universität wien

TITEL DER DISSERTATION

"Three Essays on Financial Decisions:
From Banks´ Corporate Policies
to Households´ Portfolio Choice"

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Angestrebter akademischer Grad
Doctor of Philosophy (PhD)

Wien, 2015

Studienkennzahl lt. Studienblatt:	A 794 370 145
Dissertationsgebiet lt. Studienblatt:	Finance
Betreuerin:	Univ.-Prof. Dr. Gyöngyi Lóranth

This thesis is dedicated to all people who believed in me. The first is my-self. I could have never been able to believe in my-self without the always present support from Roberto, Giannina, and Paolo. The support I got was that sound love made by smiles, friendly talks, and very hard discussions and disputes, which made this thesis a team working. In these papers there is much more than "me."

Abstract

The Dissertation constitutes from three research papers. The background is the process for making financial decisions. The first two papers focus on the corporate choices of financial firms. In particular, the first article looks at intra-firm equity holdings inside banking groups. I study the risk incentive of parent firms originated by the funding of subsidiaries´ equity via so-called *double leverage*. The second paper investigates the decisions of banks on dividends in relation to their debt funding structures, distinguishing deposit versus non-deposit impacts. The third paper concentrates on the financial decisions of households, surveying effects on investment portfolios from individual health conditions.

Zusammenfassung

Die Dissertation entspringt drei Forschungsarbeiten. Der Hintergrund dafür liegt im Prozess Finanzentscheidungen zu treffen. Die ersten beiden Arbeiten konzentrieren sich auf die Unternehmenswahl von Finanzfirmen. Im Speziellen sieht sich der erste Artikel den firmeninternen Aktienbesitz innerhalb von Bankengruppen an. Er untersucht den Anreiz für Mutterunternehmen Risiko zu übernehmen, wenn sie das Eigenkapital ihrer Tochtergesellschaften über den sogenannten *Double Leverage* finanzieren. Das zweite Paper untersucht Dividendenentscheidungen von Banken in Bezug auf ihre Schuldenfinanzierungsstrukturen und unterscheidet dabei Einflüsse zwischen Einlage- und Nicht-Einlageschulden. Das dritte Paper konzentriert sich auf finanzielle Entscheidungen von Haushalten und untersucht dabei Effekte individueller Gesundheitszustände auf Investmentportfolios.

- "The Funding of Subsidiaries Equity, *Double Leverage*, and the Risk of Bank Holding Companies"

- "The Interplay between Payout Policies & Debt inside Banking Firms"

- "Health Status and Portfolio Choice: Is their Relationship Economically Relevant?"

The Funding of Subsidiaries Equity, "Double Leverage," and the Risk of Bank Holding Companies (BHCs)

Abstract

Financial authorities (as the Joint Forum and the Board of Governors of the Federal Reserve System) define as "double leverage" the circumstance in which the parent company of a banking group of firms is issuing debt and uses the proceeds for buying equity of subsidiaries. The paper discusses this type of intra-firm financing. We predict that, by double leveraging the parent moral hazard gets more acute, and ultimately leads to higher risk-taking. This risk-incentive might not be counterbalanced by consolidated capital requirements. Empirical results on United States Bank Holding Companies (BHCs) confirm this view. BHCs might want to exploit double leverage techniques in order to arbitrage their capital, with potential consequences on risk. This has got important implications on the financial stability of large banking groups.

Keywords: Bank Holding Companies; Equity Financing; Double Leverage; Consolidation; Risk
JEL Classification: G21, G32

1. Introduction

In the financial industry firms are frequently organized as groups, where a parent company is related to several subsidiary firms.[1] During the last decades, the extension and the complexity of banking groups have grown very rapidly. De Nicolo´ et al. (2004) provide evidence of an increasing trend in consolidation, internationalization, and conglomeration, which tends to accentuate the risk profile of financial firms and can ultimately bring systemic risk.

Consolidation often leads to the creation of Bank Holding Companies – BHCs (12 United States Code Sections 1841-48). After the Gramm-Leach-Bliley Act of 1999 well capitalized BHCs are permitted to become Financial Holding Companies, which besides the banking activity can provide also investment advisory and insurance related services. This translates into banking groups having highly extended networks, where a huge amount of resources is exchanged among the interconnected entities.

This article focuses on the financing activity from the parent firm towards the subsidiaries. More precisely, we consider the circumstance in which the parent firm funds the subsidiaries with equity. As soon as the parent firm is issuing debt in order to invest the proceeds into subsidiaries´ equity, this produces some "double leverage" to the group. A high degree of double leverage means that the parent firm exploits its own leverage in order to buy large shares in the subsidiaries´ equity. We ask whether this type of intra-firm funding has got an ultimate implication on the risk undertaken by the group.

In order to answer this question we provide a simple example where we study how the risk-taking of two hypothesized BHCs varies with their degree of double leverage. We select the items on their balance sheets in a way that they have the same group-wide capital assessment, as well as the same consolidated leverage ratio. Under certain circumstances, the two BHCs might also have the same risk-weighted capital requirement. We show that, inside the BHC where we observe a higher degree of double leverage the parent shareholders might have also higher incentives to undertake riskier projects. The use of double leverage techniques is measured by the so-called "double leverage ratio," defined as the ratio between the equity held in subsidiaries over

[1] The paper does not consider issues concerning the specific organizational structure which the group can assume. There are four types of group structure which are typically distinguished: the integrated model, the parent-subsidiary model, the holding company model and the horizontal group (Dierick (2004)).

the stand-alone equity capital of the parent company (see the Unite States Office of the Comptroller of the Currency, 2009).

Our working hypothesis is that, all else equal, those parent firms which acquire huge participations into subsidiaries by double leveraging do also exhibit higher levels of risk. This happens despite the group is subject to some consolidated capital requirements.

