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Ireland's 2010 EU/IMF intervention: Costs and benefits

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ABSTRACT

This paper examines the costs and benefits of the EU/IMF rescue package for Ireland, on November 29, 2010. We analyze the costs of the intervention and the subsequent increase in value of debt and/or equity issued by Irish banks, the Irish government, and European banks with substantial holdings of Irish debt. The total initial value increase around the announcement amounts to €5.59bln at a realized taxpayers' cost of €4.23bln. While the value increase depends on somewhat generous assumptions, it further increases by €2.8bln up to Ireland's exit in December 2013. About €3.1bln of the value created indirectly supports the European banking sector, indicating that substantial benefits arise from systemic risk containment.

"Strive to help, but above all, do no harm"
[Hippocratic injunction]

1. Introduction

The recent Euro crisis has witnessed several multi-billion euro interventions by the European Union (EU) and International Monetary Fund (IMF) that alleviated distressed government finances and calmed financial markets. Prior work has shown how publicly announced commitments to such interventions have improved financial market stability in the Euro area. For instance, Horváth and Huizinga (2011) find that the May 2010 announcement of the European Financial Stability Facility (EFSF) had a positive impact on bank share prices, and lowered bank and sovereign credit default swaps (CDS) spreads. Several other papers find similar evidence after the October 2008 announcement by euro area governments to rescue their national banking systems (e.g., Attinasi et al., 2009; Ejsing and Lemke, 2009; King, 2009).

While all these papers find that announcing an intervention stabilizes financial markets and lowers sovereign and corporate credit risk, little is known about the benefits of these programs relative to their costs. However, the idea behind government-sponsored bailouts is that the costs of a rescue (repayment of the principal loan plus interest) are relatively small compared to its benefits: A government bailout lowers the probability of default which should benefit creditors (i.e., increased asset value of foreign banks with substantial exposure to the sovereign) and debtors (i.e., decreased borrowing costs for the sovereign and its national banks). Indirectly, bailouts may also prevent liquidity runs (Caballero and Krishnamurthy, 2007), and recapitalize banks which eases credit rationing and allows for positive NPV lending.

This paper attempts to make a cost-benefit analysis for Ireland, the first European country that has entered *and exited* such a rescue program. Ireland was cut off from international bond market funding and entered the program in 2010, but exited the program by the end of 2013 through a successful government bond auction and full payback of its loan plus interest. This makes Ireland a somewhat exemplary case that fits the purpose of comparing bailout costs and benefits.[2] We perform an event study around the time of the actual bailout announcement, November 29, 2010, to estimate the expected benefits around the bailout announcement. We offset these expected benefits by the actual costs of the bailout, which can be calculated in retrospect and used as an estimate of the expected (but unobservable) costs of the bailout.

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[2] A study on Ireland's 2010 bailout program is also attractive because Ireland experienced a classic banking crisis, and theory predicts that government interventions are beneficial for such liquidity problems (Bagehot, 1897; Caballero and Krishnamurthy, 2007)) by calming markets. This is in contrast to the events in, e.g., Greece that have at the heart a classic debt crisis, for which an intervention is not necessarily optimal. Furthermore, it was the first case of coordinated crisis intervention by the EU, whereas the banking crises that followed (e.g., Spain) are difficult to isolate from other political events and from Ireland's bailout.

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We focus on how the bailout affects the valuation of Irish debt.[3] To compute the effect of the bailout on the main beneficiaries, we examine changes in the value of equity and long-term debt following a dif-in-dif approach as in Veronesi and Zingales (2010; VZ hereafter). VZ calculate such changes as the present value of the reduction in insurance costs paid on all the debt outstanding using credit default swaps (CDS) rates. Specifically, we directly examine changes in CDS rates to capture changes in the riskiness of outstanding debt, and combine CDS rates with the notional amount of bonds outstanding to calculate changes in the value of debt.

Making several simplifying assumptions, we estimate that the bailout announcement initially increased the value of outstanding debt to Irish government bond holders, the bondholders of major Irish banks, and stock/bondholders of European banks, by about €5.59bln. This was followed by a further increase of €2.8bln until Ireland exits the program in December 2013. The bailout came at a cost for Irish taxpayers who payed interest rate costs on the loan that, in retrospect, amount to about €4.23bln.[4] However, the estimates are surrounded by substantial uncertainty. On the one hand, our finding that benefits exceed costs relies on somewhat generous assumptions such as using actual rather than expected costs, which turned out lower due to lowered interest rates and penalty-free early paybacks. We also "fish" in the data for significant value increases that are not at first instance associated with the bailout. Furthermore, benefits also depend on how we determine the cut-off levels in identifying significant changes in debt or equity. On the other hand, the estimated benefits do not include a €2.8bln value increase over the course of the program up to Ireland's exit in December 2013. Nevertheless, despite of these reservations, our paper indicates that the Irish bailout has created value greater than or equal to its costs.

The paper proceeds as follows. Section 2 provides an historical overview of Ireland's bailout. Section 3 describes the data used. Section 4 describes how an event study on CDS is performed. Section 5 presents results and Section 6 concludes.

2. Institutional and historical background

This section draws heavily from Kelly (2009) and Whelan (2011). Ireland was frequently named the "Celtic Tiger" to describe Ireland's vast growth during the 1990s that was driven by a baby boom in the 1980s, a previously low rate of labor participation, as well as exports, direct investments, and development/structural subsidies from EU member countries. The economic growth, combined with a low housing stock per capita, led to a construction boom in the 2000s that accounted for about 15% of total employment in Ireland. Additionally, the Irish government had altered its tax base to collect revenues from real estate-related taxes, and Irish banks had adapted their business model towards borrowing heavily in international wholesale markets and lending to real estate developers and property buyers. Hence, when the housing bubble burst, a significant source of government revenue disappeared almost overnight while Irish banks faced increasing difficulties acquiring additional financing on international capital markets.

Two weeks after the collapse of Lehman Brothers on September 15, 2008, Irish banks were forced to file for government support. On September 30, 2008, the government decided to safeguard the deposits and liabilities of six major Irish banks despite warnings of Merrill Lynch who questioned the long term solvency of the institutions. In February 2009, when share prices of Irish banks kept on declining despite the deposits and liabilities guarantee, the Irish government took a €5.5bln stake in Anglo Irish Bank (AngIB) and Bank of Ireland (BOI), and established a "bad bank" (NAMA; National Asset Management Agency) with the purpose of recapitalizing banks through the purchase of non-performing loans from Irish banks. However, since the European Commission required that the Irish government could only pay 70% of the face value of non-performing loans, bank equities continued to decline in value. Problems worsened at a later stage, when the Commission stipulated that loans should be valued at market rates. Furthermore, UK banks started offering NAMA borrowers to repay their loans if they switched their business to UK banks. This led to adverse selection problems so that loans that were to generate most of its cash flow actually performed far worse than expected.

