The Portuguese money market throughout the crisis What was the impact of ECB liquidity provision?

Sofia Saldanha Banco de Portugal

Carla SoaresBanco de Portugal

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Abstract

Money markets were severely impaired by the financial and sovereign debt crises. We investigate how the Portuguese part of the euro unsecured interbank money market was affected by the crises and how the ECB's unconventional policy measures, in particular the fixed rate full allotment procedure, impacted the market. We adapt a widely used method in the economic literature to identify unsecured interbank loans – with maturities ranging from overnight to one-month - settled in TARGET payment system, in which at least one of the counterparties is a Portuguese bank. We find that the Portuguese unsecured money market was hit especially by the sovereign debt crisis. There was a significant reduction in market activity, both in the number of operations and in market turnover. Alongside, price dispersion increased and rates agreed upon loans became on average more expensive than the reference rate for the respective maturity. We also find that domestic loans were more expensive than loans traded with a foreign bank. Finally, by analyzing the impact of monetary policy measures taken during the crises' periods, we find that the increased intermediation by the central bank contributed to a compression of spreads and a reduction in loan amounts. We observe that banks perceived as riskier began being penalized during the crisis. (JEL: E58, G21)

Introduction

In normal times, interbank money markets are among the most liquid in the financial system. Well functioning money markets allow the smooth transmission of liquidity throughout the banking system. Monetary policy responds to aggregate liquidity shocks, while idiosyncratic shocks are absorbed in money markets. The financial crisis that began in August 2007 in the US severely impacted these markets, leading to, what some call, a run on interbank markets. Banks increased significantly their precautionary

E-mail: assaldanha@bportugal.pt; csoares@bportugal.pt

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demand for liquidity and, at the same time, the market was asking for a high counterparty risk premium. For this reason, there was also a substitution from unsecured to secured interbank loans¹ (ECB 2015). Later on, in the euro area, the negative feedback loop between sovereigns and banks associated to the sovereign debt crisis led to a fragmentation of the market. Even though market conditions have recently improved, a proper assessment of these markets and of the monetary policy effects is of great relevance. Thus, the purpose of this paper is to get a better understanding of the Portuguese part of the euro unsecured interbank money market and evaluate how ECB's monetary policy measures impacted this market. With that purpose, we use effective transactions data, which is not easily available given the over-the-counter nature of the market.

We begin by identifying overnight, one-week and one-month operations settled in TARGET/TARGET2, the large value payment system owned and operated by the Eurosystem. In such a manner, it is possible to describe and quantify the activity of the Portuguese unsecured money market in great detail. Since overnight operations represent the largest share of operations and volumes traded, we merged these transactions with bank's balance sheet, monetary policy operations and reserve compliance data. Hence, we are able to test the impact of the fixed rate full allotment (FRFA) policy and of the excess liquidity created in the market. We find that monetary policy measures were effective in reducing interest rates. They also contributed to a reduction in market activity as a consequence of the increased intermediation by the ECB. The results are in line with the hypothesis of market segmentation across the euro area from which Portuguese banks seem to be penalized in the course of the sovereign debt crisis. Moreover, there is also evidence supporting price discrimination in the overnight market favoring banks with a higher solvency ratio, especially during the crisis.

The article is organized as follows. We begin by introducing the relevant economic literature, followed by a brief review of the major crisis' events and the Eurosystem's policy response to it. Then, we explain the data and methodology used to withdraw effective money market transactions. The following section describes the Portuguese money market based on our dataset, with a special emphasis on the crisis' period. Afterwards, we present a simple analysis of the effects of the policy measures pursued by the Eurosystem aimed at normalizing market conditions. We finish with some concluding remarks.

^{1.} Our analysis is focused only in the unsecured part of the money market, for data availability reasons. However, one should have in mind that the fall in market activity discussed in the article is also justified by this substitution effect.

