.* (2017), Ongena *et al.* (2016) and Marco and Macchiavelli (2016), who have documented a particularly strong home bias in sovereign debt holdings during the euro area crisis in the case of risky, fiscally distressed sovereigns. Overall, these studies point to government ownership, political connections and public bailouts

as further determinants of the surge in sovereign exposures in this period, especially in the case of undercapitalised banks. This is in line with the hypothesis that moral suasion by the government is a lead channel transmitting risk from the sovereign to the banking sector.

In addition to moral suasion, Battistini *et al.* (2013), Acharya and Steffen (2015) and Altavilla *et al.* (2017) also emphasize the role of banks' carry-trade behaviour. Again, empirical evidence suggests that undercapitalised banks in peripheral countries are more likely to engage in such practices, in line with a gambling for resurrection argument. By contrast, Lamas and Mencía (2019) show that, in the case of significant Spanish banks, there is no clear evidence of carry-trade behaviour by weakly capitalized institutions. If anything, their results suggest that such opportunistic behaviour would be more likely in the case of well-capitalised banks which would be in a better position to cushion adverse shocks stemming from 'search-for-yield' practices.

Liquidity considerations are a further motivation for holding public sector debt. Banks may wish to hold sovereign bonds as a way to build up collateral and access Eurosystem liquidity, since in general those bonds are eligible collateral with low haircuts. In turn, banks may use central bank liquidity to invest in high-yield Treasury bonds (Crosignani *et al.*, 2019; Drechsel *et al.*, 2016; Lamas and Mencía, 2019), effectively engaging in carry-trade behaviour. The liquidity provided by the 3-year Long Term Refinancing Operations of the European Central Bank (in December 2011 and February 2012) arguably gave rise to this kind of behaviour (Horváth *et al.*, 2015; Crosignani *et al.*, 2019). Lamas and Mencía (2019) point out that, at least in the case of Spanish banks, financial fragmentation within the Monetary Union is also relevant to understand the evolution of banks' sovereign exposures. In particular, they argue that perceived risks of redenomination provide incentives for banks to increase the share of domestic assets in their portfolios.

Finally, it is worth highlighting a further strand of literature focusing not only on the determinants but also on the consequences of the adverse loop between sovereigns and banks. Altavilla *et al.* (2017) provide evidence that, in those countries most hit during the crisis, more exposed banks experienced higher increases in solvency risk, stronger contraction in lending to non-financial corporations and higher rises in lending rates than less exposed peers. The results therein also point to moral suasion mechanisms amplifying these effects. This is consistent with results obtained by Acharya *et al.* (2018) and Popov and Van Horen (2015), according to which lending by heavily exposed banks declined persistently, particularly as regards credit to foreign firms. Acharya *et al.* (2018) indeed signal that expansion of banks' sovereign debt holdings for gambling for resurrection purposes contributed to a crowding-out of private lending during the crisis.

3. A new dataset on bank exposures to the public sector

We have assembled a unique dataset built from different data sources which allows for an exhaustive coverage of domestic public sector exposures of the Portuguese banking system. In particular, we use Banco de Portugal's Securities Statistics Integrated System (SSIS) and Central Credit Register (CCR) to collect end-of-month information on security holdings and loans recorded on the balance sheet of every monetary financial institution (MFI) and having as counterpart any domestic public sector entity over 2008-2016, which is our sample period for econometric analysis. Additionally, we also get information on the bond exposures of each resident MFI to entities belonging to the general government of each of the other EU countries from securities statistics. This allows us to work with a dataset containing individual exposures of each bank to each public sector entity. This ensures better bank coverage, and thus better account of bank heterogeneity, than relying on a limited sample of (mostly) large banks.[1] It also yields better coverage of public sector counterparts. Instead of only taking general government as a whole, as often in the literature, we can also study exposures to state-owned enterprises (SOEs) outside the general government, and to consider different subsets within the general government or the public sector.

We use data on both exposure stocks and flows (*i.e.* net transactions). The change in stocks can differ from flows due to a number of adjustments, such as changes in prices, write-offs of assets, and reclassifications of public sector units. Our source for securities holdings (SSIS) includes information on both stocks (at book value) and net transactions (at market value). In contrast, the credit register only includes stocks of loans and, in this case, net transactions have been computed as the change in stocks, correcting for write-offs and exchange rate fluctuations.

Our dataset contains 82 monetary financial institutions (henceforth loosely referred to as "banks") over the 2008-2016 period, 42 of which are banks or savings banks (including foreign subsidiaries), 6 are mutual agricultural credit banks, 26 are branches of credit institutions located in or outside the European Union (EU) and 8 are money market funds. Table 1 gives the distribution of banks by size and country of (majority) ownership.

We have also distinguished public from private ownership and identified institutions for which support by the Portuguese government was provided, either through equity injections or the granting of guarantees. Additionally, our dataset covers accounting and prudential attributes, such as balance sheet structure, solvency and liquidity. All data refers to banks on an individual basis (*i.e.* non-consolidated).[2]

1. Studies using the EBA stress tests or the ECB´s Individual Balance Sheet Items (IBSI) dataset as sources for sovereign exposures (*e.g.* Ongena *et al.*, 2016; Altavilla *et al.*, 2017; Marco and Macchiavelli, 2016) indeed cover only a limited sample of large banks.

2. We have aggregated 106 "Caixas de Crédito Agrícola Mútuo" which are part of an integrated system, Sistema Integrado de Crédito Agrícola Mútuo (SICAM), into its Head Office, Caixa Central

	Domestic	Foreign
All institutions	42	40
Large: Maximum assets $\geq$ EUR 10 bn	8	3
Medium: EUR 10 bn $>$ Maximum assets $\geq$ EUR 2.5 bn	7	9
Small: EUR 2.5 bn $>$ Maximum assets $\geq$ EUR 1 bn	8	9
Very small: Maximum assets $<$ EUR 1 bn	19	19

Table 1. Dataset: breakdown of banks, by size and country of ownership

Source: Banco de Portugal and authors' calculations.
Notes: This table refers to all institutions operating in Portugal that had, at least for one month, outstanding exposures to the Portuguese public sector during 2008-2016. It includes banks, savings banks (including foreign subsidiaries), branches of credit institutions located in or outside the European Union (EU) and money market funds. It excludes 105 Caixas de Crédito Agrícola Mútuo, which belong to domestic banking group SICAM (Sistema Integrado do Crédito Agrícola Mútuo), headed by Caixa Central de Crédito Agrícola Mútuo. Banks are classified as domestic in case a majority of capital is held by Portuguese shareholders as of 31 December 2016, with the remaining banks being classified as foreign. Classification by size was made in accordance with the maximum value of total assets in 2008-2016.

We cover all domestic public sector counterparts, thus comprising entities classified within the general government, but also entities held by the State or other public bodies classified in a different national accounts institutional sector (*e.g.* non-financial corporations). Over 2008-2016, our dataset includes 3,409 public sector units – all those which, at some point in that period, had either outstanding securities held or loans granted by banks operating in Portugal. The only exception to this universal coverage refers to banks´ exposures to public sector banks, which we exclude from the analysis.[3]

Public sector entities are classified according to two criteria. First, we identify whether they are SOEs. In the absence of a national accounts identification criterion, we take as SOEs all public sector units outside general government, as well as those inside general government with a corporate nature, identified on the basis of statutory criteria. Second, we classify general government units according to the respective subsector[4] (*i.e.* central government, regional governments, local

de Crédito Agrícola Mútuo, which we have treated as a single institution. To ensure consistency, solvency, liquidity and profitability variables refer to information on a consolidated basis at the level of the Head Office.

3. One reason for doing so is dataset consistency, since we have information on bond holdings but bank loans to other banks are not reported in the credit register.

4. In the case of non-general government public entities, we identify the subsector of the controlling unit (*e.g.* local government, in the case of a public enterprise owned by a municipality).

governments and Social Security funds). Figure A.4 in the Appendix provides a representation of the Portuguese public sector.

The set of public sector entities is time-varying: units are created, merged, shut down, or reclassified. For instance, during our sample period many SOEs were reclassified from the non-financial corporations sector to the general government, while some others were privatised and hence left the public sector. Monetary and financial statistics, among other datasets, adopt a real-time delimitation of general government: in each month, the national accounts criteria in force define the set of entities to be included. As a consequence, reclassifications induce variation in stocks unaccounted for by corresponding flows.

In our dataset we use two alternative criteria for defining the perimeter of the public sector (and, within it, of the general government): the real-time delimitation as previously described, and a perimeter corrected for reclassifications, which is the baseline approach in this paper (although the real-time delimitation is sometimes used for specific analyses).

In defining the general government perimeter corrected for reclassifications, we assume that units that are in any of the statistical authorities' official lists of public sector entities referring to 2016 (one list for general government units, and another for units outside general government) have belonged to the public sector since 2008. Moreover, units are allocated throughout the whole 2008-2016 period to their 2016 subsector. For instance, an SOE reclassified into general government in 2012 is included in that sector since the outset (2008), and an SOE privatised in 2014 is never included in the public sector. Entities that are extinct (or merged into others) at some point between 2008 and 2016 are included in the analysis while operating and, throughout this period of operation, are assumed to have remained in the institutional sector in which they were last classified. This set of assumptions implies that the composition of the public sector and of general government changes due to the creation or extinction of units, but not due to reclassifications. The latest large wave of reclassifications took place in 2014, following the implementation of the ESA2010 accounting framework, and essentially closed the gap between the two approaches. In December 2016, the two approaches are identical by construction. Further details on the assumptions underlying the definition of the general government delimitation corrected for reclassifications may be found in Campos *et al.* (2019). Throughout this paper, all charts, tables and analyses are based, unless otherwise indicated, on the perimeter corrected for reclassifications.