The Irish banking sector faced large losses on loans to builders and developers, little willingness of wholesale investors to buy bonds, and an increased likelihood of considerable losses on mortgages. By mid-2010, Irish banks were running out of eligible collateral to obtain loans from the European Central Bank (ECB). In response, the ECB allowed the Central Bank of Ireland to start making 'emergency liquidity assistance' loans to the Irish banks. During September and October 2010, international investors became concerned that the Irish banking sector was too large for the Irish sovereign, and bond yields on Irish government bonds started to increase.

Yields exploded following the Deauville declaration of October 18, 2010, when the German and French prime ministers announced a deal that envisaged tougher monitoring of countries' budgets and economics policies and a rapid amendment to the European Union's treaties (Economist, 2011). The Irish government turned to the EU and IMF for assistance on November 22, 2010. On Sunday November 28, finance ministers from the 17 euro-area countries unanimously decided to grant financial assistance in response to the Irish authorities' request and endorsed a multi-year funding package with the EU and the IMF. The total bailout amounted €67.5bln, funded by the European Financial Stability Mechanism (€22.5bln); the IMF (€22.5bln); the European Financial Stability Facility (€17.7bln); and bilateral contributions from the UK, Denmark, and Sweden (€4.8bln).

The course of events is summarized in Table 1, and Fig. 1 shows the five-year CDS rates of the Irish government during the year of the bailout, 2010. We observe an upward sloping pattern, with CDS rates being relatively stable until May 2010 and heavily increasing afterward. The graph clearly follows the course of events described just above.

The Irish bailout resembles a classical lender-of-last resort mechanism as in Bagehot (1873), with a policy-driven lender who lends to an institution that cannot get financing anywhere else. We note that the bailout should have a positive effect on market prices associated with the reduction in the probability of bankruptcy and hence the expected cost of bankruptcy. However, it may also elicit a negative response depending on the credibility of the signal to the bond markets: the effectiveness of any bailout depends on how it restores confidence in the financial system, which requires a strong signal that government bonds are insured. If bond investors perceive the bailout as insufficient, it will only further depress the value of debt. Hence, our event study may pick up two counteracting forces.

3. Data

Our initial sample includes the bondholders of the Irish government, six Irish banks, and the 18 Non-Irish banks that have the

[3] Studying the effect on the bailout on the entire Irish economy is more difficult. For instance, it would require estimating the sensitivity of economic recovery to the availability (or lack thereof) of credit.

[4] This paper focuses on the costs and benefits of the EU/IMF intervention, and thus ignores other costs and benefits associated with Ireland's banking crisis. For instance, in terms of other *costs*, the Irish taxpayer also "bailed in" through €17.5bln of fiscal adjustments over the period 2011–2014. However, this bail-in preceded the EU/IMF bailout and actually became part of Ireland's problem in 2009, when its government tried to save banks that were to big to be saved. As an example of other *benefits*, the decrease in the pricing of credit risk for the Irish state is sixteen times larger in the two years following the intervention. We discuss these and other indirect benefits in more detail below, in Section 5.2.

Table 1
Historical overview of the Irish bailout.

Date	Event
September 2008	Safeguard of the deposits of six major Irish banks by the Irish government
January/February 2009	Nationalization of Anglo Irish bank, capital injection Bank of Ireland and Allied Irish Bank
March 2010	Introduction of the National Asset Management Agency
April 2010–August 2010	Increased ECB lending, Irish banks facing severe refinancing problems
September 2010–October 2010	Bond yields rising due to concerns of international capital markets
18th of October 2010	Deauville declaration
21th of November 2010	Irish government files for EU/IMF assistance
28th of November 2010	Bailout of Ireland by the EU and the IMF

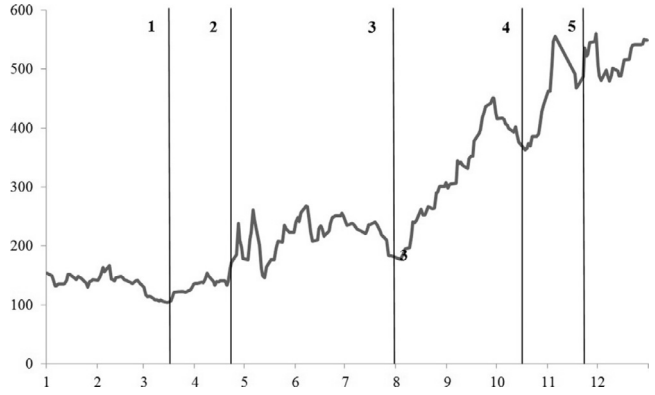

Fig. 1. Irish CDS rates during the year of the bailout. This figure plots the five-year CDS rate of Irish government in basis points per year. The horizontal axis shows the months of the year 2010. The numbers 1–5 are related to the following events: (1) introduction of the National Asset Management Agency, (2) increased ECB lending due to severe refinancing problems Irish banks, (3) increasing concerns in international capital markets about the creditworthiness of Ireland, (4) the Deauville declaration that signaled increased monitoring of sovereign budgets and economic policies, and (5) the bailout of Ireland by the EU and the IMF.

highest exposure to Irish debt as listed in "Stress test shows RBS exposure to Irish debt," (Financial Times, October 1, 2010). The list is based on the March 2010 stress test conducted by the Committee of European Banking Supervisors (CEBS). Since this list contains private and publicly listed banks, we hand-collect balance sheet information from the annual reports and use Bloomberg or Datastream to obtain CDS data for contracts up to five years, equity market capitalization and stock returns, and bond principal amounts.