Literature review

The main function of money markets is to provide an environment for the distribution of liquidity between banks in the system, i.e., banks with short-term liquidity surplus lend to those with shortages, fulfilling their reserve requirements and insuring against idiosyncratic liquidity shocks. It is in these markets where monetary policy impulses begin, since the central bank provides primary liquidity to banks at the target rate, which serves as a benchmark for the secondary market. A number of theoretical studies justify central bank intervention. When markets are efficient the central bank provides liquidity through open market operations, allowing institutions to endogenously reallocate it (Goodfriend and King 1988). However, in the presence of some inefficiency or market frictions, a more active central bank intervention is justified. It has been shown that during banking crises the central bank can use open market operations to provide liquidity and smooth interest rates (Goodfriend and King 1988; Allen et al. 2009). Some authors argue that when there are inefficiencies related with market-power issues as when banks with greater liquidity surplus have more power -, the central bank can improve efficiency in the market and avoid situations such as a fire sale (Acharya et al. 2012). To do so, the central bank must be able to provide liquidity at a cost affordable to the banks in need. Thus, it should either be prepared to sustain losses, or it should be better than other investors at monitoring the loans. The policy implications of this are that (i) there are gains in having in the same institution the roles of both supervisor and lender of last resort and (ii) the central bank should be ready to accept less liquid collateral or to pump a large amount of liquidity. In Freixas et al. (2011), when there are aggregate liquidity shocks, such as the increased demand for liquidity observed during the crisis, the central bank should inject liquid assets into the banking system. In this way, these and other studies provide grounds for central banks' interventions in the last years.

This article also follows the empirical work of other researchers that have studied the impact of monetary policy measures. Focusing on money market's benchmark interest rates, some studies found that these measures helped reduce interbank spreads and/or volatility (Soares and Rodrigues 2013; Carpenter et al. 2014; Szccerbowicz 2014; Hesse and Frank 2009). However, only some studies use effective data on transactions. Brunetti et al. (2011) use e-MID² data and conclude that central bank intervention consistently adds uncertainty to the interbank market and that actions that do not target interbank asymmetric information fail to improve market liquidity. More recently, several papers using TARGET payments data study the crisis and the policy effects. Bräuning and Fecht (2012) use German data up to the end of

^{2.} E-MID is an Italian interbank market electronic platform.

2008 and find evidence strongly supporting a liquidity effect and a reduction in market activity due to the increased central bank intermediation. Arciero et al. (2014) use data for the euro area, covering all maturities of the market and describing the euro market during the crisis. de Andoain et al. (2014) document the fragmentation in the euro overnight unsecured money market and conclude that policy measures were successful in reducing tensions, but did not eliminate them. Finally, Abbassi et al. (2015) focus only on two episodes, the Lehman default and the sovereign (Greek) debt crisis. They analyze both intensive and extensive margins of interbank lending – both on loan volumes and spreads - and study price dispersion based on a revealed preference argument – if during the same morning the same borrower is paying substantially different prices from different lenders, it implies that the borrower has limits to additional borrowing from the lender charging the lowest price. They find that price dispersion increased with both crises episodes, but that policy measures were effective in reducing it. Following these studies, this article contributes with an adaptation of the procedure for selecting operations of the recent Portuguese market and the evaluation of policy effects, filling a gap by analyzing one of the economies mostly affected by the sovereign debt crisis.

Events and policy responses

During the summer of 2007, the uncertainty surrounding the US subprime credit market provoked a suspension of redemptions for three investments funds by BNP Paribas. This event triggered the first stage of the financial crisis in the euro area and it was the link with the burst of the bubble in the subprime market (see Brunnermeier (2008) for a description of the crisis and its causes). As a consequence, the euro interbank money market froze, inducing the ECB to intervene through the injection of liquidity in the banking system during the following months, and by conducting more operations for larger amounts and maturities. The collapse of Lehman Brothers in September 2008 deteriorated the situation, requiring further central bank intervention. Besides regular monetary policy operations, the ECB further increased liquidity provision through an increased number of refinancing operations, accepted a broader range of collateral for these operations and opted for a fixed rate full allotment (FRFA) procedure at the main refinancing rate - at first only for main refinancing operations and later it was extended to all refinancing operations. The FRFA consists in a tender procedure where banks bid an amount which the central bank satisfies completely at a fixed rate that has been previously set. Consequentially, liquidity supply in the Eurosystem became demand-driven, inducing a significant excess liquidity in the euro banking system. Here, excess liquidity is defined as liquidity provided above the strict aggregate liquidity needs of the banking system, such as the demand for banknotes or for minimum reserve compliance. Hence, the term 'excess liquidity' does not take into account banks' preferences for liquidity – for instance keeping liquidity for precautionary motives.