This dataset provides valuable insights on the evolution of the exposures of banks operating in Portugal to the Portuguese public sector. It shows, in the first place, that these exposures sharply increased over 2008-2016. Moreover, exposures to the general government drive the bulk of the increase in public sector asset holdings, rising markedly in 2009-2011 and broadly stabilising afterwards. Though smaller, exposures to public entities outside the general government are far from negligible (Figure 1). Likewise, exposures to the general governments of other EU countries are not irrelevant and have gained significance since 2013 (Figure 2).

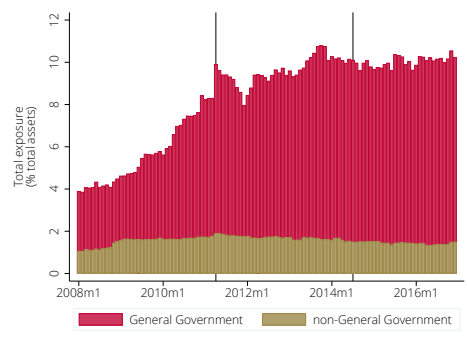


Figure 1: Total exposure to the domestic Public Sector

Source: Banco de Portugal and authors' calculations.
Notes: Exposure computed as the sum of every institution's stock of public sector debt (both loans and securities) as a ratio to the sum of assets in all institutions' balance sheets. Vertical lines mark May 2011 and June 2014 (beginning and end of the Programme).

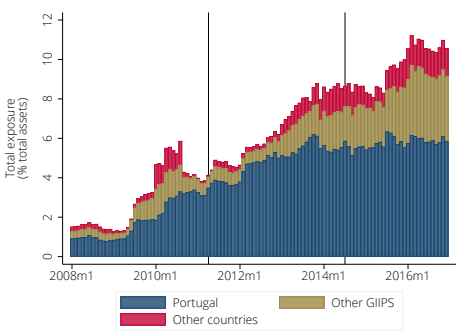
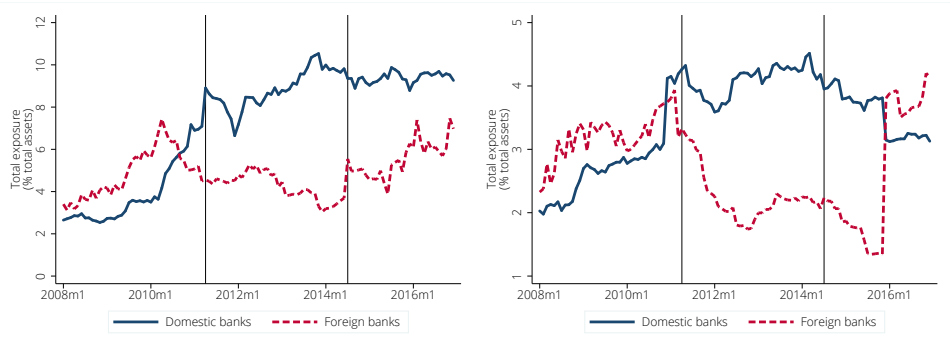


Figure 2: Total exposure to Treasury securities of EU countries

Source: Banco de Portugal and authors' calculations.
Notes: Exposure computed as the sum of every institution's stock of Treasury debt securities as a ratio to the sum of assets in all institutions' balance sheets. Vertical lines mark May 2011 and June 2014 (beginning and end of the Programme). GIIPS stands for Greece, Ireland, Italy, Portugal and Spain.

The dynamics of banks' exposures vary depending on the type of banks, as well as on the Portuguese public sector segment considered. For instance, certain exposures of domestic and foreign banks (both operating in Portugal, but with the majority of capital held by foreign shareholders in the latter case) followed divergent paths at certain points in time. This was the case with exposures to the general government in the run-up to the Programme (panel (A) of Figure 3), and with exposures to SOEs after it started (panel (B) of Figure 3). A companion piece documents in greater detail the construction of the dataset and the dynamics of aggregate exposures (Campos *et al.*, 2019).

Starting from the fact that public sector exposures in banks' balance sheets increased significantly over 2008-2016, this paper analyses the dynamics and determinants of such development. When modelling different drivers, we take advantage of the richness of our dataset in a variety of dimensions. To give a few examples, we can investigate whether a certain effect holds in different sub-periods of our 2008-2016 total sample, how bank size matters for sovereign exposures or if certain motivations apply to both domestic and foreign sovereign bonds. We will do so in the next section.



(a) Total exposure to the general government

(b) Total exposure to SOEs, in and outside the general government

Figure 3: Total exposure to public entities

Source: Banco de Portugal and authors' calculations.
Notes: Exposure computed as the sum of every institution's stock of public sector debt (both loans and securities) as a ratio to the sum of assets in all institutions' balance sheets. The increase in the exposure by foreign banks at the end of 2015 is influenced by the fact that, in the context of a resolution measure, a foreign institution took over a domestic institution. Vertical lines mark May 2011 and June 2014 (beginning and end of the Programme).

4. Modelling bank exposures to general government bonds

In this section we analyse the empirical relevance of the different incentives identified in the literature for banks to buy and sell sovereign bonds. As with any other market, government bonds market developments depend both on supply and demand pressures. On the one hand, government issuances are not constant in time and may depend on many factors such as funding needs and cost optimisation. On the other hand, economic agents and, among them, banks optimise their balance sheets with respect to many factors, such as liquidity and returns and these are also time-varying.

Furthermore, banks' creditworthiness is usually perceived to be linked to their sovereign, notably when their core business is domestic and there is the impression that if worse comes to worst, sovereigns bailout their banks. Notable developments have occurred since 2008, specifically in what concerns the establishment of a EU-wide legal resolution framework, the reinforcement of banking regulation (single rule book) and the setting up of a Banking Union in the euro area, all of which contribute to disentangling sovereigns and banks. However, these developments are still being implemented and warrant further advances to fully enable an effective Banking Union, namely by fully implementing the decision to establish the ESM as backstop to the Single Resolution Fund and by agreeing and establishing an euro area deposit insurance guarantee scheme. The link between sovereign and banks, still manifest and present during the period under analysis, helps explaining moral suasion, one

of the channels we assess. In a context where the sovereign may face difficulties in finding enough demand for its funding needs, banks, the creditworthiness of which is deemed to be linked to the sovereign, may have incentives to fill in the gap. Simultaneously, in a sluggish economic environment, banks may struggle to find investments for which the risk-return relation is more appealing than sovereign bonds of a higher-yield country. Hence, in difficult times, both for the sovereign and for the economy as a whole, it is likely that domestic banks have the incentive to stand by their sovereign and finance its needs, acting in this way as a buffer, but also in a way that does not worsen their own creditworthiness and funding costs.

The possible usages of sovereign bonds by banks are manifold.[5] Among these, their usage as collateral and quick retrieval of liquidity ranks high, since in many jurisdictions these securities tend to be the most liquid assets. Moreover, in a context of low policy interest rates, higher-yield sovereign debt securities can also be quite appealing from a profitability viewpoint, thus a good investment in terms of the risk-return trade-off. Finally, sovereign debt securities can be held by banks for regulatory reasons, since not only does the regulatory framework ascribe them a more favourable treatment in terms of capital requirements, but they are also required as part of a buffer of liquid assets.[6]

Drawing on the manifold motives for banks to hold sovereign debt securities, we test whether incentives related to liquidity and return could have played significant roles in driving banks' sovereign bond exposures. Notwithstanding the fact that regulation might also have influenced banks´ incentives, testing its role proved unfeasible, since there were too many regulatory changes and add-on requirements

5. We will only touch upon some of these usages, which are of particular importance to the paper. For a broader perspective, see BCBS (2017).

6. Although this requirement was still being phased-in in the European Union during our period of analysis.

throughout the period under analysis.[7] This is, nevertheless, accounted for insofar we factor in time fixed effects in every regression.

Moral suasion, liquidity and carry-trade motivations are first dealt with separately (sections 4.1 to 4.3) and then modelled together (section 4.4). In all regressions, the dependent variable is the net flow of exposures by bank i in month t, relative to the stock of exposures in the previous month: $\frac{flow_{it}}{stock_{it-1}}$.

By taking the flow rather than the change in the stock of exposures ($\Delta stock$), we net out changes in holdings due to valuation effects or other adjustments. Outliers are excluded by trimming the dependent variable to the [-1; 1] interval. We include bank and time fixed effects to control for unobserved time-invariant bank heterogeneity and time-varying factors common to all banks, such as macroeconomic and regulatory conditions. Furthermore, we include bank-specific balance sheet controls, all lagged three months: the logarithm of total assets, and the ratios of deposits to assets, loans to deposits and capital and reserves to assets.[8] Unless otherwise indicated, the sample period is 2008m1 – 2016m12 and estimation is done by Ordinary Least Squares (OLS), with standard errors clustered at the bank level. Banks´ exposures to securities issued by public sector banks (*e.g.* holdings of own securities by state-owned banks) are excluded for dataset consistency reasons, as loans to other banks are not reported in our data source for loans.

Furthermore, since banks differ widely in size, and the behaviour of the largest ones has greater aggregate relevance, equations are by default estimated for a sample of large and medium-sized banks, as previously defined. Sensitivity analyses will also consider smaller banks. Table A.1 in the Appendix provides descriptive statistics for the main variables pertaining to banks used in the regressions below. Graphical illustrations of some other covariates can be found in the Appendix.

7. The last decade witnessed significant regulatory changes in terms of own funds requirements. From a more structural perspective, there were changes introduced in terms of definitions and requirements by the Capital Requirements Regulation/Capital Requirements Directive IV (CRR/CRD IV package) – Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms. Moreover, there were many policy decisions throughout that period, of which we provide some examples. In 2008, Banco de Portugal recommended credit institutions to strengthen their Tier 1 ratio to a level above 8% (on a consolidated and individual basis). In 2011, Banco de Portugal required banking groups and credit institutions to strengthen their Core Tier 1 ratio (national definition) to 9% and then 10% (consolidated basis and individual basis for stand-alone credit institutions). In 2011, the EBA recommended banking groups to constitute a buffer for sovereign exposures in order to uphold a Core Tier 1 ratio (EU definition) of 9%, including a buffer for sovereign risks. Banco de Portugal adopted this recommendation by issuing a requirement for the 4 largest banking groups. In 2013, the EBA recommended the previous buffer to be maintained during the transition period until the implementation of the CRD IV/CRR. In 2013, Banco de Portugal required credit institutions to maintain a Common Equity Tier 1 ratio (CET1) of, at least, 7% (consolidated basis and individual basis for stand-alone credit institutions).