In this sample, CDS rates for Education Building Society, Irish Nationwide (Irish banks), Groupe BPCE, Banco BPI, Bank of Cyprus, DZ Bank, WestLB and WGZ Bank (European banks) were not available in Bloomberg and removed from our sample. Furthermore, in November 2010, CDS rates for Anglo Irish Bank reach levels of around 4000 basis points per year. Closer inspection also reveals very large differences between the 1 and 2 year CDS rates (of around 4000 basis points) compared to the 3, 4, and 5 year CDS rates of around 2000 basis points. In fact, the 1 and 2 year CDS rates become unavailable after the 25th and the 26th of November 2010. Since this leads to unusual and even negative default probabilities, we remove Anglo Irish Bank from our sample (AIB refers to Allied Irish Bank). Hence, we measure the amount of value created by the bailout for bondholders of the Irish government, three Irish banks (Allied Irish Bank, Bank Of Ireland, Irish Life & Permanent) and 12 European banks (shown below).

Some key characteristics of the final sample are described in Table 2. Except for the Irish banks, Royal Bank of Scotland has the largest exposure to Irish debt, both in monetary terms as well as relative to assets. Most of the banks are highly levered, with a book equity/assets ratio ranging between about 2 and 6 percent. Furthermore, issued debt securities are a major source of European bank funding, up to at least 30 percent of total assets for several banks.

4. Event study methodology

4.1. An event study on credit default swaps

We calculate the benefits for the bailout using an event study on CDS rates as developed by Veronesi and Zingales (2010; VZ

Table 2
Final sample.

Rank	Bank	Country (Currency)	Listed	Total assets	Book equity	Debt issue	$\frac{\text{Exposure}}{\text{Assets}}$	Bank rating
1	Allied Irish Bank	Ireland	Yes	145,222	4349	15,664	4100	Baa3
2	Bank of Ireland	Ireland	Yes	177,370	7234	37,187	1200	Baa2
3	Royal Bank of Scotland	United Kingdom (GB£)	Yes	1,307,330	57,607	164,662	4300	Aa3
4	SNS Bank	Netherlands	Yes	78,918	1836	29,523	209	Baa1
5	Caixa Geral de Depositos	Portugal	No	125,862	7840	19,307	231	A1
6	Danske Bank	Denmark	Yes	3,213,886	104,742	1,005,705	655	Aaa
7	Norddeutsche Landesbank	Germany	No	228,586	5890	71,061	274	Aa2
9	LBBW	Germany	No	374,474	9991	81,692	408	Aaa
11	Credit Agricole	France	Yes	1,593,529	52,149	170,337	929	Aa1
14	Societe Generale	France	Yes	1,132,072	50,975	141,385(restated)	453	Aa2
15	HSBC	Hong Kong (US$)	Yes	2454,689	147,667	145,401	816	Aa3
18	BNP Paribas	France	Yes	1,998,158	74,632	948,575	571	Aa2
19	ING	Netherlands	Yes	1716,700	44,099	157,900	300	Aa3
20	Rabobank	Netherlands	No	652,536	40,757	196,819	222	Aaa
–	Irish government	Ireland	No	–	–	–	–	Baa1
–	Irish Life & Permanent	Ireland	Yes	75,699	1616	10,034	–	–

This table provides an overview of the institutions used in our analysis. We examine the Irish government, three Irish banks (Allied Irish Bank, Bank Of Ireland, Irish Life & Permanent) and 12 listed and unlisted European banks with the largest exposures to Irish debt and available data on CDS. All figures are reported in millions of euros unless noted otherwise. Total assets, book equity, and debt securities issued ("Debt issue") are taken directly from the 2010 annual reports. Banks' exposure to Irish sovereign debt ("Exposure/Assets") is the exposure obtained from the top-20 ranking in the Financial Times on October 1, 2010, divided by total assets. Bank credit ratings are from Moody's.

hereafter). VZ study the market response of publicly traded bonds issued by ten large banks to the Troubled Asset Relief Program (TARP), which the U.S. government effectuated after the collapse of Lehman Brothers. In a similar spirit, we use their methodology to study how the Irish bailout announcement elicits market reactions around the time of the bailout from publicly traded bonds issued by the Irish government and the Irish and E.U. financial sector.

Generally, an event study framework is informative when examining the impact of the Irish bailout, since the forward-looking nature of bond markets immediately incorporates expectations about credit risk of the Irish state, its debtors, and its creditors. Hence, an effective Irish bailout that restores financial stability by improving such expectations should translate instantly into higher debt values. However, since bond investors face high levels of uncertainty in the weeks before and after the government intervention, we take a similar period to examine when (and to what extent) bond markets benefit from the intervention. In addition, we also do an event study on equities since Horváth and Huizinga (2011) find that equity values changed significantly on the announcement of the E.U. bailout mechanism. In Section 5.2, we further extend our event window to the full length of the rescue program.

VZ's event study quantifies changes in the market value of bonds using changes in CDS rates. Although other studies better address the regime switching properties of CDS rates before and after a bailout event (which is an attempt to change from a volatile to a calm regime; e.g., Alexander and Kaeck, 2008), the VZ approach is particularly attractive since it allows a direct comparison of the increased *dollar* value in bond holdings to the cost of the Irish financial support. Furthermore, while other studies have compared Ireland's recovery with past recoveries from property boom-bust cycles (e,g, IMF, 2012; page 14), the VZ approach allows for a difference-in-difference setup that isolates the effect of the bailout from the impact that the bailout could have had, *at the same time*, on other dimensions (e.g., the impact of the intervention on systemic risk in the Euro-area). This is done by examining changes in CDS rates relative to the change in rates of a similar "benchmark" company that has no exposure to Irish debt, described in more detail below.

If debt becomes less risky, it appreciates in value as the interest rate used for compounding decreases. Even though we cannot observe this appreciation directly, we can measure it by looking at the reduced cost of insuring this debt with a CDS (the insurance payments). This cost will go down since a reduction in the risk of default (a lower default probability) will lead to a reduction in CDS rates. CDS rates are primarily driven by default risk rather than other determinants such as liquidity and taxes (Longstaff et al., 2005) and predict credit rating announcements (Hull et al., 2004; Norden and Weber, 2005). The event study methodology of VZ is based on an arbitrage relationship between CDS prices and credit prices: the payoff of a bond and an accompanying CDS should be equal to the risk-free rate. VZ equate the value of a bond (B) plus the present value of the cost of insuring it with CDSs to the value of a riskless government bond (GB) with similar rate and maturity:

$$B + PV(\textit{Insurance Cost}) = GB. \tag{1}$$

We note that a key feature of the Euro-crisis is a violation of this very arbitrage relationship, and no government bonds (particularly those issued by European governments) are without risk. Furthermore, Eq. (1) does not contain premiums for illiquidity or counterparty risk, which may be substantial (Bongaerts et al., 2011). However, Longstaff et al. (2005) show that CDS rates largely reflect default risk of bond issuers, while liquidity risk more relevant for "off-the-run" bonds (Forte and Peña, 2009).