We analyze a large sample of United States BHCs during the period 1990-2014. The risk-taking of the BHCs is captured by the variability of the holding company stock returns. Regression results reveal that this proxy for risk-taking is positively related to the double leverage ratio. These results are robust to the inclusion of other important aspects driving the BHCs risk-taking, as business model, size effects, continuation value, capital requirements, and diversification benefits.

Besides the use of ordinary least squares (OLS) and fixed effects, we employ econometric tools which help in attenuating potential endogeneity in our results. These include the estimation of treatment effects models, propensity score matching, and regression discontinuity (RD) design. We also investigate how changes in corporate taxation interact with double leverage, and the analysis employs difference-in-difference and instrumental variables (IV). The employed quantitative methods allow detecting some causality in the inspected relationship. This supports our idea that the risk of banking groups is importantly affected by the funding relationship existing among the interconnected firms.[2]

The paper offers new knowledge on the flows of equity inside banking groups. We establish an increasing relationship between intra-firm equity financing and risk-taking. This has important consequences on the stability of the financial system. Our view is that, by double leveraging financial groups can arbitrage part of their regulatory capital. We argue that, as soon as capital requirements are computed on the base of consolidated balance sheets, they might not calibrate well the type of risk-incentive which this paper has discussed. Regulators and, more generally, policy makers should seriously take into account this result. In the final part of the paper we mention some recent proposals for imposing stronger capital standards on banking groups. The type of dynamics pointed out by this paper might help to evaluate the effectiveness of those proposals.

[2] The model of Freixas, Lóránth, and Morrison (2007) implies different risk-incentives between group structures and stand-alone firms.

So far, the resort from firms on double leverage has been raised much more often by financial authorities rather than academics. The Board of Governors of the Federal Reserve System defines double leverage as "the situation in which debt is issued by the parent company and the proceeds are invested in subsidiaries as equity" (Board of Governors of the Federal Reserve System, Division of Banking Supervision and Regulation, 2012, "Bank Holding Company Supervision Manual"). The Joint Forum affirms that, situations of "excessive leverage" inside financial conglomerates can give rise to "double gearing," occurring whenever one entity holds regulatory capital issued by another entity within the same group, and the issuer is allowed to count the capital in its own balance sheet (Joint Forum, July 2001, "Compendium of Documents Produced by the Joint Forum").[3]

The main concern is the ultimate effect that this type of intra-firm financing can have on the assessment of the group-wide capital. In that circumstance "measures of *solo* capital are likely to overstate the external capital of the group (…) [while] only capital issued to external (i.e., non-group) investors provides support to the group" (Joint Forum, 2001, "Compendium of Documents produced by the Joint Forum").[4] For this reason, it is recommended to give evidence in the group-wide capital assessment on the equity participations existing across the group firms.[5]

[3] The Joint Forum is the international authority deputed to the regulation and the supervision of financial conglomerates. The Joint Forum held its first meeting in January 1996 and has met regularly three times a year since. It is comprised of an equal number of senior bank, insurance and securities supervisors representing each supervisory constituency. Thirteen countries are represented in the Joint Forum: Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, United Kingdom and United States. The European Commission is attending in as an observer capacity (Joint Forum (1999)). The principles dictated by the Joint Forum cover different fields on the regulation and the supervision of financial conglomerates. In particular, the application of those principles should ensure that financial conglomerates are adequately capitalized. On the main issues concerning financial conglomerates we send to Herring and Carmassi (2010) and Yoo (2010). Besides the two mentioned in the text, we also mention the United States Office of Thrift Supervision, which denotes "double leverage" as a situation in which "the same capital is used simultaneously as a buffer against risk in two or more legal entities" (Holding Company Handbook (2009))

[4] An example on how double leverage might affect the capital assessment of the group entities can be found in the Joint Forum, 1999, Supplement to the Capital Adequacy Principles Paper.

[5] "Capital should also be addressed at the parent company level by specifying the degree of double leverage that the parent is willing to accept. The parent's capital policy should provide some measure of assessing each individual subsidiary's capital adequacy in the context of the double leverage within the organization" (Board of Governors of the Federal Reserve System, Division of Banking Supervision and Regulation, 2012, "Bank Holding Company Supervision Manual"). "Supervisors should require that capital adequacy assessment and measurement techniques address excessive leverage and situations where a parent issues debt and downstreams the proceeds in the form of equity to a subsidiary (Joint Forum, 2011, "Principles for the Supervision of Financial Conglomerates").

Whenever firms consolidate their balance sheets, accountancy procedures should avoid that capital is double counted.[6]

With this paper we extend with a more academic discussion the views of financial authorities. Our results offer quantitative evidence supporting the opinions from Dierick (2004) and Yoo (2010), who say that significant degrees of double leverage reflect arbitraging of regulatory capital.[7] We are also consistent to Lumpkin (2010), who claims that the "risk" of double gearing is one of the risks carried by financial groups.[8]

As already emphasized, our researched question cannot get important hints from the previous academic papers. There are some relatively old articles which mention issues of double gearing, but do not discuss them in an extensive way. These include Holland (1975), Karna and Graddy (1984), Pozdena (1986), and Wall (1987).

In the next section we develop a simple example which gets some hints from Bebchuk and Spamann (2010). Bebchuk and Spamann (2010) argue that the generic moral hazard[9] problem of equity inside banks might become more severe as soon as firms are organized as bank holding companies rather than as stand-alone firms. The reason is that the holding company has got an additional layer of debt financing which it can use in order to finance the equity capital of the subsidiaries. As soon as those subsidiaries suffer some losses, the equity value of the holding company reduces, leverage raises, and equityholders might want to risk more.