Aside from the liquidity policy, the ECB pursued a series of adjustments to the standing facilities' interest rate corridor that, naturally, also had an impact on the money market. Following the bankruptcy of Lehman Brothers, this corridor – that used to be 200 b.p. – was lowered to 100 b.p.. Even though the corridor returned to the previous 200 b.p. level for a short period of time, in response to worsened market conditions and in order to avoid a negative deposit facility rate when cutting official interest rates, the ECB tightened the corridor once more from 150 b.p. in May 2009 to 75 b.p. in November 2013.

By the end 2009, conditions in Europe deteriorated as the euro market reacted to misgivings about Greece's government accounts. The sovereign debt crisis reinforced the instability in the euro area with successive requests for financial assistance³ and the uncertainty around both governments and banks – the results on banks stress tests did not ease the fears about the negative feedback loop between sovereigns and the banking system –, and was responsible for creating contrasting credit conditions among European countries. In particular, Portugal, Spain, Greece, Ireland and Italy experienced increased sovereign risk premia and decreased cross-border flows, also leading to a fragmentation of the euro money market (de Andoain et al. 2014).

The ECB, alongside with the objectives of easing banks' funding conditions and, ultimately, supporting bank lending to the economy, responded with a series of measures in order to support money market activity and the narrowing of spreads. On the liquidity policy side, it included two 3-year LTROs, an increase in the eligible collateral and a reduction in the minimum reserve ratio. These measures were reinforced by two Covered Bond Purchase Programs, given its relevance for the funding of euro area banks, and the Securities Market Program, with the purpose of correcting the deficient price formation process in the bond market that was impairing the transmission mechanism.

Finally, the deterioration of the sovereign debt crisis and the surge of a non-trivial redenomination risk of the euro motivated the ECB president to ensure, in the summer 2012, the ECB would "do whatever it takes to preserve the euro", followed by the launch of the Outright Monetary Transactions (OMT) program – the possibility of unlimited purchases of government bond securities with maturities between one and three years, conditional on the member state being in an European Financial Stability Facility (EFSF) macroeconomic adjustment program or a precautionary program –, to address this market instability. The OMT have not been activated so far.

^{3.} Financial assistance requests: Greece in May 2010, Ireland in November 2010 and Portugal in April 2011

More recently, the weak inflation dynamics – with a decreasing trend in inflation expectations and the persistence of a sizeable economic slack – led the ECB to provide further monetary stimulus. In mid-2014 and in January 2015, it implemented a program of purchases of public and private sectors securities (Asset Purchase Program), and a series of refinancing operations designed in a way to promote lending to the real economy (Targeted Long-Term Refinancing Operations).

Data

The money market consists mostly of over-the-counter (OTC) transactions. Lender and borrower usually agree upon a loan amount, a term and an interest rate and settle the transaction through a settlement system. In the euro area, the majority of money market operations are settled via TARGET/TARGET2⁴, the Real-Time Gross Settlement System (RTGS) owned and operated by the Eurosystem⁵. Several types of payments go through TARGET, ranging from monetary policy operations and interbank transactions to payments involving other financial institutions such as securities settlement systems. The system is accessible to a large number of participants.

In this paper we use all transactions settled on the Portuguese component of TARGET managed by Banco de Portugal. Data available from TARGET payments has, among other things, information on the amount transfered, the date and exact time of the transaction, and a Bank Identifier Code (BIC) for both participants. It is important to mention that there are no upper or lower limits on the value of payments. Therefore, from TARGET data we are able to observe a payment made from one institution to another, but it is not possible to assure it corresponds to a short-term interbank loan. We apply a method already used in the economic literature to identify these operations in order to overcome this issue (Furfine 2007; Armantier and Copeland 2012; Arciero et al. 2014).

^{4.} TARGET stands for "Trans-European Automated Real-time Gross settlement Express Transfer". TARGET2 is an improvement on TARGET (system previously at work). The transition from the latter to the former was implemented in phases beginning in 19 November 2007 and completely concluded in May 2008. From now on we will use TARGET and TARGET2 interchangeably.

^{5.} There are other large-value payment systems in the euro area, but of much more reduced dimension. In 2011, TARGET2 had a market share of 61% in quantities and 91% in value (see Banco de Portugal (2015)).

Identification of unsecured interbank money market transactions

We have a wide period of data covering the financial crisis and more than two years prior to the crisis period. Data has daily frequency and covers the period from 1 January 2005 to 31 December 2013. We are interested in selecting overnight, one-week, and one-month maturity payments, *i.e.*, transactions that correspond to rounded values going from institution i to j at day t, and in the opposite direction at day t+1, t+7, or $t+30^6$ in an equal amount plus a plausible interest.