We define the present value of the insurance cost in Eq. (1) as follows:

$$PV(\textit{Insurance Cost}) = \sum_{t=0}^{T} \frac{CDS(t)}{10{,}000} D(t)Q(t)Z(t),$$

where $D(t)$ equals the amount of existing debt that will not have matured by year t,$Q(t)$ is the risk neutral probability of not defaulting up to year t, and $Z(t)$ is the risk-free discount factor. VZ note that "[a] decline in the risk of a bond not triggered by a change in the bond's rate and/or maturity should not affect the value of its corresponding government bond." Hence, an increase in the value of B that is due to a reduction in risk translates into an equivalent reduction in the present value of the insurance cost, or:

$$\begin{aligned}\Delta PV(CDS) = &\sum_{t=0}^{T} \frac{CDS_1(t)}{10{,}000} D(t)Q_1(t)Z(t) \\ &- \sum_{t=0}^{T} \frac{CDS_0(t)}{10{,}000} D(t)Q_0(t)Z(t),\end{aligned} \tag{2}$$

where subscripts equal one after the bailout of Ireland and zero before the bailout of Ireland. As a result, the change in value of a bond can be obtained from CDS rates.

To implement the CDS event study methodology, we construct the variables from Eq. (2) as follows. First, CDS rates before and after the bailout $CDS_0(t)$ and $CDS_1(t)$ are from CDSs on Irish government bonds, bonds of the three Irish banks that received government support, and bonds of the selection of European banks. As mentioned previously, this selection is based on their exposures to Irish government bonds as published in the Financial Times on October 1, 2010 (see Table 2).

Next, we estimate the amount of existing debt $D(t)$ that will not have matured by year t. Although the current amount of debt securities issued can be taken directly from the annual reports (see Table 2), financial statements do not disclose what portion of the existing debt matures in the next 1–5 years. Furthermore, Bloomberg and Datastream do not have any historical information on the maturity of bonds outstanding back in 2010. Therefore, we use the maturity distribution of bonds in 2013 as an estimate for the maturity distribution back in 2010.[5] Specifically, we calculate the percentage of currently existing bonds maturing in year $2013+t$, $t = 1,\ldots,5$, and apply these percentages to the total value of bonds outstanding in 2010 to calculate the amount of existing debt at in 2010 that will not have matured by year $2010+t$. The Appendix shows how this works out, and indicates that substantial heterogeneity exists in the banks' debt maturity structure. We then multiply these percentages by the dollar amount of debt securities issued.

We compute a bond's risk-neutral probability of default $Q(t)$ at time t as in, e.g., Hull and White (2012). If s_t equals the paid CDS premium with maturity time t, the risk-neutral probability of no-default from $t = 0$ up to t is given by:

$$1 - Q(t) = \exp\left(-\frac{s_t}{1-R}\right),$$

where R equals the recovery rate that we set to 60%. Now the unconditional risk neutral probability of default between times $t-1$ and t equals:

$$Q_{t-1}(t) = \exp\left(-\frac{s_{t-1}}{1-R}\right) - \exp\left(-\frac{s_t}{1-R}\right).$$

[5] This does not take into account the re-pricing of risks that has taken place since the Euro crisis started, and which must have affected the investors' appetite for risk. For instance, five-year bonds issued before 2008 will have a low risk premium, but would receive relatively little weight in the 2013 distribution as several would have matured by then.

We follow VZ and set the discount factor $Z(t)$ to 3.5 percent per year. Similar to the argument against riskless (European) government bonds above, one could argue that this discount factor is possibly too low and will likely change due to the events we are interested in. Therefore, we further examine the sensitivity of our result to this and other assumptions in Section 5.3.

4.2. Other events at the time of the bailout

Although we focus on Ireland for several reasons explained in the Introduction, focusing on a single country also has its drawbacks. For instance, several papers indicate that developments in Greece had an important influence on developments in other Eurozone countries (e.g., Beetsma et al., 2013; Mink and De Haan, 2013; Bhanot et al., 2014). As a result, domestic European contagion risks might have elevated *all* European banks' CDS rates around the time of the Irish bailout. However, we interpret our results as differential impacts as in Eq. (2), which alleviates this concern.

At the same time, the intervention may also decrease European banks' CDS rates to the extent that it removes systemic risk from the financial industry. This would amount to an indirect channel of value creation, and omitting this channel would underestimate the intervention's benefits. More generally, our event study should account for the possibility of the occurrence of events unrelated to, but occurring simultaneously with, the Irish intervention.

To address this issue, we isolate the effect of the bailout by adjusting the change in bond value by the change in bond value of a reference bank with substantial exposures to Greece, Italy, and Spain, but *not* to Ireland. To find the reference bank, we further study the CEBS stress tests.[6] As can be observed from the country-by-country exposures reported in Deutsche Bank (2010), Deutsche Bank (DB) is a bank well-suited for this purpose since it has positive net exposures to Italy, Greece, and Spain of €1–8bln per country. These exposures are substantial, even in comparison to the €15 trillion net exposures in DB's home country Germany. By contrast, DB has only a very small, and *negative*,net exposure to Ireland of -€69 million. Indeed, we find that the value of Deutsche Bank bonds also increased during the bailout, and this cannot be directly the result of the bailout itself.[7]

Specifically, we follow Veronesi and Zingales by subtracting from Eq. (2) the ex-ante cost of insurance of bank i, multiplied by the percentage change in insurance costs of Deutsche Bank, our control:

$$Adjusted\ \Delta PV^i(CDS) = \Delta PV^i(CDS) - PV_0^i(CDS) \times \left(\frac{PV_1^{DB}(CDS)}{PV_0^{DB}(CDS)} - 1\right). \quad (3)$$

Hence, we use Eq. (3) to control for simultaneous events and possible systemic effects of the bailout, in particular the containment of contagion across the European periphery. For instance, when the insurance costs of Deutsche Bank have decreased around the bailout date, the difference $\Delta PV(CDS)$ from Eq. (2) is adjusted upward. Hence, Eq. (3) creates a difference-in-difference setup that specifically incorporates spillovers to the rest of the banking system.