In more general terms, the topic of our paper can be related to the literature on the activities of banking groups. The intra-firm funding belongs to the so-called internal capital market. The features of the internal capital markets of multinational banks have been treated by, among oth-

[6] The Basel Capital Accord applies the regulatory capital standard on groups of firms on the base of consolidated balance sheets items. In general, for subsidiaries not included in the consolidated items of the parent company holds the principle that capital investments into those entities have to be deducted from the group capital (Basel Committee, 1999, "A New Capital Adequacy Framework," Consultative Paper Issued by the Basel Committee on Banking Supervision, Bank for International Settlements, Basel).

[7] The term "capital arbitrage" is meant as in Yoo (2010). Thus, financial groups capitalize on the misalignment between their actual risks taken and the sectoral regulatory requirements that they need to comply with. Kuritzkes, Schuermann, and Weiner (2003) claim that, one limitation of the silo approach for capital regulation of financial conglomerates is the increased potential for regulatory arbitrage.

[8] Fukao (2003) notes how the double leverage inside the Japanese financial industry generates poor quality capital and ultimately raises systemic risk.

[9] The moral hazard problem of equity was introduced by Jensen and Meckling (1976).

ers, Houston, James, and Markus (1997), Houston and James (1998), Campello (2002), De Haas and Van Lelyveld (2010), and Cetorelli and Goldberg (2012).[10]

We focus on the case in which the parent firm uses external debt for investing into the subsidiaries. Papers on the leverage choices of business groups include Bianco and Nicodano (2006), Verschueren and Deloof (2006), Manos, Murinde, and Green (2007), Luciano and Wihlborg (2013), and Luciano and Nicodano (2014). None of these papers though, relate explicitly the usage of debt to the funding of subsidiaries. Closer to this point is De Jong et al. (2011). De Jong et al. (2011) discover that highly levered French pyramidal firms have also higher dividend payouts. This is consistent to a debt service hypothesis, where holding companies exploit their own leverage for acquiring the control of the operating companies, which hence receiving huge dividends from them.

The funding choices of subsidiaries have been studied by Chowdhry and Nanda (1994), Chowdhry and Coval (1998), and Gopalan, Nanda, and Seru (2007).[11] These latter papers look at non-financial firms. To our knowledge there is no paper which studies the funding of subsidiaries inside financial conglomerates.

The paper is organized as follows. Section 2 addresses the research question of the paper. We formulate our testable hypothesis on the relationship occurring between the risk-taking of banking groups of firms and double leverage. This prediction is supported by a simple example where we show how one can assess the presence of some double leverage by the inspection of the firms´ balance sheets, and how it can impact risk. Section 3 is the empirical analysis of the paper. Data are from the United States banking industry, and regard a large sample of BHCs during the period 1990-2014. Several econometric techniques are implemented in order to test the working hypothesis. Section 4 does addition empirical tests. These are important checks which make the interpretations of the estimated outcomes more robust. In particular, the task is to offer stronger support to claims on causality. In Section 5 we discuss our main empirical pattern in relation to the formulated prediction. The discussion emphasizes how our results can be exploited for policy purposes. Section 6 concludes the paper.

[10] Several studies have looked at capital markets internal to non-financial groups, highlighting the respective costs and benefits, and questioning on their efficiencies. These include Stein (1997), Shin and Stulz (1998), Hubbard and Palia (1999), Scharfstein and Stein (2000), Matsusaka and Nanda (2002), and Desai, Foley, and Hines (2004).

[11] In addition to those papers, we also mention Aggarwal and Kyaw (2008) who say that multinational companies have a strategic competitive advantage deriving from internal financial networks. This allows subsidiaries to substitute external debt with parent debt, in order to overcome weak financial markets and institutional environments.

2. Motivating Example: Double Leverage, Capital Ratios, and the Holding Company Risk-Taking

2.1 A Simple Numerical Example

The current section has got the following tasks. First, we show how the balance sheets of the group entities would change when parent firms finance their subsidiaries by double leveraging. We consider the simple case of a group with two only entities and no frictions involved. We show how intra-firm funding based on double leverage might impact the group-wide capital assessment. We further show how the rules for the consolidation of balances sheets deal with this issue.[12] Second, with this example we want to stress the importance of our research question. The view point of regulators is that opportunities for double leveraging bring risk to the firm. With the following figures we show that, inside the BHC with highest double leverage the parent shareholders can gain larger benefits from the risky strategy undertaken by the subsidiary. We show that, while differences in the degree of double leverage would correspond to different risk incentives, we might not have different capital assessments for the two firms. The hints we get from this example lead us in stating the working hypothesis of this paper, which is tested in the succeeding section.

The framework of the example is the following. We consider two different Bank Holding Companies (BHCs) denoted with subscript A and B, respectively. The two groups are constituted by two only entities: the Holding Company (HC) and the unique subsidiary firm (S).[13] We consider two periods of time; for simplicity discount rates and taxes are set to zero. Investors are risk-neutral. The example develops in two parts. First we show that the balance sheet items of

[12] According to international working groups, the regulation of group-wide capital of financial conglomerates should follow one of the following two approaches: i) capital regulation on a consolidated basis and ii) a solo-plus approach to capital regulation. When capital regulation is applied on a consolidated basis all balance sheets of the group members are consolidated into a unique one, and the capital requirements are applied on the consolidated entity. According to the solo-plus approach instead, the group entities are subject to their own sector regimes, and the supervision is integrated by a group-wide quantitative and qualitative assessment. Common to both approaches is the measurement of group-wide capital adequacy. On this regard, the Financial Conglomerates Directive lists four calculation methods: the accounting consolidation method, the deduction and aggregation method, the book value and/or requirement deduction method, and a combination of all methods. All the four methodologies should address the concern about double leveraging.