8. This choice of bank-specific controls follows Ongena *et al.* (2016), though they use a 12-month lag.

4.1. Moral suasion

To assess the relevance of moral suasion incentives, we follow Ongena *et al.* (2016) and test whether domestic banks, relative to their foreign counterparts, tend to purchase more domestic general government securities when Treasury financing is more challenging. Difficult times for the domestic Treasury are identified on the basis of a double criterion: adverse market conditions and the need to auction new debt. In stressful conditions, an undersubscribed auction not only deprives the Treasury of resources but is also likely to heighten market concerns about the sovereign's solvency, with an ensuing rise in funding costs for both the Treasury and domestic banks. The latter have therefore a strong interest in helping avoid that outcome.

In line with the above discussion, we restrict the dependent variable to refer only to general government securities and estimate the following baseline specification:

$$\begin{aligned}\frac{flow_{it}}{stock_{it-1}} =& \beta_0 + \beta_1(domestic_{it} \times FundingNeed_t \times \Delta yield_t) + \\ &+ \beta_2(domestic_{it} \times FundingNeed_t) + \beta_3(domestic_{it} \times \Delta yield_t) + \\ &+ \boldsymbol{X}_{it-3}^T\theta + \gamma_i + \delta_t + \varepsilon_{it} \qquad (1)\end{aligned}$$

The triple interaction on the right-hand side contains two indicator variables for whether bank i is domestic[9] in month t and for whether the Treasury needs market financing in month t. This $FundingNeed$ dummy takes value one in months when an auction of medium- and long-term Treasury bonds ("Obrigações do Tesouro") took place (there were 43 such months out of a sample total of 108). The triple interaction also comprises the monthly change in 10-year sovereign bond yields (in percentage points). Vector $\boldsymbol{X}_{it}$ includes all bank-specific balance sheet controls.

To capture challenging times for Treasury financing we resort to the dynamics of 10-year sovereign bond yields, as Altavilla *et al.* (2017) have done.[10] A different approach, taken by Ongena *et al.* (2016), would be to restrict the estimation period to the most acute phase of the sovereign debt crisis, or, if using a wider sample, to include a dummy for that phase in a triple interaction.

Positive values for our main parameter of interest, β_1, would lend support to the moral suasion hypothesis, meaning that, all else equal, domestic banks tend to buy more sovereign securities when the Treasury is in need and yields rise. Table 2 shows that this is indeed the case. In column 1, which reports results for the above baseline specification, the coefficient on the triple interaction reaches 0.18

9. In the large majority of banks the $domestic$ variable stays constant throughout the sample period, and therefore this variable is not included on its own in the regressions due to the inclusion of bank fixed effects.

10. More precisely, they use the percentage change in the price of sovereign debt, computed as the product of the change in yield by the corresponding duration.

and is highly significant: all else constant, if 10-year sovereign yields rise by 50 basis points (approximately the standard deviation of $\Delta yield$ in our sample period) in an auction month, domestic banks are estimated to increase their holdings to an extent that is 9 per cent higher than that of comparable foreign banks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dom. × Fund. need × Δ yield	0.18***			0.19***	0.09	0.20***	-0.04
	(2.91)			(3.09)	(1.01)	(3.40)	(-0.92)
Dom. × Fund. need × Δ yield>0		0.20**					
		(2.27)					
Dom. × Fund. need × Δ yield<0		0.06					
		(0.40)					
Dom. × Fund. need	-0.03	-0.04	-0.02	-0.01	-0.06	-0.01	0.02
	(-1.34)	(-1.58)	(-0.76)	(-0.22)	(-1.60)	(-0.59)	(1.11)
Dom. × Δ yield	-0.03			-0.03*	-0.01	-0.02	0.02
	(-1.62)			(-1.80)	(-0.26)	(-1.70)	(0.96)
Dom. × Δ yield>0		-0.00					
		(-0.07)					
Dom. × Δ yield<0		-0.05**					
		(-2.28)					
Observations	2022	2022	2022	1112	910	2022	2022
R^2	0.11	0.11	0.10	0.13	0.11	0.11	0.10
N. banks	24	24	24	24	19	24	24
Definition of Funding Need	Auct.	Auct.	Auct.	Auct.	Auct.	Large Auct.	Synd.

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2. Moral suasion estimates for domestic general government exposures

Notes: All regressions include banks' balance sheet controls and time and bank fixed effects. The estimation sample is 2008m1-2016m12 except in col. 4 (2008m1-2012m7) and col. 5 (2012m8-2016m12). The funding need dummy takes value 1 in months of auctions (columns 1 to 5), auctions with above-median amounts (column 6) or syndicated issuance (column 7). See text for further detail.

The above interpretation of a positive β_1 coefficient as evidence of moral suasion has in mind times of rising yields. Column 2 allows for different coefficients on the interactions with positive and negative values of $\Delta yield$, and confirms that yield increases, rather than decreases, are indeed behind the significance of β_1. Allowing for different coefficients uncovers a further interesting finding: when yields fall, domestic banks increase their holdings relative to foreign banks ($\beta_3 < 0$). This could be due to more aggressive sales by foreign banks when bond prices recover.

The interaction $domestic \times FundingNeed$ alone does not reach statistical significance and even presents a negative sign (column 3), which underlines the importance of *both* debt issuance needs *and* market stress for the moral suasion hypothesis. Interestingly, the interaction coefficient remains insignificant if the estimation sample is restricted to May 2010 – August 2012 (not reported), the period used by Ongena *et al.* (2016) in the case of Portugal. To check whether

moral suasion holds in different periods, we have re-estimated Equation (1) in two subsamples, one up to July 2012 (when Mario Draghi delivered his renowned "whatever it takes" speech) and other for the subsequent period. As it could be expected, columns 4 and 5 confirm the significance of β_1 in the former subsample but not in the latter, when the worst of the sovereign debt crisis was already over.

We have also considered alternative definitions of the $FundingNeed$ variable. First, we have restricted it to equal one only if allotted amounts in a given auction exceed the median of the sample period distribution. The significance of β_1 is slightly reinforced, both numerically and statistically (column 6). Second, we have taken syndicated debt issuance instead of auctions. The coefficient on the triple interaction loses significance and even changes sign (column 7), in line with the safer, more controlled nature of this kind of issuance.[11]

Unlike Ongena *et al.* (2016), we have not taken debt redemptions as an indicator of Treasury refinancing needs. As far as exogeneity is concerned, redemption dates, often pre-determined a long time ago, seem indeed a better choice than auction dates. However, there are several important counterarguments. First, given our focus on medium- and long-term bonds, the number of months with maturing debt is fairly limited (only 13 over 2008-2016).[12] Second, the exogeneity of redeemed amounts on maturity is undermined by the fact that the Portuguese Treasury often carries out early redemptions through reverse auctions. Finally, as Ongena *et al.* (2016) acknowledge, auctions may capture better than redemptions the sovereign´s need to pressure banks to buy debt.

Having found empirical support for the moral suasion hypothesis, we investigate the role played by a number of bank characteristics. Column 2 in Table 3 reruns Equation (1) only for a sample of small and very small banks. Relative to column 1 (which repeats results obtained for large and medium-sized banks), the numerical and statistical significance of β_1 decreases. This decrease appears to suggest that, due to their limited ability to intervene, the incentives for smaller banks to step in to ensure enough demand in an auction are smaller.

We also analysed whether banks acting as primary dealers could also matter. It could be the case that some domestic banks are buying large amounts of debt in auctions simply on behalf of other buyers with no access to the primary market of Treasury bonds.[13] However, this would seem unlikely, since many primary dealers are foreign banks which do not even operate in Portugal (and hence are not in our

11. If instead $FundingNeed$ is redefined to take value one in months of either auctions or bond syndications, the significance of β_1 is preserved but weakened compared to column 1.

12. If short-term bonds (Treasury bills) were also considered, the exogeneity of redemption dates would be weakened (Ongena *et al.*, 2016).

13. We take as primary dealers banks which are either OEVT (*Operadores Especializados de Valores do Tesouro*) or OMP (*Operadores de Mercado Primário*). See www.igcp.pt for further information. Econometric results are qualitatively similar if a stricter definition (OEVT only) is adopted.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dom. × Funding need × Δyield	0.18***	0.10**	0.18***	0.18**		0.13*	0.04	0.01
	(2.91)	(2.72)	(3.06)	(2.66)		(1.84)	(0.67)	(0.27)
Dom. × Funding need	-0.03	-0.02	-0.03	-0.03		-0.04**	0.02	-0.01
	(-1.34)	(-0.85)	(-1.37)	(-1.24)		(-2.34)	(0.62)	(-0.38)
Dom. × Δ yield	-0.03	-0.02	-0.03*	-0.03		-0.01	-0.01	-0.01
	(-1.62)	(-0.67)	(-1.72)	(-1.46)		(-0.77)	(-0.27)	(-0.54)
Prim. dealer × Funding need × Δ yield			-0.05					
			(-0.99)					
Prim. dealer × Funding need			0.02					
			(1.11)					
Prim. dealer × Δ yield			0.02*					
			(1.75)					
Prim. dealer			-0.03**					
			(-2.30)					
Pub. intervention × Funding need × Δ yield					-0.01			
					(-0.34)			
Pub. intervention × Funding need					0.01			
					(0.27)			
Pub. intervention × Δyield					0.00			
					(0.31)			
Pub. intervention					-0.05**			
					(-2.54)			
Observations	2022	1944	2022	1432	1386	1920	1185	1752
R^2	0.11	0.10	0.12	0.13	0.15	0.11	0.13	0.26
N. banks	24	28	24	22	15	23	21	24
Excludes foreign banks	NO	NO	NO	NO	YES	NO	NO	NO
Excludes public or supported banks	NO	NO	NO	YES	NO	NO	NO	NO
Bank size classes	L+M	S+VS	L+M	L+M	L+M	L+M	L+M	L+M
Exposures considered	B S13	B S13	B S13	B S13	B S13	B Tr.	B rS13	L S13

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3. Moral suasion estimates for domestic general government exposures

Notes:All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12. Col. 2 considers a sample of small and very small banks, while all the others take a sample of large and medium-sized banks. The exposures considered are general government (S13) bonds (columns 1-5), Treasury bonds (column 6), rest of S13 bonds (column 7), and loans to S13 (column 8). See text for further detail.

sample). Indeed, column 3 shows that controlling for primary dealer status leaves results virtually unchanged.