5. Cost-benefits analysis

5.1. Initial benefits

The key event from Section 2 is November 29, 2010, when the full details of the rescue package became widely available. Fig. 2 plots the changes in present value of debt in € million from November 1 to December 15, 2010, for the Irish government, Irish banks, and European banks. We can see clear value increases around December 2 for all institutions of interest, with a dramatic spike in the value of Irish government bonds. Hence, the change in debt value is clearly related to a key date after the bailout, December 2.

The main result from Fig. 2 is backed by the evidence in Table 3. This table shows the average change in the present value of debt from November 22 (when Ireland asked for EU/IMF assistance) until December 6. The majority of changes is negative and relatively small, but the value of debt strongly increases on December 1–3. To assess whether the value created on these days is significant, we perform a t-test using the standard deviation of debt values from November 1 until November 19, 2010. Clearly, Fig. 1 shows that taking a longer estimation window would result in much higher standard errors due to the dramatic increase in CDS rates since August 2010. Hence, we are somewhat generous towards any evidence that might indicate the benefits of the bailout and return to this issue in Section 5.4.

We document several market reactions that are significant at the 10% level or better. The significant reactions in the CDS market suggest a gain of €2579bln consisting of €813 million for bondholders of Irish government bonds, a gain of €1,056 million on Irish bank bonds, and a gain of €710 million on European bank bonds.

In contrast to the US bailout studied by VZ, the EU and IMF provide loans and do not receive any (preferred) equity and warrants in exchange for the intervention. Nevertheless, since sovereign bonds are part of the makeup of a bank's asset base, substantial value may still be created in the equity markets as Irish banks received an injection of capital, and non-Irish banks benefited from the reduction in the impairment of their assets (i.e., Irish sovereign bonds). Empirically, evidence in Horváth and Huizinga (2011) indicates that equity values changed significantly around the May 2010 EFSF announcement. Therefore, we also run the event study on stocks for those European banks that are traded publicly (this ignores unlisted banks such as Rabobank and state-owned banks such as Norddeutsche Landesbanken and Caixa Depositos).[8] We find that volatility in European bank equities is quite high around the bailout, but that the equity value of publicly listed European banks significantly improved by €1,473 million.[9] Hence, the total value increase immediately after the bailout amounts to €4051 million.

[6] The stress test for Deutsche Bank and the test results for other banks reported in Table 2 are all as of March 31, 2010 and calculated according to the guidelines of the Committee of European Banking Supervisors.

[7] An alternative explanation for the value increase in DB bonds is that a flight-to-safety took place into assets of German banks. For example, Graph III.1.7 in European Commission (2013, p. 32) shows that the net international investment position of Germany's financial sector is positive, indicating an increase in holdings of German bank assets relative to their liabilities. As a consequence, the value increase in DB bonds may also indicate a largely opposite development, i.e., the escalation of the crisis in the euro-area. However, the 2010Q2-2011Q2 increase is quite modest, and negligible in comparison to the negative NIIP of deficit countries such as Ireland (30–40 percent of GDP for 2010Q2-2011Q2: Graph III.1.8 on p.32). Since only a small portion of these capital outflows seem to be funding German bank assets, flight-to-safety appears a relatively minor concern.

[8] Rather than market-adjusted returns as in VZ, we use the same procedure for equity as for debt and calculate the change in the value of equity using matched-firm-adjusted returns, with Deutsche Bank taken as reference firm, multiplied by each bank's market capitalization. For the purpose of comparing value changes (in euros rather than percentages) between an international selection of banks, returns are arguably better adjusted by DB than by correlations with the market index. This also circumvents the problem to decide what relevant market index to use as the banks are interconnected yet come from many different countries.

[9] We limit ourselves to European banks because Irish bank stocks trade at very low market prices (in the €1–3 range). Calculating returns from such prices increases volatility even more and, due to such low prices, focusing on European banks ignores a relatively minor source of benefits from the announcement (in monetary terms).

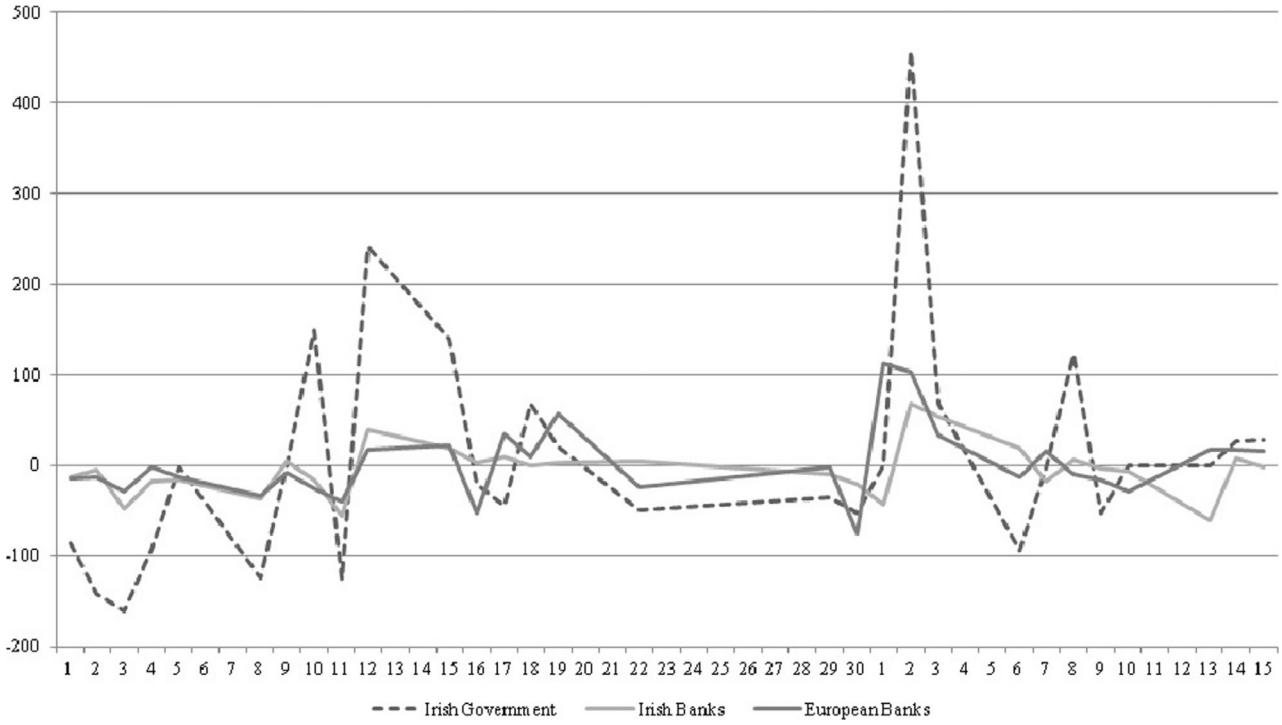

Fig. 2. Changes in of debt value over the month of the bailout. This figure plots changes in the present value of debt for the Irish government, the Irish banks and European banks from November 1 to December 15, 2010, in millions of euros. The horizontal axis reflects the days in November and December.