[13] For the legal definition of a "Bank Holding Company" and the related "Subsidiary" see the 12 United States Code Sections 1841-48 (so-called Bank Holding Company Act of 1956). The paper focuses on the parent-subsidiary relationship and we do not discuss the presence of branches. In general, branches of banks are fully owned by their parents and represent their operations. They are not separate legal entities, while subsidiaries, in general, are separate legal entities which are owned or controlled directly or indirectly by the holding company. We use the terms "parent firm" and "holding company" interchangeably.

the two BHCs can be chosen in a way that the two firms have the same capital assessment and consolidated leverage ratio, while having different degree of double leverage, as measured by the so-called double leverage ratio. Second, we demonstrate that, inside the BHC where we compute the highest double leverage ratio, shareholders are better off if the subsidiary is undertaking a risky strategy.[14]

2.2 Two BHCs: Same Capital, Different "Double Leverage"

HC_A acquires the "targeted" S_A.[15] Before the deal HC_A and S_A have got balance sheets as follows:

Holding Company (HC_A)			
Assets		**Liabilities**	
Loans	150	Equity	40
		Debt	110
Total	150	Total	150

Subsidiary (S_A)			
Assets		**Liabilities**	
Loans	100	Equity	50
		Debt	50
Total	100	Total	100

HC_A acquires the full control of S_A by issuing debt.[16] Afterwards, the consolidated balance sheet of the group looks as follows:[17]

[14] Our example is closely related to the example in Bebchuk and Spamann (2010). Bebchuk and Spamann (2010) show that the risk incentive for shareholders of a holding company is higher as soon as the firm is doing some risky activities via a related subsidiary, rather than operating as a stand-alone firm. Our example integrates the example of Bebchuk and Spamann (2010) further showing that, the risk incentive for the holding company shareholders is proportional to its double leverage ratio.

[15] When HC buys more than 50% of the outstanding common stock of S the purchasing company HC has legal "control" over the acquired company. For the definition of control see the Bank Holding Company Act of 1956.

[16] The simple example abstracts from issues which might affect transactions, as taxes or discount rates. We consider two only points in time: the moment in which the holding company and the subsidiary are both in place and the holding company has not invested into the subsidiary yet, and the period immediately after the acquisition. For simplicity, between the two periods there is no further change in the balance sheet composition of the firms. In particular, the holding company is not rising in capital.

[17] The two balance sheets are fully consolidated. Our example is similar to the example we find in the Appendix B from the Office of Thrift Supervision, 2009, "Holding Company Handbook."

Consolidated Balance Sheet of Bank Holding Company A ($HC_A + S_A$)			
Assets		**Liabilities**	
Loans	150+100	Equity	40 ~~+ 50~~
~~BV participation in S~~	~~50~~	Debt	110+50+50
Total	250	Total	250

Note that, on the consolidated asset side of the balance sheet the participation into S_A offsets with the equity value of S_A on the liability side, and the consolidated entity relies on the holding company capital. The equity-asset ratio for BHC_A results to be equal to 16% (=40/250).

We employ the items from the balance sheets above in order to compute the so-called double leverage ratio. This equals to the stake of the subsidiary´s equity held by the parent company divided by the parent company own equity capital.[18] When the double leverage ratio is higher than one it means that the parent has acquired the subsidiary in a larger measure than its *solo* capital. This implies that the deal has been funded with some debt issuance. The double leverage ratio for BHC_A is *DLR* = 125% (=50/40).

The capital adequacy of BHC_A is evaluated as follows. We assess the group-wide capital as follows.[19] First, we establish the fraction of capital which the two firms are required to have for regulatory purposes, fixing this share equal to the 10% of the total assets. The capital surplus/deficit stems from the difference between the firm equity capital and the required capital. HC_A has to subtract from its equity capital the investment in S_A. The group-wide capital is the sum of the capital surplus/deficit computed for both firms. The Table below shows the calculations:

[18] We are consistent with the definition of double leverage ratio provided by the Office of Thrift Supervision, now part of the Office of the Comptroller of the Currency, 2009, "Holding Company Handbook." Some empirical papers employ slight different measures for the group double leverage. In Mayne (1980) and Karna and Graddy (1984) the double leverage ratio is the quotient between the investment in subsidiaries equity and the parent company net worth, minus one. Wall and Peterson (1988) divide the investment in subsidiaries equity by the BHC consolidated net worth less goodwill. In the more recent paper of Krainer and Lopez (2009) the double leverage ratio is computed as we do in this example.

[19] For the group-wide capital assessment we follow the instructions from the Office of Thrift Supervision (2009, "Holding Company Handbook") and from the Joint Forum (1999, "Capital Adequacy Principles Paper"). In particular, among the several methods which institutions can use with discretion in order to assess capital, the example follows the so-called full accounting consolidation method.

	HC_A	S_A	Group-Wide Total
Equity Capital	40	50	90
Deduct Investment in S_A	-50	0	-50
Capital Required (10%*Assets)	-15	-10	-25
Capital Surplus / Deficit (-)	-25	40	15

On a stand-alone basis HC_A has got a capital surplus of 25. Nonetheless, the investment into S_A brings down its effective capital position. The overall capital for BHC_A is a surplus of 15.

Let´s now consider a second different group. BHC_B is constituted by HC_B and S_B, which have the following balance sheets:

Holding Company B (HC_B)			
Assets		**Liabilities**	
Loans	140	Equity	30
		Debt	110
Total	140	Total	140

Subsidiary B (S_B)			
Assets		**Liabilities**	
Loans	110	Equity	50
		Debt	60
Total	110	Total	110

HC_B acquires the fraction *x* of S_B using debt proceeds. Assuming that *x* equals to 80%, the consolidated balance sheet of the group would be the following:

Consolidated Balance Sheet of Bank Holding Company B (HC_B + S_B)			
Assets		**Liabilities**	
Loans	140+110	Equity	30+~~0.8*(50)~~
~~BV participation in S~~	~~0.8*50~~	Minority Interests	0.2*(50)
		Debt	110+0.8*(50)+60
Total	250	Total	250