The first step was to carefully choose and match all pairwise combinations ij-ji in business days t and t+1, t+7 and t+30. Basing our decision on the relevant literature, we kept only the combinations with a first payment of a rounded amount larger or equal to EUR 100 000 and multiple of 100 000 (Farinha 2007; Fernandes 2011).

The next phase was to determine the transactions' annualized implicit interest rate and which of those lay inside a plausibility area. Since we have no information on the interest rate agreed upon each transaction, we need to define an interval where interest rates on interbank loans will most probably lay. In doing so, we use data on EONIA, EURIBOR⁷, the deposit facility rate and the marginal lending facility rate⁸. We contemplated different plausibility intervals around these benchmark rates, depending on the operations' maturity. For overnight payments we considered an interval with a lower bound equal to the minimum between EONIA minus 100 b.p. and the deposit facility rate, and an upper bound equal to the maximum between EONIA plus 100 b.p. and the marginal lending facility rate. For one week and one-month maturity operations we have a corridor of 100 b.p. above and below the corresponding EURIBOR reference rate. After selecting repayments equal to the original loan plus a plausible interest, we excluded the pairs of transactions with zero or negative implicit interest rate.

Finally, we may have some problems associated with multiple matches or with the identification of operations. Multiple matches may take place within the same day or between days, especially when reference rates approach the zero lower bound and plausibility areas for different maturities overlap. The most relevant criteria used to overcome intraday multiple matches was to

^{6.} To avoid excluding interbank loans that actually took place, we allowed the algorithm to capture operations that happened between t+5 and t+9 (one-week), and between t+27 and t+33 (one-month).

^{7.} EONIA is the effective overnight reference rate for the euro. EURIBOR is the rate "at which Euro interbank term deposits are offered" by and between prime banks in the euro area. This rate is used as a reference for one week and one month operations.

^{8.} The Eurosystem offers credit institutions the marginal lending facility in order to obtain overnight liquidity from the central bank, against the presentation of sufficient eligible assets, at the marginal lending facility rate. It also offers credit institutions the deposit facility so banks are able to make overnight deposits with the central bank, at the deposit facility rate.

choose the operation with the interest rate closest to EONIA/EURIBOR. For the case of multiple matches that involve different days, the most relevant criteria was to opt for shorter-term transactions. Turning to problems with the identification of interbank loans, it could be that the algorithm incorrectly identifies a pair of payments as a bank loan (Type 1 error or false positive), or it can fail to identify a bank loan (Type 2 error or false negative). The accuracy of the algorithm diminishes with the maturity of the transaction and as the reference rate approaches the zero lower bound.

This method to identify money market loans has been widely used for the euro area (Arciero et al. 2014; Bräuning and Fecht 2012; Heijmans et al. 2011; Farinha 2007) as well as for other countries (Furfine 2007; Demiralp et al. 2006; Armantier and Copeland 2012). Some authors have performed validation tests on the method for parts of the euro money market. Arciero et al. (2014) used the Italian e-MID platform and de Frutos et al. (2013) the Spanish e-MID platform. Both concluded that up to three-month maturities the algorithm is very reliable for identifying unsecured interbank loans⁹. In the following section some descriptive statistics on the Portuguese interbank money market are presented.

Given that the purpose of the study is also to analyze the effect of non-conventional monetary policy measures, TARGET data had to be complemented with data on banks' balance sheets and monetary policy instruments. For the former, we accessed monthly data from supervisory reports at Banco de Portugal, and for the latter we gathered data on Portuguese monetary policy counterparties use of ECB policy instruments – such as reserve requirements, monetary policy operations, standing facilities, and collateral use.

Statistics

Market activity in quantities

During the nine year period considered in this study, the number of transactions in the market has reduced significantly. From 2005 to 2013 there were on average 50 daily transactions, from which 83% were overnight, 10% were one-week operations, and 7% were one-month maturity loans. Of these 50 daily operations, on average 26% were held between Portuguese banks. 10

^{9.} Arciero et al. (2014) show that the share of non-identified transactions in the best performing algorithm setup is 0.92%. On the other hand, the reliability of the algorithm for the Fed funds market is found to be significantly smaller (Armantier and Copeland 2012).