Table 3
Change in the value of long term debt and equity around the announcement of the Irish bailout.

Event date	Irish government debt	Irish bank debt	EU bank debt	EU bank equity	Grand total
22-11-2010	−124.13	−68.89	−79.72	−1,193.04	
	(−0.59)	(−1.37)	(−1.06)	(−1.48)	
29-11-2010	−292.51	−68.89	0.00	−98.02	
	(−1.39)	(−1.37)	(0.00)	(−0.12)	
30-11-2010	−12.45	69.58	−47.90	−601.01	
	(−0.06)	(1.38)	(−0.64)	(−0.75)	
01-12-2010	265.19	**380.17*****	**342.11*****	**1472.80***	
	(1.26)	(**7.56**)	(**4.54**)	(**1.83**)	
02-12-2010	**812.54*****	**577.15*****	**368.21*****	1,135.92	
	(**3.87**)	(**11.48**)	(**4.89**)	(1.41)	
03-12-2010	70.03	**98.70****	49.45	−105.05	
	(0.33)	(**1.96**)	(0.66)	(−0.13)	
06-12-2010	−93.32	31.88	−19.13	−183.63	
	(−0.44)	(0.63)	(−0.25)	(−0.23)	
	⋮	⋮	⋮	⋮	
Total significant benefits:	1588.66	1743.36	782.51	1472.80	5587.33

This table shows the change in present value of debt and/or equity for the Irish government and all financial institutions of interest around the Irish bailout. The figures are reported in millions of euros, with pricing information taken from Bloomberg and Datastream. The change in the value of long term debt is the present value of the reduction in insurance costs paid on all the debt outstanding as a result of a drop in the CDS rates, calculated using the methodology of Veronesi and Zingales (2010) described in Section 4.1. The change in the value of equity is calculated using matched-firm-adjusted returns, with Deutsche Bank taken as reference firm, multiplied by each bank's market capitalization. Debt and equity gains are adjusted for the percentage reduction in Deutsche Bank debt insurance costs. The bottom row is calculated from these and additional significant event dates described in Section 5.1. We calculate *t*-statistics, reported in parentheses, from the standard deviation in the value of debt or equity from November 1 to November 19, 2010. ∗∗∗, ∗∗, ∗ denote 1, 5, and 10 percent statistical significance, respectively.

Furthermore, the course of events discussed earlier leaves open the possibility that wehave overlooked events that have significantly increased the value of debt. To address this concern, we reverse our event study method. Instead of testing abnormal returns around event dates to determine when value is created for debtors and creditors of Ireland, we search the data and "fish" for event windows that could indicate additional debt value creation. We find that the present value of debt increases substantially over the weekend of November 12–15, 2010. This is illustrated by the hump around these dates in Fig. 2. Although we did not link this date to any political event a priori,a newspaper search shows that the finance minister of Ireland officially *denies* the bailout on November 12. Such a statement could be driven by rumors about a bailout that did not make the headlines at the time. Therefore, we also calculate the change in debt value over these days and find that the present value of debt increases significantly by €821 million and €894 million on November 12 and 15, respectively. Adding these numbers to the amounts

calculated above brings the total increase in debt value to €5,767 million.

Finally, the bailout did not pass in Ireland without controversy. Under the terms of the bailout, Irish taxpayers face years of cutbacks and tax increases while banks preserve full repayment of their senior bonds. As a consequence, public anger built with the political opposition arguing that *"Ireland has no moral or legal obligation to cover this debt. That's why it's a bad deal, that's one of the principal reasons we're going to vote against it, and that's why it has to be renegotiated."*[10] Hence, considerable uncertainty remained after the bailout announcement until on December, 15, 2010, Ireland's parliament approved the rescue package. In the meanwhile, the present value of debt fluctuated and actually dropped significantly by €609 million between December 7 and December 14. Yet, it significantly increased again by €429 million on the day that the bailout passed parliament. See also Fig. 2.

In sum, when adding up all significant changes in debt value, we find that the bailout initially generated a significant amount of €5,586 million for investors in government debt, bank debt, and bank equity.

5.2. Long-term benefits

The main focus of this study is to examine the *initial* market reaction to the Irish rescue package. This is appropriate to the extent that aspects of the post-bailout policy and legislative changes have been expected at the time of the announcement and, as such, constitute the announcement effect. Indeed, one reason why we expand our event window up to December 15, more than two weeks after the announcement, is to pick up more other post-bailout effects. However, one major difficulty with doing an event study in this context is that it does not take into account more recent institutional changes that benefit the debtors and creditors of Ireland. This concern is important because, before Ireland's succesful exit on December 15, 2013, Ireland's initial bailout in 2010 has led to several institutional changes intended to stabilize the European financial sector, but developed only partially and very gradually. For instance, the "*Joint Statement on Ireland by EU Commissioner Oli Rehn and IMF Managing Director Dominique Strauss-Kahn*" that announces the bailout[11] conveys a commitment to deleverage and recapitalize banks and measures to impose fiscal discipline, but did not mention more recent steps towards a banking union and the announcement of the ECB's Outright Monetary Transactions.

While it is difficult to determine the extent to which these institutional changes are initiated by the Irish bailout (e.g., they are not explicitly stated in this Joint Statement), this example illustrates that the initial market reactions only reflect changes in expectations of market participants for the length of the event window, and are based on imperfect foresight. Furthermore, investors form these expectations under the prevailing (either optimistic or pessimistic) sentiment. This has also been demonstrated repeatedly in previous debt and credit crises. As a consequence, if market participants have changed their expectations after the event window, or if they waited until prices fully impounded all the effects of the intervention, the event study will not capture all benefits of the program. This may explain why the pricing of credit risk for the Irish state has decreased quite a bit more in the two years following the intervention.