Among domestic banks, there is no evidence that state-owned ones, or banks having benefitted from public support during the crisis (either in the form of recapitalisation or guarantees on bond issuance), behaved differently from other institutions. Results are essentially unchanged if public or publicly supported banks are excluded from the sample[14] (column 4). When restricting attention to domestic banks (column 5), public or publicly supported institutions seem, if anything, *less* likely to purchase domestic general government securities (in general, and not just in challenging times, as interaction terms are not significant).

The absence of a stronger moral suasion channel for public or publicly supported banks runs counter to evidence from cross-country studies (Ongena *et al.*, 2016; Altavilla *et al.*, 2017), but can be at least partly explained by the duration of State guarantees and the timing of public recapitalisations. For the vast majority of institutions that issued bonds with public guarantees, these lasted way beyond the most acute phase of the sovereign crisis, with many issuances coming to maturity only in 2015. In turn, public recapitalisation of banks only started in June 2012, at a time when the bulk of public guarantees (including those to the recapitalised banks) had already been granted.

The three final columns of Table 3 clarify that Treasury bonds are indeed the driving force behind the above results for the broader concept of general government securities. Columns 6 and 7 estimate Equation (1) with a modified dependent variable, referring respectively to Treasury bonds and to the remainder of general government bonds (*i.e.*, bonds issued by all the other general government entities). Coefficient β_1 retains significance in the former case, but not in the latter.[15] When the dependent variable refers to loan rather than bond exposures, no evidence of moral suasion is detected either (column 8).

4.2. Liquidity channel

As from 2008, there were strains to banks' market funding due to higher risk aversion and pressure on the Portuguese sovereign. To cope with such strains, banks benefitted from the possibility to issue state-guaranteed debt, and intensified the resort to central bank funding. The rise in the levels of central bank funding in banks' balance sheets lasted until 2012, broadly coinciding with the period that witnessed the most significant intakes of sovereign debt securities. After 2012, the ratio of central bank funding to total liabilities has steadily decreased.

14. The bank characteristics at hand (public or publicly supported) are not time-invariant. For instance, as regards public support, column 4 only disregards those months in which a given bank had outstanding state-guaranteed bonds or still unreimbursed public recapitalisation instruments.

15. The estimate in column 6 is nonetheless numerically and statistically weaker than in column 1, which is counterintuitive. One explanation is the loss of some observations due to our criterion for outliers, which tends to become more stringent as the denominator of the dependent variable becomes smaller (as it does when that variable refers to bond exposures to the Treasury rather than to the whole general government).

In trying to assess a potential intertwining between liquidity motives and changes in holdings of sovereign debt securities, we took into consideration the fact that banks' liquidity variables can be significantly influenced by sovereign debt securities, insofar as these are highly liquid and can be used to borrow from markets as well as from central banks. For this reason, we chose to focus on a specific channel stemming from access to and availability of central bank funding. Our main covariate will, thus, be the monthly percentage change in central bank funding.[16] Equation (2) presents the baseline specification.

$$\begin{aligned}\frac{flow_{it}}{stock_{it-1}} =& \beta_0 + \beta_1 CBfunding_{it} + \beta_2(CBfunding_{it} \times MonPol_t) + \\ & \beta_3(CBfunding_{it} \times TLTRO_t) + \beta_4(CBfunding_{it} \times \Delta yield_t) + \\ & \beta_5 GuaranteedDebt_{it} + \boldsymbol{X}_{it-3}^T \theta + \gamma_i + \delta_t + \varepsilon_{it} \end{aligned} \quad (2)$$

where $CBfunding$ is the monthly rate of change of each bank's funding from central banks; $MonPol$, $TLTRO$ and$GuaranteedDebt$ are dummy variables that equal 1 in months of loosening in the Eurosystem's monetary policy framework (detailed in the Appendix, Table A.2), during which the Targeted Long-Term Refinancing Operations (TLTRO) took place and during which each bank had State-guaranteed debt outstanding, respectively; $\Delta yield$ is the monthly change in 10-year sovereign bond yields (in percentage points).

Behind this formulation lies the reasoning that increases in liquidity obtained from central banks can be used to purchase sovereign debt securities. Likewise, having guaranteed debt outstanding could mean that such financing can be invested in sovereign debt securities. The regression tries to gauge whether increases in liquidity coincide with intakes of sovereign debt securities, accounting for the possibility of a stronger effect in moments of monetary policy loosening, either in terms of access to liquidity (*e.g.* collateral framework) or in terms of liquidity injections (*e.g.* long-term refinancing operations, LTROs).

In a context of sluggish economic activity, and thus of few profitable business opportunities and depressed returns, we would expect increases in liquidity and liquidity availability to be associated to increases in the intake of sovereign debt securities (i.e. positive β_1, β_2 and β_5), in particular high-yield securities as was the case of the Portuguese ones. We would also expect this to be particularly relevant in months with rising yields (*i.e.* positive β_4). Should this channel be significant, we would expect it to be relevant for high-yield sovereign bonds of different euro area countries, and not only for Portuguese ones. In contrast, we posit the effect of the TLTROs to be negative on our dependent variable, since the TLTROs were designed to promote lending to the real economy (*i.e.* negative β_3).

16. Outliers are excluded by trimming the $CBfunding$ variable to the [-1; 1] interval. This type of specification inevitably implies that we drop from the sample all those institutions that do not resort to central bank funding.

	(1)	(2)	(3)	(4)	(5)
CB funding	0.1815***	0.1520*	0.1228*	0.1885***	0.2173***
	(3.64)	(2.14)	(1.94)	(3.14)	(5.44)
CB funding × Monet.pol. easing	0.1571	0.1575	0.1924		
	(1.38)	(1.19)	(1.38)		
CB funding × TLTRO	-0.3043***			-0.3093***	-0.3023***
	(-3.72)			(-3.45)	(-4.38)
CB funding × Δ yield	-0.0487	0.3439	0.4797	-0.1223	-0.9624
	(-0.08)	(0.46)	(0.49)	(-0.16)	(-1.35)
Guarant. debt	0.0545**	-0.0834***	-0.0813**	0.0564	0.0366
	(2.28)	(-3.42)	(-2.68)	(1.73)	(0.76)
Marginal effects:					
CB funding	0.1519***	0.1867***	0.1666***	0.1312*	0.1739***
	(3.18)	(3.71)	(4.19)	(1.95)	(4.66)
N.obs	992	346	293	646	499
N. banks	15	12	10	14	11
R^2	0.20	0.25	0.31	0.17	0.23
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Liquidity channel estimates for domestic general government exposures (debt securities only)

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of Portuguese sovereign debt securities exposures by bank i in month t, relative to the stock of Portuguese sovereign debt securities in the previous month. Outliers are excluded by trimming the dependent and the $CBfunding$ variables to the [-1; 1] interval. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks. Marginal effects provide a measure of the overall impact of a change in central bank funding on the dependent variable, evaluating the other interacted covariates at the respective means.

We find increases in funding from central banks to be indeed associated with higher net purchases of sovereign debt securities, as can be shown by the statistically significant 0.15 marginal effect of this covariate (Table 4, column 1) and the positive and statistically significant β_1 (0.18). This effect is reversed in months when the TLTROs took place (every end of quarter since September 2014 and until December 2016), as implied by a negative β_3 (-0.30), which is consistent with the TLTRO objective of financing the real economy. Furthermore, the positive sign in β_5 suggests that having state-guaranteed debt outstanding is associated with inflows of sovereign bonds, though this result turns out fragile (see below). Finally, for the whole sample period, interactions with loosening in the monetary policy framework and with yields do not seem statistically relevant.

Breaking the sample period into two parts (before and after the 'whatever it takes´ speech) yields similar outcomes for the impact of central bank funding, albeit slightly milder until 2012 (columns 2 and 3 in Table 4) than afterwards (columns 4 and 5). In contrast, outstanding state-guaranteed debt ceases to display

a positive coefficient. Results for subsamples do not seem to depend on the change of yields, as the coefficient of the interaction between $CBfunding$ and $\Delta yield$ remains statistically non-significant. In the most recent period, the results related to central bank funding are slightly stronger for domestic banks than for foreign banks (column 5).

When running these regressions for all banks (and not only for those that are medium-sized and large), results (not reported) are weakened and some covariates, such as $GuaranteedDebt$, lose their significance altogether. This is not surprising since small banks tend to resort less to financing from central banks and to benefit less from guaranteed debt. However, the positive coefficient on the interaction between $MonPol$ and $CBfunding$ becomes statistically significant. Albeit slightly weaker, though still statistically significant, results are broadly unchanged if we run these same regressions with a dependent variable that includes loans to the general government and not only sovereign bonds (not reported).