^{10.} In the Appendix we present further detailed information supporting the statements made in the text

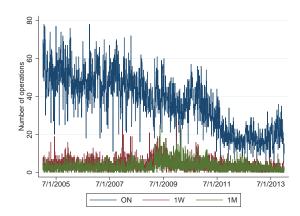


FIGURE 1: Number of operations per day

When we disaggregate operations by maturity we find that the decrease in market activity was due to the decrease in the overnight activity. From Figure 1 we can clearly see that along the whole period the daily number of interbank loans with one-week and one-month maturity contracts remained fairly constant. The number of overnight operations, on the other hand, progressively decreased, having had a major drop from 2010 onwards. We also find that in all three different maturity segments there was a considerable increase in the number of operations traded between domestic banks. From Figure 2, we can see that until the Lehman Brothers' collapse domestic operations were a small share of the market. In the particular case of overnight operations, loans between Portuguese banks represented less than 20% of all operations. After a period when almost no loans were being traded in the domestic market, the share of these operations began to increase, representing around 70% of the market by the end of the period. Thus, at a first glance we indeed find evidence of some market segmentation in the euro area, where Portuguese banks seem to face some difficulty in funding themselves outside.

Figure 3 gives a more detailed picture of the overnight cross-border market. The fall in the share of cross-border overnight operations coincided with a decrease in cross-border operations with a Portuguese lender, during the financial crisis. However, they still account for more than half of the transactions in the cross-border market. For one-week interbank loans the situation is slightly different. For the pre-crisis period, operations with a Portuguese lender account for most of cross-border activity. With the financial crisis the share of these transactions steadily dropped until 2012. Finally, when we look at the one-month maturity segment, it is visible that the share of operations with a Portuguese lender remained constant throughout the entire period, even though the share of cross-border operations as a whole has notably decreased with the financial crisis – at first these represented

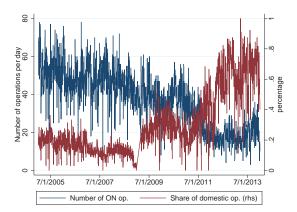


FIGURE 2: Overnight money market activity: share of operations in the domestic market

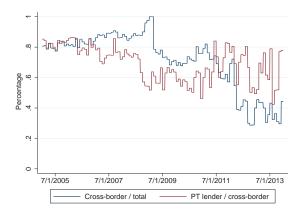


FIGURE 3: Cross-border market for overnight operations: share of activity according to counterparty origin

around 80% of the market and by the end of the period only around 40% (see Appendix B.1.).

Market turnover

The evolution of market turnover follows the evolution of the number of daily operations in the previous subsection. Figure 4 shows that the daily market turnover steadily decreased throughout the period. This reduction in market turnover was in great part a result of the decrease of the number of operations and of the average operation amount. In the particular case of the overnight market, which was the most impacted one, the average operation amount fell from 39 million euro before the crisis to 12 million between 2011 and 2013.

Notwithstanding, it is important to notice the high pick in turnover of one-week maturity operations between 2010 and 2012 which was due to a substantial increase in the average amount per transaction where a Portuguese bank receives a loan from a foreign counterpart (Figure 5). This suggests that Portuguese banks were still able to find funding outside, even though at a higher cost, as we shall see next. The period in which the increase took place corresponds to the beginning of the sovereign debt crisis in the euro area and it is the period when Portuguese banks were excluded from some international funding markets. Considering that credit risk is lower for shorter maturities, these developments indicate a substitution towards shorter maturities of the interbank money market funding.¹¹ However, our dataset does not allow us to prove this hypothesis. Arciero et al. (2014) also show an increase in crossborder loans in the peripheral countries of the euro area during the same period, alongside an increase in the rates agreed. Furthermore, another source of data, survey-based, points to the maintenance of the downward trend for the euro area as a whole (ECB 2015).

In the one-month maturity case the turnover, as the number of operations traded, remained fairly constant during the entire period in both the domestic and cross-border markets.

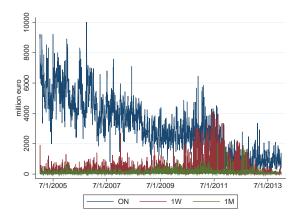


FIGURE 4: Daily turnover

^{11.} Even though we only study overnight, one-week and one-month maturity operations, loans in the interbank money market usually have up to 1 year maturity.