To address this concern, we also examine the change in debt value up to mid-December 2013, when the bailout program was completed. Although many things have happened during this period, doing so has the advantage that, while changing expectations may incur temporary or persistent price fluctuations, these expectations become irrelevant once the program is completed. Thus, all else equal, the difference in CDS rates between the time the initial bailout program was announced and the time the program was concluded should depend only on the *actual* changes in debt value over the life of the program.

Using CDS rates from December 13, 2013, the day Ireland exited the EU/IMF program, we find that the dollar value of debt has increased by another €2.8bln for the banks in our sample, over the life of the whole program. We acknowledge that this estimate cannot be attributed solely to the effect of the Irish bailout. It is likely that there are other events influencing bond values between December 16, 2010 and December 15, 2013 that are unrelated to the bailout, and we do not isolate these effects. Therefore, we are careful not to read too much into this. Nevertheless, it indicates that the initial announcement effect of the bailout substantially understates the total benefits of the program, which would increase by another 50 percent if we add benefits that materialized over the course of the program, and would increase even further when we would incorporate the increased long-run stock prices over the same three-year period.

5.3. Costs

For Irish taxpayers, the increase in bond value came at a cost. Although the expected costs of the bailout in November 2010 are largely unobservable, we do know that under the original terms of the bailout, €11.4bln was to be disbursed in the first 6 months at an average yield of 5.91% with an average maturity of 6.87 years.[12] This would amount to $11.4(1.0591^{6.87} - 1) = €5.51$bln for the first installment. This number is close to the initial market reaction from Section 5.1.

Unfortunately, most details about the expected costs of the bailout are unobserved. However, with hindsight, we can calculate the actual costs with some accuracy based on more recent press coverage. This is because even though the terms of the loans are not publicly disclosed, they have been eased several times upon decisions made by the European Council, in terms of lowered interest rates and penalty-free early paybacks.

Specifically, on the euro zone summit of July 21, 2011, the European Commission cut the interest rate on its loan to Ireland down to the European Financial Stability Mechanism (EFSM)'s funding costs.[13] Therefore, we assume an interest rate of 2.59 percent on the bailout funds – the average yield of the special-issue EFSM bonds that were auctioned to finance the first payout of bailout funds. Second, on July 18, 2013, Ireland's finance ministry announced that it had only used 91% of the available funding. Furthermore, Ireland exited the bailout after exactly three years at the end of 2013, since it has met nearly all its funding needs through 2014 by successfully issuing debt, including a 10-year bond.[14] So roughly, with hindsight, the actual total interest costs amount to $(0.91 * 67.5)(1.0259^{3.0} - 1) = €4.89$bln.

We note the interest rate is an important uncertain parameter in our analysis. For instance, after the bailout, the average yield of the special-issue EFSM bonds above only reflects the costs of the EU bond issuance that has been used to fund the support given to Ireland and not the cost of the EFSF.[15] The EFSF contributed a

[10] http://www.reuters.com/article/2010/12/15/us-ireland-idUSTRE6B942X20101215.

[11] https://www.imf.org/external/np/s/pr/2010/pr10461.htm.

[12] As reported by the Irish Department of Finance. See http://www.kildarestreet.com/wrans/?id=2011-07-12.983.0.

[13] See "Commission proposes better financial terms for EU loans to Ireland and Portugal," European Commission Memo/11/602, 14 September, 2011.

[14] See http://www.reuters.com/article/2013/07/18/us-ireland-imf-idUSBRE96H0JZ20130718.

[15] Whereas the EFSM relies on the European Commission to borrow in financial markets using the EU budget as collateral, the EFSF is a special-purpose vehicle that can issue bonds guaranteed by all Euro-zone member states.

Table 4
Sensitivity analysis.

	Irish government debt	Irish bank debt	European bank debt	European bank equity	Total
Base case	1588.66	1743.36	782.51	1472.80	5587.33
Changes in discount rate (all else equal)					
$Z(t) = 0\%$	1746.53	1670.93	1134.67	1472.80	6024.94
$Z(t) = 7\%$	1453.32	1633.25	846.76	1472.80	5406.13
$Z(t) = 10.5\%$	1336.46	1547.63	790.64	1472.80	5147.54
$Z(t) = 14\%$	1234.90	1471.04	740.94	1472.80	4919.69
Changes in significance level (all else equal)					
$p < 0.01$	812.54	1760.26	710.31	0.00	3283.11
$p < 0.05$	812.54	1858.96	1050.99	0.00	3722.49
$p < 1.00$	1730.11	1835.02	1008.77	−242.89	4331.01
No correction for spillovers (all else equal)					
No spillover effects	408.94	290.53	243.40	1477.80	2420.66

This table present the total significant changes in long-term debt and equity for the base case estimates from Table 3 (top row), as well as for several alternative specifications with variation in the discount rate $Z(t)$, variation in the level of significance p used to determine the significance of changes, and without indirect spillover effects to debt and equity of the European banking sector. The amounts are reported in millions of euros. ∗, ∗∗, and ∗∗∗ indicate significance at the 10% level, 5% level, and 1% level, respectively.

total of €17.7bln to the joint external financing package[16], and its bond yield averaged only 1.39 percent from 2012 until 2014, ranging from 2.57 percent in May 2012 to 0.43 percent in August 2014. For the EFSF, Ireland also pays an interest rate equal to the cost of funding. An average yield of 1.39 percent would further lower the cost for the Irish program by $17.7(1.0259^{3.0} - 1.0139^{3.0}) = €662$ million. On the other hand, the Irish Department of Finance states that the average mixed cost of funding as of March 31, 2014, is 3.06%.[17] Using this rate instead would increase the costs of the bailout by $17.7(1.036^{3.0} - 1.0259^{3.0}) = €570$ million.

5.4. Further analysis

While the estimates on costs and benefits of the Irish program to its taxpayers are quite uncertain, the benefits seem to be greater than or equal to the costs of the program. However, the numbers presented in this paper depend on several assumptions that we make while empirically implementing the event study. For instance, on the benefits side, while we follow VZ in setting a discount rate of 3.5 percent, this rate is probably too low for bonds that are not truly riskless and not perfectly liquid. Furthermore, it may change over the course of the bailout, and CDS rates may reflect other risks (e.g., counterparty and settlement risks) that are not part of our framework. Table 4 demonstrates how sensitive our estimates are as the discount rate $Z(t)$ varies between zero and fourteen percent, i.e., −100 percent to +400 percent times its base value. All else equal, the estimated benefits vary from €4.9bln to €6.0bln, indicating that while the discount rate substantially changes the benefits, they stay within the same order of magnitude.