Note that, HC_B has to register a minority interest on its liability side.[20] The consolidated equity-asset ratio equals to 16% (=(30+10)/250)).[21] HC_B holds a participation of 40 with respect to its own capital of 30, hence the group has double leverage ratio slightly above 133%. The capital adequacy of BHC_B is summarized in the following Table:

	HC_B	**S_B**	**Group-Wide Total**
Equity Capital	30	50	80
Deduct Investment in S_B	-40	0	-40
Capital Required (10%*Assets)	-14	-11	-25
Capital Surplus / Deficit (-)	-24	39	15

Comparing the capital assessments of the two BHCs we note that the group-wide capital for BHC_B is the same as in BHC_A. The consolidated leverage measure based on book values is also the same. We could further assume that the two BHCs have got the same risk weighted assets. In that case, if the capital of the firms is all qualified for regulatory purposes, then the capital ratio we just computed would be close to the regulatory standard. In terms of double leverage instead, the two firms are different. BHC_B is carrying higher double leverage on its structure,

[20] In this case HC_B has not the full control of its subsidiary. When a subsidiary is less than wholly owned, a portion of its income accrues to its non-controlling shareholders and this will be excluded from the consolidated net income (Baker et al. (2005)).

[21] In our example the firm capital includes minority interests. The treatment of minority interests can affect the capital position, therefore supervisors require to take the due attention in applying the method of capital assessment which more properly deals with the relevance of the minority interests held in the various entities of the group (see the Joint Forum, 1999, "Capital Adequacy Principles Paper"). In general, in the Basel environment minority interests are included in the regulatory capital. After the first Basel Accord, several amendments on the definition of BHCs capital have posed some restrictions on the conditions under which minority interests can be classified as capital. Under Basel II tier 1 capital includes qualifying minority interests issued by consolidated depository institutions or foreign bank subsidiaries. Other types of qualifying minority interests are part of tier 2 capital. Basel III has placed qualitative and quantitative limits on the ability of a banking organization to count minority interests towards its consolidated regulatory capital (see the Basel Committee on Banking Supervision, 2010, "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems," available from http://www.bis.org/publ/bcbs189.pdf).

and HC_B is more largely exposed to the subsidiary.[22] The task of the succeeding part of the example is to show how this exposure might affect the risk-taking of the two parent companies.

2.3 Two BHCs: Different "Double Leverage," Different Risk Incentives

We assume that in both groups the subsidiary adopts a value neutral strategy which produces with equal probability a loss or a gain of $x\pi$. Remember that x is the stake of HC_B owned in S_B. In general, the participation into the subsidiary is an asset for the holding company, thereby the activities run by the subsidiary affect the value for the holding company shareholders.[23] The second and third columns of the table below report the expected value for equityholders inside both HCs. The worth of their claim depends on whether S plays or not the risky strategy, and on the entity of the loss/gain π as compared to the equity value of the holding company. In the last column of the table the quantity delta is the difference in expected value terms between the holding company equity when S is playing the risky strategy, and the same equity when no risk is taken by S. In other terms, delta measures the advantage for the holding company shareholders that the risk-taking of the group is higher.

	Expected Value of HC Equity if:				**Delta (b-a)**	
	S does not play the Risky Strategy (a)		**S plays the Risky Strategy (b)**			
	HC_A	HC_B	HC_A	HC_B	HC_A	HC_B
$0.8\pi < 30$	40	30	$0.5*(40 + 0.8\pi) + 0.5*(40 - 0.8\pi) = 40$	$0.5*(30 + 0.8\pi) + 0.5*(30 - 0.8\pi) = 30$	0	0
$30 \leq 0.8\pi < 40$	40	30	$0.5*(40 + 0.8\pi) + 0.5*(40 - 0.8\pi) = 40$	$0.5*(30 + 0.8\pi) + 0.5*(0) = 15 + 0.4\pi$	0	$0.4\pi - 15$
$0.8\pi \geq 40$	40	30	$0.5*(40 + 0.8\pi) + 0.5*(0) = 20 + 0.4\pi$	$0.5*(30 + 0.8\pi) + 0.5*(0) = 15 + 0.4\pi$	$0.4\pi - 20$	$0.4\pi - 15$

Note: Equity $HC_A = 40$; Equity $HC_B = 30$; Holdings of HC_B into $S_B = 0.8$; π = gain/loss

[22] In both cases we choose values in a way that in the two BHCs the *DLR* is above 100%. This means that the two holding companies are investing into their subsidiaries in a larger measure than their stand-alone capital.

[23] In the example we concentrate only on the benefits for shareholders and do not consider benefits for executive managers.

In the first row the gain/loss π is lower than the equity of HC_B. Given that HC_B is lower than HC_A, inside both groups the loss would be entirely absorbed by the holding company equity. Based on the expected value of their claim, shareholders would not have an advantage that the subsidiary does the risky activity, since the computed delta is in both cases zero. The third row is the extreme case in which the gain/loss overcomes the equity of HC_A. If S is losing π, the equityholders of both firms are wiped out, and part of the loss has to be borne by creditors. The strategy of S brings a positive expected benefit, which is larger for HC_B.[24] The second row represents the intermediate situation in which the loss π triggers the distress inside HC_B, where shareholders are wiped out, while HC_A has got enough capital to absorb the same loss. In this case only inside HC_B the shareholders get a positive delta.

Between the two groups, BHC_B is the firm where we observed the highest degree of double leverage. We have showed that, under certain circumstances, BHC_B might be more encouraged to undertake risk. Recall that, we chose the items of the two balance sheets in a way that they produced the same capital assessment. The task was to point out that, despite the two organizations would be equally assessed on their capital adequacy, the consolidated capital available to BHC_B might be more frequently insufficient for covering losses once that the subsidiary decides to carry the risky project.

2.4 Discussion on the Numerical Example and Empirical Prediction

We discuss the way in which our simple example motivates our research question summarizing the main insights we get from it. We finally formulate the prediction which we test in the empirical part of the paper.