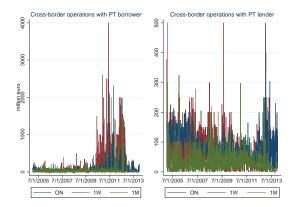


FIGURE 5: Daily average operation volume

Interest rates

In all the market segments, interest rates follow the respective benchmark interest rate closely - a consequence of the way the dataset is constructed, which identifies operations according to their proximity to the reference rate. The top panel of Figure 6 depicts the ECB's standing facilities rates, EONIA and the daily overnight rates of the identified transactions. Even though in the first part of the sample interest rates do not show much variation around EONIA, beginning in the fourth quarter of 2008 the dispersion increases. When comparing the weighted average interest rate of the operations with EONIA it becomes clear that from 2011 onwards Portuguese banks are trading above the reference rate. Looking into more detail, during that period domestic operations are more expensive than cross-border ones. Finally, in the cross-border market there are also some differences in the way Portuguese lenders and borrowers were being priced. From 2010 to the middle of 2011 Portuguese borrowers were, on average, paying more than what Portuguese lenders were getting from foreign banks. From then onwards the situation is reversed and Portuguese borrowers were paying lower rates than the ones lenders were being able to get.

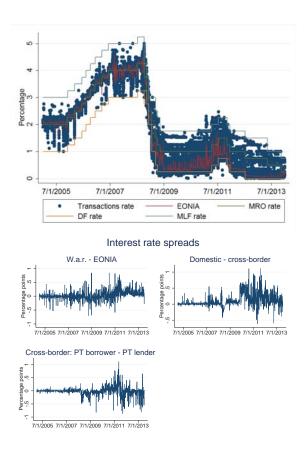


FIGURE 6: Overnight interest rates

In the one-week maturity case we will focus on the period when turnover in loans with this maturity increased. We find that around that time banks were trading slightly below EURIBOR, which may justify the increase in the average operation amount. Comparing rates from domestic and cross-border operations we find that domestic loans were priced below cross-border ones. Moreover, from the previous section we know the increase in turnover took place in cross-border operations with a Portuguese borrower, which are also priced above operations with a Portuguese lender, supporting the idea that there was some discrimination against Portuguese banks during the euro sovereign debt crisis (see Appendix B.2.).

The effects of monetary policy

Summing up, during the crisis we observed a fall in market activity and an increase in the dispersion of interest rates, while simultaneously several policy measures were being taken by the ECB. What is then the real effect of these measures in the money market? With the purpose of understanding these effects we run a simple regression using our unsecured interbank money market transactions' dataset. In this section we focus on the overnight segment, because it is not only the one that concentrates the largest share of market activity, but it is also the most important maturity for the implementation of monetary policy.

The policy followed by the Eurosystem – especially the change to the FRFA procedure, and also the enlargement of the accepted collateral and the increase in the number and maturity of refinancing operations – resulted in the existence of an aggregate excess liquidity in the banking system (ECB 2014). Along these lines, we want to understand the effect of monetary policy measures as proxied by the Eurosystem's aggregate excess liquidity. The liquidity expansion and the measures decided by the Eurosystem were not designed to respond to specific developments in the Portuguese money market, but to euro area developments as a whole. Moreover, the equivalent excess liquidity in the Portuguese banking system was close to zero and it is uncorrelated to the Eurosystem's. For this reason, our policy variable (*EL* in Table 1) is exogenous, i.e., it influences the Portuguese money market but is not influenced by it.

The Portuguese money market activity was also influenced by the tensions in financial markets and the shifts in risk perceptions by market participants. In this way, we control for these effects by including two crisis variables in the analysis. The spread between the 1-month Euribor and the Overnight Interest rate Swap (OIS) is used as a proxy of the tensions in money markets in the euro area as a whole. The Portuguese sovereign debt Credit Default Swap (CDS) spread is a proxy for the sovereign debt crisis period.

The result of a transaction also depends on the two counterparties involved. From theory we would expect that larger banks would be able to find more favorable conditions in the market, or that two banks that trade more frequently would do it at better terms between them than with any other bank. Therefore, in our regression we control for the origin of the bank, *i.e.*, if it is either a domestic or a foreign bank. In the case of domestic banks we also control for banks' balance sheet characteristics. In order to account for the effect of the frequency of interactions between lenders and borrowers there are two variables that measure it, one for the lending side of the relationship and the other for the borrowing side. Moreover, there may be other banks' features that have an effect in the results. To account for those, we impose lender and borrower fixed effects in the regression. Finally, we try to take out the effects of some other factors that might influence the money market, such as changes in the standing facilities interest rates' corridor, or the days when refinancing operations were conducted.