In addition, while we calculate standard errors based on recent observations that are arguably the most relevant for our study, we should note that several value increases are only significant at the 10 percent level. This holds in particular for the event study results on bank equities, where we find a large value increase of €1.5bln immediately after the bailout that is only marginally significant, and high average volatility in the weeks before the bailout. Therefore, we also examine how the estimated benefits vary when we only count value changes if significant at better than the 1 percent, 5 percent, 10 percent level, or 100 percent. In the latter case, we count allvalue changes, positive and negative, regardless of their significance. We find that this matters substantially for the estimated benefits: results vary between €3.3bln and €5.6bln, primarily because of the €1.5bln in stock market value that is added at the 10 percent and 100 percent level, but not at the 1 percent and 5 percent level. At the 100 percent significance level, we find that the value of equity has in fact decreased somewhat, again due to highly volatile equity prices.

Finally, Eq. (3) incorporates the bailout's positive, but *indirect*, spillover effects to the European banking sector represented by the reference bank, Deutsche Bank. It is interesting to see how large these spillovers actually are. To this end, we re-run the analysis without adjusting the present value of debt as in Eq. (3), to examine the total benefits of the program to Ireland's direct debtors and creditors. Table 4 shows that more than half of the value created, about €3.1bln, comes from indirect benefits. This indicates that to a large extent, the value created from the intervention stems from indirectly supporting the European banking sector as a whole. Hence, substantial benefits arise from systemic risk containment.

6. Conclusion

To any standard, the Irish bailout has been exemplary for European policy in the debt crisis. The country is on its way back to funding itself in international bond markets and on December 2013, Ireland has become the first euro zone country to wean itself off emergency assistance. Furthermore, Ireland's favorable tax climate and position within the European Union lead to positive expectations regarding further economic recovery. However, Irish banks are still not out of trouble, and the Irish bailout has come at a high cost for Irish taxpayers. Since the Irish bailout was the first in a series of bailout packages, the question raises whether such interventions are not only effective in restoring financial stability (e.g., Attinasi et al., 2009; Ejsing and Lemke, 2009; King, 2009; Horváth and Huizinga, 2011), but also whether the benefits of the intervention exceed the costs.

This paper attempts to answer this question by comparing the actual costs of the bailout to its expected benefits as indicated by an event study on the value of equity and debt. We examine the expected benefits at the time of the bailoutthat should all be reflected into end-of-2010 investor expectations and, hence, into debt and equity market values immediately after the bailout is announced. In addition, we provide a rough estimate of the value increases over the full length of the rescue program, up to Ireland's exit in December 2013.

Using several simplifying assumptions, we estimate the expected benefits at the time of the bailout around €5.8bln, a figure that is greater than the actual costs (around €4.2bln). However, we acknowledge that our estimates bear substantial uncertainty, on both the costs and benefits side. We therefore examine the sensitivity of our estimates to several underlying assumptions.

[16] http://www.efsf.europa.eu/about/operations/ireland/index.htm.
[17] https://www.kildarestreet.com/wrans/?id=2014-07-17a.280.

On the one hand, our finding that benefits exceed costs depends to some extent on generous assumptions regarding the cut-off levels in identifying significant changes in debt or equity, using actual costs rather than expected costs, and "fishing" in the data for positive changes on dates that are not at first instance associated with relevant events. On the other hand, the estimated benefits exclude an increase of €2.8bln in debt value over the course of the rescue program up to Ireland's exit.

The picture we sketch remains incomplete. For instance, our analysis does not consider gains from the bailout in other areas such as the impact on the network of positions in derivative contracts on Eurozone bank equity, or the impact on preferred equity and warrants issued by these banks. Furthermore, as Ireland had declared unlimited deposit insurance for its largest banks in 2008, the bailout may have also lowered the pricing of government guarantees and the cost of deposit insurance. Neither do we incorporate the positive spillovers of the bailout to other distressed European (e.g., Greek/Italian/Portuguese/Spanish) government debt markets, since reduced borrowing costs in these markets are not directly relevant for our cost-benefit analysis from the perspective of the Irish taxpayer. However, this ignores the subsidies Ireland obtains from other Eurozone countries. It also ignores the indirect benefit of the Irish bailout to other countries as it reduces the probability that the EU will have to intervene directly in those countries.

Finally, there may be additional long-run benefits to the bailout that the paper does not capture. For instance, since recovering economies experience higher growth rates when credit is provided (Abiad et al., 2011), the current upwards revisions of the growth rates of the Irish economy may have been the result, at least partly, of the bailout program. However, this paper focuses on the changes on the valuation of the Irish debt and does not address the macroeconomic effects of the program on the real economy, such as the benefits of having bank credit available that accrue to the private sector.

The assumptions required to reach a break even point are in some contrast to the U.S. Troubled Asset Relief Program (TARP) that, on net, benefited the U.S. taxpayer up to $107bln (Veronesi and Zingales, 2010). However, our paper indicates that the Irish bailout has created value greater than or equal to its costs.

Appendix A. Maturity distribution of bonds outstanding

This table provides the assumed fraction of bonds maturing in the year 2010 until 2014 for the firms in our sample. The fractions are the total amount of bonds maturing in year 2013 till 2017, divided by the grand total over all bonds from 2013 onwards.

Debt outstanding in:	2010	2011	2012	2013	2014
Bank of Ireland	0.89	0.83	0.62	0.58	0.58
Allied Irish Bank	0.94	0.84	0.69	0.58	0.51
RBS	0.94	0.83	0.73	0.66	0.60
Credit Agricole	0.92	0.81	0.72	0.66	0.58
HSBC	0.87	0.65	0.57	0.53	0.45
Danske Bank	0.98	0.75	0.62	0.51	0.44
BNP Paribas	0.91	0.75	0.59	0.48	0.37
Societe Generale	0.92	0.82	0.70	0.59	0.51
LBBW	0.89	0.71	0.40	0.30	0.20
Postbank	0.93	0.73	0.57	0.44	0.34
Norddeutsche Landesbank	0.90	0.66	0.45	0.34	0.25
Caixa Geral de Depositos	0.98	0.70	0.60	0.50	0.45
Rabobank	0.92	0.69	0.56	0.46	0.37
SNS Bank	0.94	0.57	0.48	0.44	0.27

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