A priori, the drivers behind this liquidity channel should not depend on whether the debt securities have been issued by the domestic sovereign or by foreign ones. As such, we ran the same regressions allowing exposures to refer to sovereign debt securities issued by any of the GIIPS countries, rather than restricting exposures to debt issued by the Portuguese government. Results are summarised in Table 5. As expected, results hold in similar fashion, in the sense that $CBfunding$ seems to be associated with changes in holdings of sovereign debt securities (column 1) and results are slightly stronger for domestic banks in the period after the 'whatever it takes' speech (columns 5). Despite the overall marginal effect of $CBfunding$ being statistically significant in both sub-periods considered, the stand-alone coefficients β_1 to β_5 lose their significance in the first sub-period (columns 2 and 3).

	(1)	(2)	(3)	(4)	(5)
CB funding	0.1830***	0.1240	0.0809	0.2174***	0.2526***
	(3.60)	(1.68)	(1.41)	(3.15)	(3.89)
CB funding × Mon.Pol.Easing	0.0568	0.0877	0.1357		
	(0.67)	(0.80)	(1.33)		
CB funding × TLTRO	-0.1918**			-0.2244**	-0.2218**
	(-2.33)			(-2.59)	(-2.50)
CB funding × Δ yield	-0.0576	0.3705	0.4430	-0.0842	-0.5660
	(-0.12)	(0.53)	(0.49)	(-0.15)	(-0.88)
Guarant. debt	0.0556***	-0.0369	-0.0410	0.0444**	0.0418*
	(4.46)	(-1.69)	(-1.22)	(2.34)	(1.99)
Marginal effects:					
CB funding	0.1619***	0.1491**	0.1153***	0.1755**	0.2189***
	(3.37)	(2.66)	(3.76)	(2.47)	(3.54)
N.obs	992	344	292	648	502
N. banks	15	12	10	14	11
R^2	0.24	0.27	0.34	0.21	0.30
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Liquidity channel estimates for GIIPS general government exposures (debt securities only)

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of debt securities exposures by bank i in month t, relative to the stock of debt securities in the previous month. These securities are those issued by the general governments of Spain, Ireland, Italy, Greece and Portugal. Outliers are excluded by trimming the dependent and the CBfunding variables to the [-1; 1] interval. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks. Marginal effects provide a measure of the overall impact of a change in central bank funding on the dependent variable, evaluating the other interacted covariates at the respective means.

When comparing regressions that use Portuguese debt securities as a dependent variable (as in Table 4) with similar regressions that use all other four GIIPS (Greece, Ireland, Italy and Spain) debt securities as a dependent variable (not reported), results are somewhat stronger in the former case, but only when considering the whole sample. This could hint that, in the first period, home bias could have played a non-negligible role in driving Portuguese sovereign exposures. However, in the second sub-period analysed, *i.e.* after the 'whatever it takes' speech, this liquidity channel is much stronger for other GIIPS debt securities. This could mean that, in this latter period, decisions to invest in sovereign debt securities were not driven by a home bias, but rather by the intent to invest in higher-yielding debt securities while striving for some diversification.

Admittedly, since sovereign debt securities are prime collateral in central bank funding operations, our results may be affected by simultaneity issues and thus endogeneity. For this reason, as a robustness check, we estimated the abovementioned regressions with the $CBfunding$ variable lagged one month

	(1)	(2)	(3)	(4)	(5)
CB funding$_{(t-1)}$	0.0511**	0.0219	0.0273	0.1290**	0.1361**
	(2.32)	(1.38)	(1.51)	(2.24)	(2.51)
CB funding$_{(t-1)}$ × Monet.pol. easing$_{(t-1)}$	0.0559	0.0327	0.0853		
	(0.66)	(0.42)	(0.56)		
CB funding$_{(t-1)}$ × TLTRO$_{(t-1)}$	-0.0821**			-0.1515**	-0.1716
	(-2.18)			(-2.39)	(-1.71)
CB funding$_{(t-1)}$ × Δ yield$_{(t)}$	0.0723	-0.2013	-0.2637	0.5663	1.1092**
	(0.16)	(-1.02)	(-1.29)	(0.89)	(2.43)
Guarant. debt	0.0540**	-0.0785**	-0.0770**	0.0641**	0.0328
	(2.46)	(-3.10)	(-2.99)	(2.42)	(0.71)
Marginal effects:					
CB funding$_{(t-1)}$	0.0452*	0.0202	0.0314	0.0960**	0.0931**
	(1.81)	(1.11)	(1.09)	(2.28)	(2.45)
N.obs	974	334	284	640	495
N. banks	15	12	10	14	11
R^2	0.17	0.21	0.27	0.16	0.23
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Liquidity channel estimates for domestic general government exposures with lagged covariates (debt securities only)

All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of Portuguese sovereign debt securities exposures by bank i in month t, relative to the stock of Portuguese sovereign debt securities in the previous month. Outliers are excluded by trimming the dependent and the $CBfunding$ variables to the [-1; 1] interval. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks. Marginal effects provide a measure of the overall impact of a change in central bank funding on the dependent variable, evaluating the other interacted covariates at the respective means.

(Table 6). While results become somewhat weaker (numerically and statistically), we still find some explanatory capacity stemming from $CBfunding$. One reason for weaker results is that liquidity variables may swiftly change and a one-month lag does not need to be positively correlated with the contemporaneous variable.[17] In the period after the 'whatever it takes' speech, the interaction between $CBfunding$ and $\Delta yield$ becomes statistically significant (column 5), which means that domestic banks seem to buy more Portuguese sovereign bonds when yields rise and funding from central banks has increased recently.

17. For this reason, the lagged $CBfunding$ is a poor instrument for the contemporaneous effect, which hampers estimation by Instrumental Variables.

4.3. Profitability/ carry-trade channel

Banks' balance sheets have been shrinking since 2010, with the decrease in credit to clients playing a major role in such development. This reflects *inter alia* the scarcer opportunities for banks to grant credit to households and especially to non-financial corporations during the crisis and in its aftermath. Coupled with very low interest rates, this implies that "search for yield" practices based on investment in sovereign debt securities may become an appealing option in terms of risk-return trade-off. Against this background, investigating a possible return/carry-trade incentive guiding banks to invest in high-yield sovereign securities is warranted.

Drawing on Altavilla *et al.* (2017), we start by testing a carry-trade channel hinging on solvency. This hypothesis relies on a moral hazard argument: less capitalised banks are more willing to bet on a higher-risk-higher-return asset and invest more when yields are relatively higher, since they tend to internalise a smaller part of the losses if risks materialise. To test this hypothesis, we regress the same dependent variable on the usual covariates and on a Tier1 Ratio[18] as a proxy for solvency. This variable is taken with a lag to minimise simultaneity concerns. The Tier1 Ratio is included on its own and in interaction with the change in yields, as well as with months of monetary policy loosening or TLTROs, as defined above:

$$\begin{aligned}\frac{flow_{it}}{stock_{it-1}} =& \beta_0 + \beta_1 Tier1_{it-1} + \beta_2(Tier1_{it-1} \times \Delta yield_t) + \\ & \beta_3(Tier1_{it-1} \times MonPol_{t-1}) + \beta_4(Tier1_{it-1} \times TLTRO_{t-1}) + \\ & \boldsymbol{X}_{it-3}^T\theta + \gamma_i + \delta_t + \varepsilon_{it} \end{aligned} \quad (3)$$

Should the carry-trade hypothesis hold, banks with a lower Tier1 ratio would invest more in high-yield sovereign debt securities, in particular in periods of rising yields (implying a negative sign for β_2). However, unlike Altavilla *et al.* (2017), we find very little evidence supporting this hypothesis (Table 7). This is consistent with the alternative hypothesis posed by Lamas and Mencía (2019), according to which stronger banks are the ones engaging in such practices given their greater ability to cushion adverse shocks. Nonetheless, the negative coefficient of the interaction between the $Tier1$ and the $MonPol$ dummy suggests that in periods of monetary policy loosening, which can be related to periods of liquidity injections, banks

18. Given that the time span (2008-2016) covers a period that includes both data gathered according to the national reporting framework and to the Common Reporting (COREP) at the EU level, and taking into consideration that there were novelties in the prudential definition of some relevant variables with the entry into force of the Capital Requirement Regulation (CRR), there are some structural breaks in the series. To minimise the impact of breaks, a Tier1 ratio, deemed the most comparable, was used throughout the period. The Tier1 ratio was computed as Tier 1 capital over Risk Weighted Assets with no corrections being made to either definition used in any of the periods (before and after introduction of the CRR). It is presented as a ratio and not as a percentage (*e.g.* 0.12 for a 12% Tier1 ratio). Outliers are excluded by trimming the $Tier1$ variable to the [0; 2] interval.

	(1)	(2)	(3)	(4)	(5)
Tier $1_{(t-1)}$	-0.2111	-0.0617	0.7056	-0.3041	-1.0370
	(-0.41)	(-0.04)	(0.77)	(-0.44)	(-1.81)
Tier $1_{(t-1)} \times \Delta$ yield$_{(t)}$	-2.0852	-10.2253	-14.1101	-1.9826	-0.3992
	(-1.06)	(-0.79)	(-0.97)	(-1.04)	(-0.23)
Tier $1_{(t-1)} \times$ Monet.pol. easing$_{(t-1)}$	-4.2703*	-4.1048	-5.7622**		
	(-2.10)	(-1.53)	(-2.53)		
Tier $1_{(t-1)} \times$ TLTRO$_{(t-1)}$	-0.5477			-0.5529	-0.5924
	(-1.60)			(-1.38)	(-1.34)
Marginal effects:					
Tier $1_{(t-1)}$	-0.5021	-1.0071	-0.5976	-0.3735	-1.1314*
	(-1.08)	(-1.18)	(-1.37)	(-0.56)	(-2.16)
N.obs	992	346	293	646	499
N. banks	15	12	10	14	11
R^2	0.17	0.21	0.28	0.15	0.20
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Carry-trade estimates for domestic general government exposures (debt securities only)

All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of Portuguese sovereign debt securities exposures by bank i in month t, relative to the stock of Portuguese sovereign debt securities in the previous month. Outliers are excluded by trimming the dependent variable to the [-1; 1] interval and the $Tier1$ variable to [0; 2]. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks. Marginal effects provide a measure of the overall impact of a change in the $Tier1$ variable on the dependent variable, evaluating the other interacted covariates at the respective means.

with lower own funds ratios tend to buy more domestic sovereign debt securities (column 1). This effect is slightly stronger for domestic banks (column 3). This outcome is, however, not surprising: it is when additional liquidity is available that less capitalised banks are likely to find it more appealing to invest in higher yield assets.