We choose the items on the balance sheets of the two BHCs in a way to point out how the group capital assessment might not reveal potential frictions originating from double leverage on risk. There might be several issues which our example does not take into account exhaustively. Note that the analysis is not developed under the framework of Modigliani and Miller (1958). This might be left to future research, and effort could be spent in order to offer a better modeling for the dynamics which our figures have represented in a very stylized way. Despite of this, we think the example offers the following main insights.

[24] In the last row π is larger or equal than 50. Delta for the equityholders of HC_A is at minimum zero (0.4*50-20=0), while delta for the equityholders of HC_B is at minimum five (0.4*50-15=5).

As the holding company acquires a certain stake in the equity of the subsidiary, it adds an asset to its investment portfolio. If the subsidiary is successful in the risky strategy, the holding company shareholders gain on that asset. At the same time, they suffer a shortfall if the subsidiary is losing on the strategy. In our example we assumed that the holding company is liable in the limit of the exposure towards the subsidiary.[25]

The opportunistic behavior of the holding company might depend on how the firm finances the subsidiary. When the firm invests debt proceeds and at the same time maintains a relatively low stand-alone capital, the moral hazard might get more acute, because shareholders can get larger upsides from the risky activity of the subsidiary.[26] In other terms, we argue that, intra-firm funding of equity producing double leverage can encourage firms to undertake higher levels of risk.

By construction the two BHCs have got the same capital assessment and, under certain conditions, also the same consolidated regulatory capital ratio. Despite of this, the example shows that there are some states in which a certain loss triggers the distress of BHC_B while it is fully absorbed by the capital buffer of BHC_A.[27]

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[25] In a parent-subsidiary relationship the principles of limited liability and corporate personality do apply. Although, according to the so-called "source of strength doctrine" there are circumstances in which the holding company provides financial support to distressed subsidiaries (among others, see Gilbert (1991) and Ashcraft (2008), and for a more legal perspective of the topic see Duncan (1987) and the Bureau of National Affairs (1987)). As a matter of fact the parent may or may not be liable for the losses suffered by subsidiaries depending on the type of legal agreement which the firms do have. For instance, firms might be related by Capital Maintenance Agreements (11 United States Code Section 507). In addition, Galgano (1991) notes that the board of the subsidiary works under the influence of the parent, since directors in the subsidiary owe their positions to the parent company. This finds its expressions in the confidential directions issued by the controlling shareholders and with which the directors spontaneously comply.

[26] The outcome would be different in the opposite case in which the holding company raises equity on its own and acquires equity in the subsidiary in the correspondent measure. For example, let´s consider the deal inside BHC_A. HC_A issues equity by 50 and buys all the stocks of S_A. In that case there is no funding of the subsidiary through double leverage, since the holding company is not raising debt on its own. The loss π can be at maximum 50, and we can show that, for all the values between 0 and 50, the delta for shareholders would be always zero, since the capital of the holding company would be 90 (the initial 40 plus the 50 issued for acquiring the subsidiary). In the opposite case we represent in the example instead, the holding company raises the additional 50 by debt. The same loss of 50 is now providing shareholders with a delta equal to five.

[27] As we have remarked, this example is constructed *ad hoc*. We would though exclude that the result we get from the example is an immediate consequence of the fact that, BHC_A fully controls the subsidiary, while in BHC_B the subsidiary in partially owned by the holding company. Let´s construct a third group BHC_C. HC_C has got equity and debt equal to 40 and 100, respectively. S_C has got equity and debt equal to 45 and 65, respectively. In this case HC_C fully acquires S_C by issuing debt. BHC_C have equity-asset ratio equal to 16% (=40/250), and *DLR* equal to 112.5% = (45/40). HC_C has same capital of HC_A. If we compare the risk incentive between the two firms as we did in text, we see that, delta of owners is the same in both cases: zero as long as $\pi \leq 40$, and then turns positive for $\pi > 40$. Inside both BHC_A and BHC_C the subsidiary is fully controlled. We find more plausible that risk-taking incentives would be higher inside HC_A, for the following reason. Losses of $\pi \in (45, 50)$ would be absorbed by the capital of S_A, while the equity of S_C will completely vanish. Consider for example a loss of 47. S_A covers the loss with its

Our expectation on the relationship occurring among double leverage, risk, and banking capital is the following:

A holding company increasingly investing into the equity of its subsidiaries as compared to its own equity capital (thus, having higher "double leverage") might be incentivized to undertake more risk. All else equal, this risk incentive might not be entirely offset by the holding company capital requirement.

The remaining part of the paper is addressed to test empirically this view, and to discuss the policy implications of our results. We conclude this ection with an aside comment regarding the terminology used so far in our article. Financial institutions talk about a "double" counting of leverage. Nonetheless, the figures of the example do never show a duplication of leverage ratios or debt values. The term "double leverage" is to our view relatively inaccurate. It would be more appropriate to say that the parent firm can use "additional" leverage.[28] Namely, the parent can add debt to its capital structure for funding subsidiaries, besides using debt issuances for investments outside the group network. This remains a suggestion, and in the rest of the paper we continue to use the term "double leverage" with the same meaning as in the previous sections.

3. Empirical Analysis on the Relationship between Risk-Taking and Double Leverage

3.1 Sample and Data

The data for this study are obtained from SNL Financial LC. We use information on balance sheet and income statement of firms classified as "Bank Holding Company" (BHC) headquartered in the United States. The frequency of observation is quarterly and our sample spans from

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capital and shareholders on the board remain with value of 3. Inside HC_C instead, equityholders are wiped out, creditors have to bear part of the loss and the firm experiences distress. We might think that the risky strategy offering the payoff $\pi = 47$ could be more attractive to HC_A rather than to HC_C, where owners would place a lower probability of undertaking that action. To conclude, the case presented in this footnote wanted to show that the implications on risk-taking from intra-firm funding do not derive only from the ownership fraction held by the holding company into the subsidiary.