Table 1 shows the results of the regressions for (1) the spread between the interest rate of the transaction and the ECB main policy rate and (2) the logarithm of the amount traded. Starting from our main policy variable (*EL*), the Eurosystem liquidity expansion contributed to a compression of the spreads in the Portuguese market and to a fall in amounts traded, as the negative sign of the coefficient indicates. This result is consistent across all the different specifications that were tested. As the central bank increases intermediation in the market, the demand for liquidity by banks diminishes and, consequently, so does the price and quantity. We can say that the Eurosystem's policy measures where effective, at least to the extent that they allowed banks to continue to satisfy their liquidity needs and to do so at a lower cost than in their absence.

		(1) spread		(2) amount	
	EL	-0.0001	***	-0.0002	***
	1M euribor-ois	-0.0012	***	0.0001	
	PT sov cds	0.0002	***	-0.0001	***
	solv ratio	-0.7293	***	-20.519	***
	assets	-0.0712	***	0.0724	
	liq ratio	0.0020	***	-0.0042	*
borrower	ER	-0.0739	*	0.0494	
	foreign	-17.214	***	0.5961	
	frequent relation	-0.0009		0.0514	***
	solv ratio	-0.0609		-0.1190	
	assets	-0.1122	***	-0.0505	
	liq ratio	0.0019	***	0.0127	***
lender	ER	-0.0732	***	0.2128	***
	foreign	-21.014	***	-22.573	*
	frequent relation	0.0082	**	0.0900	***
	R2 overall	0.4943 52 601		0.5713	
	N° obs.			52 601	

TABLE 1. Results of the regression for the spread and the log of the amount of the overnight transactions

Results for the estimation on the spread between the transaction interest rate and the ECB main policy rate or on the logarithm of the transaction amount. Data has daily frequency from January 2, 2005 up to December 31, 2013. The estimated model is a panel data model with fixed effects for the lender and the borrower, an AR(1) error term and robust standard errors. Variables definition: *EL* is the Eurosystem excess liquidity defined as the sum of excess reserves and net recourse to deposit facility; *1M euribor-ois* is the spread between the 1-month Euribor and the 1-month overnight interest swap; *PT sov cds* is the Portuguese sovereign debt Credit Default Swap spread; *solv ratio* is the bank solvency ratio; *assets* are the total assets of the bank in logarithms; *liq ratio* is the bank liquidity ratio; *ER* are the banks' excess reserves deposited at the central bank at the beginning of the day; *frequent relation* is the lender/borrower preference index defined as the share of the amount traded with the specific lender/borrower during a period of 30 days. Further control variables included in the estimation but not present in the table: dummy for intragroup operations, dummies for the periods when the standing facilities corridor diverged from 200 b.p. and dummies for Eurosystem refinancing operations. Banks' characteristics (solvency and liquidity ratios, assets and ER) are only available for domestic banks.

The effect of the two crises on Portuguese banks was distinct. The euro money market crisis had no significant impact on Portuguese banks activity in the market. When we look at the effect on spreads, measured by the *1M euribor-ois* variable, we find that Portuguese banks even managed to trade at lower rates. On the other hand, the sovereign debt crisis significantly impacted Portuguese banks recourse to the money market. As the crisis heightened, Portuguese banks reduced the volume's traded and transactions became more expensive - the variable *PT sov cds* is significant in both regressions. This seems to be in line with the hypothesis of fragmentation of the market across jurisdictions.

Results on the banks' characteristics show that there is discrimination against banks perceived as riskier. When we run the same regression for separate periods, we conclude that the discrimination is only visible during the crisis. Before 2008, bank characteristics were not relevant for the pricing in the overnight market, which was a highly liquid market and with a very limited credit risk. However, the situation has changed since then. Banks with lower solvency ratios pay more for overnight loans, which are also made for larger amounts. As we can see from the results, banks' solvency ratio are only significant, in both regressions, when banks are borrowers (variable *solv ratio* in the table).

As one would expect, larger and foreign banks (variable *foreign*) usually trade at more favorable terms: transaction's rates are lower and amounts tend to be higher. Larger banks are those with a larger balance sheet as measured by the variable *assets* in both borrower and lender's characteristics. Finally, banks that trade more frequently do it for larger amounts (variable *frequent relation*).