We reach broadly the same conclusion when the dependent variable refers to exposures to all GIIPS countries, but with lower levels of statistical significance for the interaction of the capital ratio with the monetary policy loosening dummy variable (Table A.3 in the Appendix).

We have also focused on a more direct carry-trade channel hinging on profitability. In this case, we investigated whether less profitable banks face incentives to invest more in higher-risk-higher-return assets in order to boost profitability and thus market perception. To test this hypothesis, we ran regressions similar to Equation (3) but replacing the Tier 1 ratio with an indicator of profitability, Return on Equity (RoE), decomposed into Return on Assets (RoA)

	(1)	(2)	(3)	(4)	(5)
Return on assets$_{(t-1)}$	-1.1012	-3.5916	-4.5397	-0.8312	0.0678
	(-1.64)	(-1.03)	(-1.29)	(-1.09)	(0.08)
Leverage$_{(t-1)}$	0.0024*	0.0058***	0.0058***	-0.0028	-0.0018
	(2.13)	(5.00)	(6.46)	(-0.50)	(-0.44)
Return on assets$_{(t-1)}$ $\times$ Δ yield$_{(t)}$	-2.5847	-7.8582	-4.0287	-0.5007	-4.0334
	(-0.27)	(-0.54)	(-0.26)	(-0.05)	(-0.56)
Return on assets$_{(t-1)}\times$ Monet.pol. easing$_{(t-1)}$	-3.7603	-0.7909	-0.2893		
	(-1.26)	(-0.24)	(-0.07)		
Return on assets$_{(t-1)}$ $\times$ TLTRO$_{(t-1)}$	1.2804			0.7102	0.2599
	(0.97)			(0.53)	(0.13)
Observations	992	346	293	646	499
N. banks	15	12	10	14	11
R^2	0.17	0.22	0.30	0.15	0.19
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8. Carry-trade estimates for domestic general government exposures, hinging on profitability (debt securities only)

All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of Portuguese sovereign debt securities exposures by bank i in month t, relative to the stock of Portuguese sovereign debt securities in the previous month. Outliers are excluded by trimming the dependent variable to the [-1; 1] interval. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks.

and leverage.[19] Whenever we could find some statistically significant evidence, it seemed to stem from domestic banks' leverage rather than from their profitability levels: until the 'whatever it takes' speech, banks with higher leverage seemed to invest more in domestic sovereign debt securities (Table 8).

4.4. All channels together

In practice, the channels described above may operate concomitantly in driving banks' sovereign exposures. In order to highlight those with a more relevant role, we have assessed their significance when modelled together. For reasons of tractability, and given the potentially very large number of parameters, the choice of covariates in Equation (4) has taken into account their significance in the previous regressions:

19. In doing so, we removed the equity-to-assets ratio as one of the bank controls as it is the inverse of leverage as defined here.

$$\begin{aligned}\frac{flow_{it}}{stock_{it-1}} =& \beta_0 + \beta_1(Domestic_{it} \times FundingNeed_t \times \Delta yield_t) + \\ & \beta_2 CBfunding_{it} + \beta_3(CBfunding_{it} \times MonPol_t) + \\ & \beta_4(CBfunding_{it} \times TLTRO_t) + \beta_5(CBfunding_{it} \times \Delta yield_t) + \\ & \beta_6 Tier1_{it-1} + \beta_7(Tier1_{it-1} \times \Delta yield_t) + \\ & \beta_8(Tier1_{it-1} \times MonPol_t) + \beta_9(Tier1_{it-1} \times TLTRO_t) + \\ & \boldsymbol{X}_{it-3}^T \theta + \gamma_i + \delta_t + \varepsilon_{it} \end{aligned} \quad (4)$$

where the dependent variable refers only to exposure to Portuguese general government debt securities and, like the covariates, is defined as before.

Overall, the variables previously found relevant to explain the dynamics of holdings of sovereign debt securities in banks' balance sheets maintain their significance when considering all channels together (Table 9).For the whole period under analysis, β_1's positive sign suggests that domestic banks tend to buy more Portuguese sovereign debt securities than foreign-owned banks when sovereign funding needs are high and yields are rising (column 1). Moreover, increases in funding from central banks are associated with increases in holdings of sovereign debt securities (as both β_2 and the overall marginal effect of $CBfunding$ are positive and statistically significant), whereas the opposite happens in the months when the TLTROs took place (as implied by a negative β_4). However, while we find evidence of moral suasion only until the 'whatever it takes' speech, the relationship with central bank funding also holds thereafter. Once these other channels are controlled for, the carry-trade channel based on the Tier1 ratio continues not to play a role in driving the evolution of sovereign exposures.

	(1)	(2)	(3)
Domestic $_{(t)}$ × Funding need $_{(t)}$ × Δyield$_{(t)}$	0.16*	0.19*	0.10
	(1.85)	(1.94)	(1.27)
CB funding$_{(t)}$	0.18***	0.14*	0.18***
	(3.71)	(2.11)	(3.12)
CB funding$_{(t)}$ × Monet.pol. easing$_{(t)}$	0.07	0.11	
	(0.74)	(0.87)	
CB funding$_{(t)}$ × TLTRO$_{(t)}$	-0.30***		-0.31***
	(-3.54)		(-3.44)
CB funding$_{(t)}$ × Δ yield$_{(t)}$	-0.15	0.48	-0.23
	(-0.26)	(0.66)	(-0.31)
Tier 1 ratio$_{(t-1)}$	-0.32	-0.00	-0.40
	(-0.65)	(-0.00)	(-0.56)
Tier 1 ratio$_{(t-1)}$ × Δ yield$_{(t)}$	-1.96	-15.63	-1.53
	(-1.06)	(-0.98)	(-0.99)
Tier 1 ratio$_{(t-1)}$ × Monet.pol. easing$_{(t)}$	-3.67**	-2.96	
	(-2.37)	(-1.66)	
Tier 1 ratio$_{(t-1)}$ × TLTRO$_{(t)}$	0.51		0.51
	(1.75)		(1.72)
Marginal effects:			
CB funding$_{(t)}$	0.14***	0.17***	0.12*
	(3.04)	(3.42)	(1.88)
Tier 1 ratio$_{(t-1)}$	-0.46	-0.95	-0.28
	(-0.95)	(-1.39)	(-0.39)
N.obs	992	346	646
N. banks	15	12	14
R^2	0.20	0.27	0.17
Excludes foreign banks	NO	NO	NO
Whole Period	YES	NO	NO

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9. Estimates for domestic general government exposures (securities only): all channels together

All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of Portuguese sovereign debt securities exposures by bank i in month t, relative to the stock of Portuguese sovereign debt securities in the previous month. Column 2 is estimated over 2008m1-2012m7 and column 3 over 2012m8-2016m12. Outliers are excluded by trimming the dependent and the $CBfunding$ variables to the [-1; 1] interval and the $Tier1ratio$ variable to [0; 2]. Marginal effects provide a measure of the overall impact of a change in variables for central bank funding and Tier 1 on the dependent variable, evaluating the other interacted covariates at the respective means.

5. Modelling exposure to SOEs

As previously illustrated, exposures to SOEs exhibited a somewhat different pattern from those referring to the overall general government and, in particular, to the Treasury. Moreover, their specificities (including in terms of preferred funding instruments, with a greater role for loans rather than securitised debt) warrant a particular focus.

Moral suasion incentives remain a plausible driver, for much the same reasons as for Treasury bonds: it is in the best interest of both the sovereign and the domestic banks to avoid that a domestic SOE defaults, since such an event could negatively impact perceptions of the sovereign's solvency, with knock-on effects on domestic lenders. Hence, domestic banks have incentives to lend to public corporations when they lose access to financing from non-residents, as they largely did in 2011. In contrast, liquidity and regulatory incentives are much less likely to drive exposures to SOEs than holdings of Treasury bonds. The latter are far more attractive as regards access to Eurosystem refinancing operations, since they enjoy lower haircuts and benefitted from a waiver to collateral rules during the Programme. Moreover, regulatory liquidity buffers are to be composed primarily of sovereign debt securities. Finally, as for capital requirements, a 100 percent risk weight is applied to exposures to SOEs (both loans and securities), except for those companies that may be treated as equivalent to central governments in the area of credit risk.

To model suasion incentives in the case of exposures to SOEs, we follow a similar approach as that used in the case of general government bonds, focusing on "high need" months. Financing by domestic lenders was likely most needed in months when public corporations had to repay maturing debt which the respective creditors did not wish to roll over. This unwillingness likely encapsulates both adverse market conditions *and* the need to obtain new financing. In order to capture moral suasion, we regressed the same dependent variable (defined as before, but referring to exposures to SOEs through both loans and securities) on a proxy identifying the most critical periods:

$$\frac{flow_{it}}{stock_{it-1}} = \beta_0 + \beta_1(Domestic_{it} \times Low funding_t) + \boldsymbol{X}_{it-3}^{T}\theta + \gamma_i + \delta_t + \varepsilon_{it} \tag{5}$$

In this case, since data on debt redemptions by individual SOEs is often not available, the reduction in aggregate indebtedness vis-à-vis the rest of the world is used as a proxy for "high need months". In particular, $Low funding$ equals one in months when the first difference of external funding to SOEs is below the median over 2008-2016 (Figure A.5 in the Appendix).