[28] Bebchuk and Spamann (2010) refer to an "additional layer of debt financing" available to bank holding companies. In their discussion they do not mention any regulatory debate around "double leverage," although we find that Bebchuk and Spamann (2010) can give some important hints for understanding double leverage effects inside groups and their implications on risk-taking.

1990q1 till 2014q1. The data provided by SNL Financial LC are collected from the banks filing of the reporting forms FR Y9C, FR Y9LP, and FR Y9SP to the Federal Reserve System.[29]

From the same source we obtain the monthly stock prices for the quoted BHCs. Prices are adjusted for stock splits and stock dividends. We compute the monthly returns and calculate the quarter standard deviation of the returns, so that the series of standard deviations is merged with the data from the BHCs accountancy.

The results we present exclude those organizations where the holding company is a saving and loan firm, which are the 7.7% of the BHCs covered by SNL Financial LC. We checked that, including those institutions does not change the quality of the results. BHCs with only one quarter of observation are excluded as well, and the final sample counts a total number of 465,115 bank-quarter observations. Around the 97% of the firms are stock corporations, while the rest are mutual holding companies. The 83% of stock corporations are fully privately held firms.

3.2 Risk-Taking

The task is to explore whether the double leverage of a BHC is affecting the risk undertaken by the same firm. The idea is to measure whether cross-sectional differences in the double leverage ratio and other balance sheet and income statement variables are related to risk-taking.

We identify the BHC total risk with the equity market volatility, as in papers from Galloway, Lee and Roden (1997), Lee (2002), and Stiroh (2006). Thus, we measure risk through the standard deviation of the parent firm stock returns (*stdev*).[30] The average *stdev* on the whole sample is 6.7%. Table 2 reports the average *stdev* across years. We note a sharp increase in the average

[29] The filing of reports to the Federal Reserve System is related to the size of BHCs. The FR Y-9C is the Consolidated Financial Statements for Bank Holding Companies report, and is filed by all domestic BHCs with total consolidated assets of $500 million or more and all multibank holding companies with debt outstanding to the general public or engaged in certain nonbanking activities. The FR Y-9LP report is the Parent Company Only Financial Statements for Large Bank Holding Companies. This report is filed at the parent company level by all domestic bank holding companies that file the FR Y-9C. The FR Y-9SP is the Parent Company Only Financial Statements for Small Bank Holding Companies. The panel consists of all domestic BHCs with consolidated assets of less than $500 million and with only one subsidiary bank and multibank holding companies with consolidated assets of less than $500 million, without debt outstanding to the general public and not engaged in certain nonbanking activities. For the definition of Bank Holding Company (BHC) we send to the Bank Holding Company Act of 1956.

[30] Other studies test multiple measures of banks´ risk-taking. The equity volatility is often included among these measures by the papers of Saunders, Strock, and Travlos (1990), Lepetit et al. (2008), Laeven and Levine (2009), Pathan (2009), and Haq and Heaney (2012). Some earlier papers employing the standard deviation of the bank stock returns as a proxy for risk-taking are Flannery and James (1984), and Kane and Unal (1988). Zaik et al. (1996) comments that RAROC systems for assigning capital to banks are based on risk measures, and the relevant measure of risk for determining banks´ capital adequacy is the volatility of a stock returns, rather than the volatility of book or regulatory capital.

risk during 2008, and we believe this a consequence of the turmoil experienced in the United States financial market. Till 2012, *stdev* stays always above the mean annual value.

One limitation in the empirical approach of our analysis is the following. We want to identify double leverage effects on risk-taking. Nonetheless, we cannot observe the optimal amount of risk-taking, and the excessive risk-taking behaviour is inherently unobservable. Some measurement error can be spoiling proxies for risk-taking, and there are no good instruments for this errors-in-variables problem (Kim (2013)). Despite of this, we are consistent with some of the previous empirical banking literature which has often approximated risk with the standard deviation of equity. In order to make the interpretation of our results more robust, we also include a subsection where we test effects on an alternative measure for risk-taking.

3.3 "Double Leverage Ratio"

We introduced the "double leverage ratio" in the previous section, where we cited the definition provided by financial authorities on this measure. This number has been computed for the two BHCs of the example. We now calculate the double leverage ratio for the BHCs of our dataset, and the variable *DLR* is equal to the total aggregated investment of the holding company into the equity of subsidiaries divided by the equity capital of the holding company.[31] A high *DLR* denotes the circumstance in which the holding company acquires significant stakes in the equity of subsidiaries by remaining relatively low capitalized.[32]

On average, our BHCs have *DLR* of 108.5%.[33] The years of the recent crisis do not seem having induced large changes in *DLR*, since the average values during the turmoil are not strikingly different with respect to the annual values before and after the turmoil.

We want to see how the relationship between risk and double leverage reveals in the data in unconditional terms. We distinguish BHCs by their level of risk, and "riskier" firms would be those BHCs with *stdev* above the first, the second, and the third quartiles of the distribution. These firms have always higher *DLR* as compared to the rest of the sample. The difference is, at

[31] Note that, from *DLR* we cannot know whether the parent company is investing into only few or a large number of subsidiaries, since at the numerator is the aggregate value of equity invested in the subsidiaries. Furthermore, *DLR* cannot be informative on the entire capital structure of the subsidiary.

[32] Wall and Peterson (1988) claim that the double leverage ratio is an inverse function of the BHC strength.