Concluding remarks

Money markets are essential for monetary policy implementation and were among the most affected markets by the financial and sovereign crises. It is in the interest of policy to monitor conditions in these markets. However, it is difficult to obtain data on effective interbank market operations given that most of those are over-the-counter. Such problem became even more relevant to overcome as suspicions of the manipulation of interbank benchmark rates (EURIBOR, Libor) arose. In this paper we present a widely used method in the economic literature to identify unsecured interbank loans and we apply it to the Portuguese case. As a result, we are able to characterize the Portuguese unsecured interbank money market throughout the crisis. We reinforce the anecdotal evidence that there was a significant fall in market activity in the overnight segment, and we add evidence of a temporary increase in turnover in relatively longer maturities. Such events suggest that Portuguese banks recourse to the interbank market was not completely frozen. However, the price paid for loans to foreign banks was relatively high. Together with the significant fall in cross-border activity, this seems to favor the hypothesis of the fragmentation of the euro area money market. The decreasing trend became more evident since 2010, suggesting that the contagion from the sovereign debt crisis also hit Portuguese banks via the recourse to the short-term interbank market. The results of the regression analysis support this idea. Indeed, Portuguese banks were negatively hit by the sovereign debt crisis, but not so much by the first stage of the financial crisis, even though it heavily hit money markets worldwide. Nonetheless, the Eurosystem's policy measures, which implied a significant liquidity expansion in the euro area, where effective in compressing the spreads of overnight operations, while implying a reduction in market activity. Finally, it is essential to mention that we find evidence in favor of a discrimination against banks perceived as riskier, in the overnight market, since the beginning of the crisis.

Appendix A: Summary table

		Overnight	1 week	1 month	Total
	Jan 2005 - Aug 2007	51	6	4	58
Number of operations	Sep 2007 - Dec 2010	41	8	7	50
•	Jan 2011 - Dec 2013	23	4	4	29
	Jan 2005 - Aug 2007	5319,721	344,0919	135,7314	5638,512
Average daily volume (million of euros)	Sep 2007 - Dec 2010	3196,906	505,6533	181,5584	3627,952
	Jan 2011 - Dec 2013	1606,502	621,1228	180,7289	2138,818
	Jan 2005 - Aug 2007	39,3096	16,34832	7,535697	34,83724
Average daily volume per operation (million of euros)	Sep 2007 - Dec 2010	28,7322	30,15155	11,94909	27,63788
	Jan 2011 - Dec 2013	11,93885	27,59593	11,59309	13,37901
	Jan 2005 - Aug 2007	2,768	2,834	2,929	2,772
Average daily weighted interest rate	Sep 2007 - Dec 2010	2,108	1,796	1,707	2,024
	Jan 2011 - Dec 2013	0,561	0,698	0,624	0,588

TABLE A.1. Market activity summary

Appendix B: Additional figures

B.1. Market activity in quantities

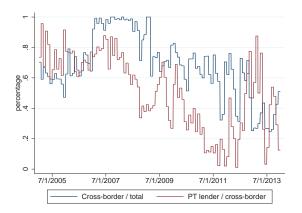


FIGURE B.1: Cross-border one-week market: share of activity according to counterparty origin

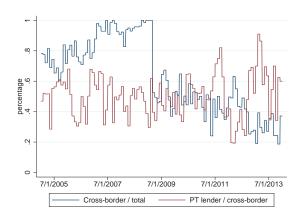


FIGURE B.2: Cross-border one-month market: share of activity according to counterparty origins

B.2. Interest rates

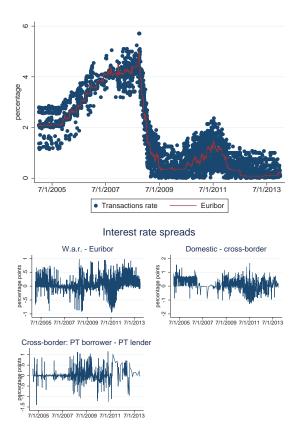


FIGURE B.3: Interest rates for one-week operations

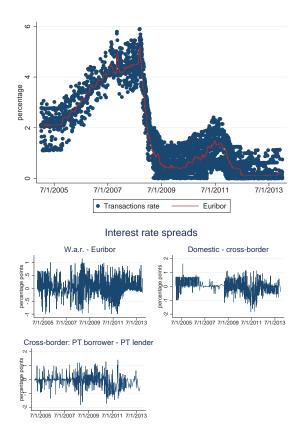


FIGURE B.4: Interest rates for one-month operations

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