In Equation (5), a positive and significant value of β_1 means that, relative to foreign-owned peers, domestic banks increased their funding to SOEs in those months when non-residents were reducing their exposure. Column 1 in Table 10

provides supporting evidence to this different behaviour of domestic banks being not only statistically significant, but also numerically sizeable. A similar result does not hold if the $Low funding$ variable is replaced by a simpler, less accurate proxy for "difficult" or "high need" months: notwithstanding the fact that SOEs faced the hardest financing difficulties during the Programme (Campos *et al.*, 2019), the interaction of Domestic with a dummy that is equal to one along the Programme has the expected sign but does not reach statistical significance (Table 10, column 4).[20]

As in Section 4.1, we have assessed whether some bank characteristics matter for moral suasion. Column 6 shows that there is no statistical evidence of moral suasion among smaller banks, in line with their more limited ability to provide significant amounts of financing of SOEs. Furthermore, as it was the case above for holdings of general government bonds, there is no evidence that state-owned banks, or banks having benefitted from public support during the crisis, were more likely to provide funds to embattled SOEs than the remaining domestic institutions (column 7 and 8).

The degree of detail provided by our dataset makes it possible to study whether and when evidence for moral suasion can still be found at a more disaggregate level. Breaking down exposures into loans and bonds (columns 2 and 3 of Table 11) suggests that the more supportive role of domestic banks has mainly taken place through lending rather than bond purchases (for comparability, column 1 repeats results for loans and bonds together). Second, evidence of moral suasion seems stronger with regard to public corporates controlled by central government than by local and regional administrations (columns 4 and 5). This could be associated to the concentration of the larger corporations (whose default may potentially have more repercussions) in the central government subsector.

We find no evidence of moral suasion in the case of SOEs classified inside the perimeter of general government (column 6 of Table 11). However, in the case of SOEs classified outside the general government, results suggest some evidence of moral suasion (column 7). A possible explanation for different results for SOEs classified in or outside general government may rely on the role of the Treasury: since 2011, the Treasury increased its role as a lender to general government SOEs, implying a smaller need for domestic banks to step in and provide funding to this segment of corporates. In contrast, Treasury borrowing to lend to SOEs outside general government would contribute to further increase the public debt stock, an impact avoided if banks lent instead. These findings are robust to the use of a real-time perimeter of general government and the public sector (columns 8 and 9). Indeed, whether lending to a given SOE impacts the public debt or not depends on the real-time definition of general government. The remaining results of this

20. Naturally, dummies for other sub-periods of the sample would be even poorer proxies (columns 2, 3 and 5). For instance, prior to the sovereign debt crisis a negative coefficient suggests that foreign-owned banks were the ones taking the lead in providing funds to SOEs, which is not surprising since at that time external funding to SOEs was still increasing (Figure A.5 and Campos *et al.*, 2019).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Domestic × Low funding	0.03**					-0.00	0.05**	
	(2.21)					(-0.03)	(2.66)	
Domestic × Before SDC		-0.04**						
		(-2.59)						
Domestic × SDC			-0.02					
			(-0.71)					
Domestic × Programme				0.03				
				(1.55)				
Domestic × Post-Programme					0.01			
					(0.76)			
Pub. intervention × Low funding								-0.03*
								(-1.97)
Pub. intervention								-0.01
								(-0.78)
Observations	1848	1848	1848	1848	1848	1589	1277	1146
N. banks	24	24	24	24	24	29	22	14
R^2	0.36	0.36	0.36	0.36	0.36	0.22	0.40	0.14
Excl. foreign banks	NO	NO	NO	NO	NO	NO	NO	YES
Excl. public or supported banks	NO	NO	NO	NO	NO	NO	YES	NO
Bank size classes	L+M	L+M	L+M	L+M	L+M	S+VS	L+M	L+M

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10. Moral suasion estimates for exposures to SOEs (securities and loans)

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12. Columns 2-5 use dummy variables for 4 sub-periods: before the peak of the sovereign debt crisis (SDC; 2008m1-2010m4); the peak of the SDC (2010m5-2011m4); the Programme (2011m5-2014m6); and after the Programme (2014m7-2016m12). Column 6 considers a sample of small and very small banks, while all the others take a sample of large and medium-sized banks. See text for further detail.

section also remain largely unchanged if real-time exposures are used (Tables A.4 and A.5 in the Appendix).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dom. × Low funding	0.03**	0.03***	-0.02	0.05**	0.02	0.01	0.03**	0.03	0.05*
	(2.21)	(3.13)	(-0.69)	(2.30)	(1.73)	(0.69)	(2.18)	(1.29)	(1.98)
Observations	1848	1753	1220	1798	1534	1674	1677	1326	1813
N. banks	24	22	18	24	18	24	22	22	23
R^2	0.36	0.43	0.10	0.35	0.18	0.12	0.44	0.21	0.36
Exposure instrument	B+L	L	B	B+L	B+L	B+L	B+L	B+L	B+L
Exposure counterpart	All	All	All	CG	RLG	in S13	out S13	in S13, RT	out S13, RT

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11. Moral suasion estimates for exposures to SOEs (securities and loans): further analysis

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, take a sample of large and medium-sized banks and are estimated over 2008m1-2016m12. Exposures can refer to bonds (B), loans (L) or both (B+L). As for counterparts, CG denotes central government, RLG regional and local government, in S13 and out S13 respectively inside and outside general government, and RT real time. See text for further detail.

6. Concluding remarks

This paper sheds light on the evolution of the sovereign exposures of banks operating in Portugal and their determinants. Using a novel, extremely detailed dataset assembled from granular data, the analysis encompasses the whole 2008-2016 period and deals separately with sovereign debt securities issued by the general government (among which Treasury bonds play a major role) and with exposures to government-controlled corporations.

Focusing on the key channels identified in the literature – moral suasion, liquidity-related incentives and carry-trade – our results suggest that moral suasion has been an important driver of the evolution of banks' exposure to the sovereign. This implies that, in times of trouble, domestic banks may have had incentives to further invest in government debt securities or, though to a smaller extent, to finance domestic state-owned enterprises. Banks indeed have incentives to do so because they know their creditworthiness is perceived by market participants as highly correlated with their sovereign´s. Therefore, they would likely be worse off (at least in the short run) if they did not step in to provide funding to public entities. This evidence is especially strong in the case of larger banks and it also holds when the other potential channels are controlled for.

We also find evidence that the availability of liquidity is a driver of banks' sovereign exposures: increases in liquidity from central banks are associated with purchases of sovereign debt securities, especially in the case of medium-sized and large banks and in the period subsequent to Mario Draghi's 'whatever it takes' speech. Interestingly, this effect is substantially weakened or even reversed in

months with TLTROs. In contrast, our results suggest that the carry-trade channel plays a negligible role in explaining the evolution of sovereign exposures in the case of banks operating in Portugal. This is both the case when focusing on solvency, *i.e.* when trying to test a "gambling for resurrection" hypothesis, and when assessing whether lower profitability could have helped explain stronger intakes of sovereign debt securities. In fact, low Tier 1 ratios or low profitability indicators do not appear to be associated with increases in exposures to sovereign debt.

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Appendix:

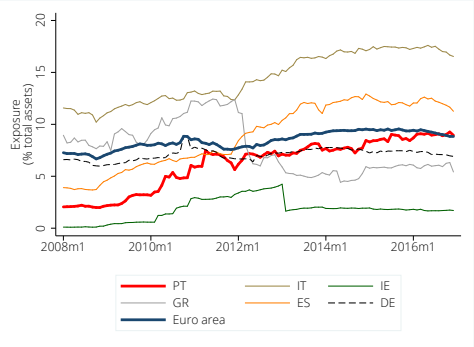

Figure A.1: Domestic sovereign exposures of banks for selected euro area countries

Source: ECB (Balance Sheet Items) and authors' calculations.
Note: Banks' sovereign exposures (loans and debt securities) to domestic general government in percentage of total assets.

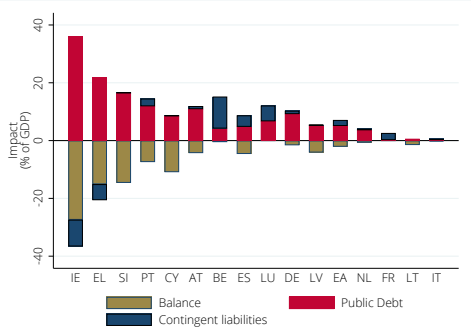

Figure A.2: Cumulative impact of government support to the banking sector: 2008-2016
Source: Eurostat and authors' calculations.

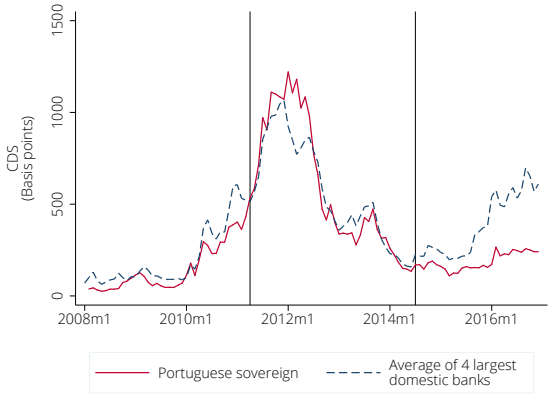

Figure A.3: Credit Default Swaps (Portuguese Republic and 4 largest domestic banks)

Source: Bloomberg and authors' calculations.
Notes: The two vertical lines correspond to the beginning and end of the Financial Assistance Programme to Portugal.

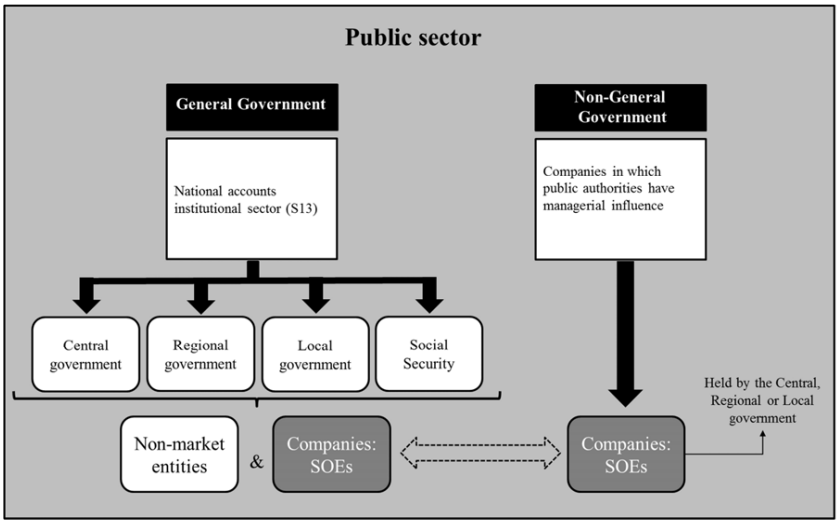

Figure A.4: The Portuguese public sector

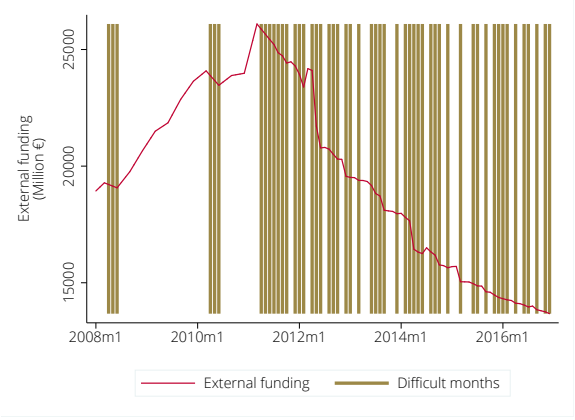

Figure A.5: External funding to SOEs

Source: Banco de Portugal and authors' calculations.
Note: "Difficult months" are defined as those in which the first difference of total external funding to non-financial SOEs is below the median computed over 2008-2016.

	N.obs.	Mean	Std.Dev	Min.	Max.
Whole sample:					
Tier 1 ratio	1690	0.14	0.082	0.052	0.87
CB funding	1690	-0.0083	0.20	-1	0.97
Total assets (log)	1633	22.3	2.02	17.8	25.5
Ratio: Deposits to assets	1633	0.56	0.15	0.032	0.92
Ratio: loans to deposits	1633	1.04	0.50	0.094	10.7
Ratio: Capital and reserves to assets	1633	0.13	0.091	0.013	0.73
Domestic banks:					
Tier 1 ratio	1293	0.15	0.088	0.052	0.68
CB funding	1293	0.000	0.19	-1.00	0.97
Total assets (log)	1293	22.3	2.14	18.4	25.5
Ratio: Deposits to assets	1293	0.53	0.14	0.032	0.90
Ratio: loans to deposits	1293	1.03	0.48	0.094	7.63
Ratio: Capital and reserves to assets	1293	0.14	0.095	0.013	0.69
Foreign banks:					
Tier 1 ratio	397	0.12	0.055	0.076	0.87
CB funding	397	-0.035	0.24	-1	0.97
Total assets (log)	340	22.5	1.49	17.8	24.8
Ratio: Deposits to assets	340	0.67	0.14	0.084	0.92
Ratio: loans to deposits	340	1.10	0.56	0.62	10.7
Ratio: Capital and reserves to assets	340	0.098	0.064	0.030	0.73

Table A.1. Descriptive statistics for main banking covariates

Source: Banco de Portugal and authors' calculations
Notes: Statistics do not refer to aggregate ratios for the banking sector, but rather to the (unweighted) means and standard deviations of variables for all banks in the sample. Statistics on CB funding refer to the monthly rate of change of this variable. The sample was restricted to include only observations for which $CBfunding$ is within the [-1;1] interval and $Tier1ratio$ is within the [0;2] interval.

Variable	Months for which the binary variable is equal to 1
MonPol	Dec 2011 (LTRO and reserve requirements decrease) Feb 2012 (LTRO and acceptance of additional credit claims as collateral) Mar 2012 (acceptance of certain government-guaranteed bank bonds as collateral) Jun 2012 (additional measures to increase collateral availability).
TLTRO	Every quarter-end starting in Sep 2014 until Dec 2016.

Table A.2. Description of binary variables controlling for periods of monetary policy easing

	(1)	(2)	(3)	(4)	(5)
Tier $1_{(t-1)}$	-0.42	-0.57	0.45	-0.36	-0.87
	(-0.94)	(-0.39)	(0.69)	(-0.56)	(-1.44)
Tier $1_{(t-1)} \times \Delta$ yield$_{(t)}$	-1.69	-4.14	-6.92	-1.67	-0.43
	(-0.92)	(-0.51)	(-0.76)	(-0.91)	(-0.44)
Tier $1_{(t-1)} \times$ Monet.pol. easing$_{(t-1)}$	-2.72*	-1.95	-3.52*		
	(-1.85)	(-0.95)	(-2.23)		
Tier $1_{(t-1)} \times$ TLTRO$_{(t-1)}$	-0.54			-0.50	-0.50
	(-1.53)			(-1.47)	(-1.40)
Marginal effects:					
Tier $1_{(t-1)}$	-0.63	-0.99	-0.29	-0.42	-0.94
	(-1.49)	(-0.93)	(-0.60)	(-0.67)	(-1.62)
N.obs	992	344	292	648	502
N. banks	15	12	10	14	11
R^2	0.20	0.24	0.33	0.18	0.24
Excludes foreign banks	NO	NO	YES	NO	YES
Whole Period	YES	NO	NO	NO	NO

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3. Carry trade estimates for GIIPS general government exposures (debt securities only)

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12, unless otherwise stated. The dependent variable refers to net flow of debt securities exposures by bank i in month t, relative to the stock of debt securities in the previous month. These securities are those issued by the general governments of Spain, Ireland, Italy, Greece and Portugal. Outliers are excluded by trimming the dependent variable to the [-1; 1] interval and the $Tier1ratio$ variable to [0; 2]. Columns 2 and 3 are estimated over 2008m1-2012m7 and columns 4 and 5 over 2012m8-2016m12. Columns 1, 2 and 4 refer to all banks, while columns 3 and 5 only to domestic banks. Marginal effects provide a measure of the overall impact of a change in variables for Tier 1 on the dependent variable, evaluating the other interacted covariates at the respective means.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Domest. × Low funding	0.05***					0.04*	0.07***	
	(3.09)					(1.78)	(3.37)	
Domest. × Before SDC		-0.03						
		(-1.66)						
Domest. × SDC			-0.04					
			(-1.47)					
Domest. × Programme				0.05**				
				(2.23)				
Domest. × Post-Programme					-0.00			
					(-0.25)			
Pub. intervention × Low funding								-0.05**
								(-2.49)
Pub. intervention								0.00
								(0.19)
Observations	1854	1854	1854	1854	1854	1537	1286	1153
N. banks	25	25	25	25	25	32	23	15
R^2	0.38	0.37	0.37	0.37	0.37	0.23	0.41	0.22
Excludes foreign banks	NO	NO	NO	NO	NO	NO	NO	YES
Excludes public or supported banks	NO	NO	NO	NO	NO	NO	YES	NO
Bank size classes	L+M	L+M	L+M	L+M	L+M	S+VS	L+M	L+M

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4. Moral suasion estimates for exposures to SOEs (securities and loans): Real-time perimeter of general government and the public sector

Notes: All regressions include balance sheet controls as well as time and bank fixed effects, and are estimated over 2008m1-2016m12. Columns 2-5 use dummy variables for 4 sub-periods: before the peak of the sovereign debt crisis (SDC; 2008m1-2010m4); the peak of the SDC (2010m5-2011m4); the Programme (2011m5-2014m6); and after the Programme (2014m7-2016m12). Column 6 considers a sample of small and very small banks, while all the others take a sample of large and medium-sized banks.

	(1)	(2)	(3)	(4)	(5)
Domestic × Low funding	0.05***	0.03***	-0.01	0.06***	0.05**
	(3.09)	(3.14)	(-0.73)	(3.04)	(2.12)
Observations	1854	1788	1147	1809	1525
N. banks	25	24	18	24	18
R^2	0.38	0.43	0.12	0.36	0.16
Exposure instrument	B+L	L	B	B+L	B+L
Exposure counterpart	All	All	All	CG	RLG

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5. Moral suasion estimates for exposures to SOEs (securities and loans): further analyses based on the real-time perimeter of general government and the public sector

Notes:All regressions include balance sheet controls as well as time and bank fixed effects, take a sample of large and medium-sized banks and are estimated over 2008m1-2016m12. Exposures can refer to bonds (B), loans (L) or both (B+L). As for counterparts, CG denotes central government and RLG regional and local government.

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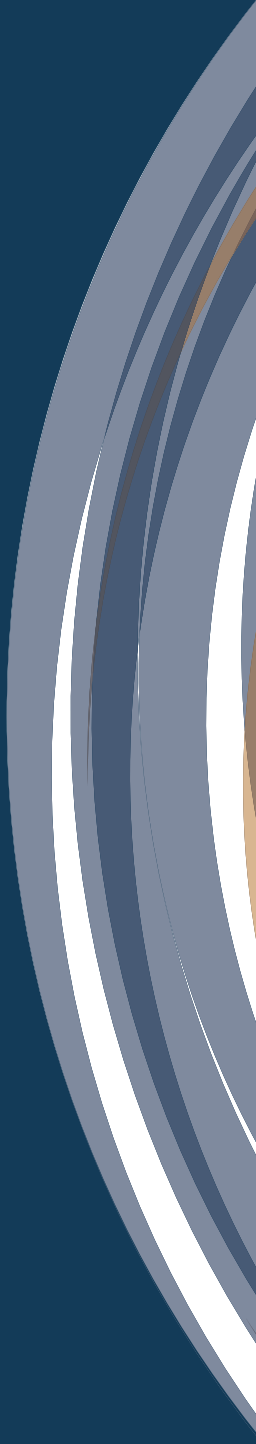

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