[33] We have scarce quantitative evidence on measures for double leverage. Wall and Peterson (1988) estimate an average double leverage ratio in the three-year period 1982-1984 of almost 115%, and this high value is said to be driven by the peak in double leverage during 1984, as the ratio was above 127%. More recently, Krainer and Lopez (2009) work on a large sample of BHCs during 1988-2004, and compute an average double leverage ratio of 82.02%.

maximum, almost 5%, and in all cases is significant according to the Wilcoxon signed-rank test, which compares the distribution of the two selected sub-samples. The estimated probability that BHCs in the upper quartiles of risk have also higher *DLR* is always above the 50%. In the following sub-sections the same relationship is explored in conditional terms, and several types of regression analyses will be performed.

3.4 Control Variables

In our regressions we include a set of control variables which reflect the characteristics of the firm which we deem to be important determinants of risk-taking. The Appendix defines those variables, while Table 1 summarizes their main statistical features.

The firm capital structure is measured by the capital asset ratio. We test effects from both the book value of the capital asset ratio (*CAP*) as well as the regulatory risk weighted capital ratio (*RISKBASED CAP*), computed as the sum of tier 1 plus tier 2 capital over risk weighted assets. In general, the capital asset ratio is inversely related to the degree of leverage, and highly levered firms (those with lower *CAP* and *RISKBASED CAP*) are expected to risk more. The continuation value in the BHC activities is proxied by the market to book ratio (*MKB*). If *MKB* is high, the firm could make higher profits if it continues with the current business, and it might want to avoid those risky strategies which could bring instability.[34] Finally, the size of the organization (*SIZE*) might attenuate risk, so that larger banks can diversify and reduce the variance of their revenues.[35]

The variables presented so far characterise our baseline model for risk-taking. In a separate regression model we test the effect of the following additional covariates. First, we include an interaction term between *DLR* and capital, in order to see whether the marginal effect from double leverage on risk varies according to the capitalization of the company. We take care for the business model of the firm, normalizing the amount of loans by deposits (*LOANS_DEPOSITS*). The complexity of the organization might matter for explaining risky attitudes. A BHC with

[34] A negative relationship between banks´ risk-taking and charter value is documented by, among others, Anderson and Fraser (2000), Konishi and Yasuda (2004), and Haq and Heaney (2012). This evidence is opposite to the outputs from Saunders and Wilson (2001), who rather show a positive relationship between the two. For a more extended discussion on banks charter value and its interaction with risk-control regulation, we send to Galloway, Lee and Roden (1997).

[35] Lee (2002) is interested in the effect on risk-taking from insider ownership. The control set of his regression for the standard deviation of stock returns includes the variables *CAP*, *MKB*, and *SIZE* as defined in our paper. We add to our empirical specifications some other features of our firms which might affect their risk-taking.

numerous subsidiaries might have more opportunities to diversify risk.[36] We count the number of non-bank subsidiaries (*NONBANK SUBS*), and the number of depository subsidiaries (*DEPOSITORY SUBS*).[37] In order to inspect implications on risk from income diversification, we compute the ratio of non-interest income to total assets (*NONINTEREST INCOME*), which measures the profits of the bank deriving from non-interest (or fee-based) activities.[38] Finally, we take into consideration the fact that our sample includes the crisis of 2007-2009, and want to be sure that the pattern observed in the data is not referable only to the period of the recent turmoil. For this purpose we include the interaction term between *DLR* and a dummy variable assuming value one during the crisis period, which we let go from 2008q2 till 2009q4.[39]

3.5 Empirical Models for Risk-Taking

We estimate regression models which relate the risk-taking of our BHCs to their degree of double leverage and to the other control variables. To our knowledge, none of the previous empirical studies has considered that the risk-taking of a business group can be determined by intra-firm financing. In particular, double leverage effects have never been estimated, and we think that the inclusion of *DLR* is a novel and interesting feature of our empirical framework.

Table 4 reports the outcomes from different econometric specifications for *stdev*. Panel A reports the output from an OLS regression on the pooled observations with inclusion of quarter fixed effects. Standard errors are clustered at the bank level in order to control for the correlation of errors along the time dimension. All the explanatory variables are one period lagged, so that

[36] For an overview on the main motives for conglomeration we send, among many, to Dierick (2004). One of the most supported explanations for conglomeration is the achievement of diversification benefits. This view is often opposed by an opinion which rather contends that conglomeration destroys value. Papers have often verified the hypothesis of "inefficient capital markets." A survey on this issue is Maksimovic and Phillips (2008), while for some evidence more closely related to conglomerates in the financial industry we send to Laeven and Levine (2007) and Schmid and Walter (2009).

[37] Depository institutions are banks or savings associations (12 United States Code Section 3201). The average number of depository subsidiaries is almost one, and it is by only a small amount lower than the average number of non-depository subsidiaries. Modern large BHCs tend to have one or few affiliated banks, while more numerous non-bank affiliates.

[38] See for instance DeYoung and Roland (2001) and Stiroh and Rumble (2006).

[39] We looked at the average *stdev* across quarters. During the interval 2008q2 - 2009q4 we observe that the standard deviation of the BHCs´ stock returns remains above the value of 10 (in 2008q1 it was about 7) across all quarters. We also verify that the quality of the results remains unchanged extending the length of the crisis period, namely from 2007q2 till 2009q4. The coefficient on *DLR* persists to be positive and significant if we split the sample into three groups coinciding to the pre-crisis period, the crisis period, and the post crisis period. In another specification the regressors include the control variables plus the interaction of all these variables with the crisis dummy. We prefer omitting to report these latter results for not overloading the set of outputs.

we relate the ex-ante risk-taking incentive to the ex-post risk-taking.[40] This type of regression model resembles the empirical studies from Galloway, Lee, and Roden (1997), Lee (2002), and Stiroh (2006). We additionally include the first lag of the dependent variable as regressor, thus we assume that the equation for the stock return standard deviation has got a recursive structure.[41]

The pooled OLS specification might not be capturing the cross-sectional dimension of the results, so that there could be some unobserved heterogeneity among the firms which is not properly taken into account. In order to attenuate this concern, in Table 4-Panel B the coefficients are estimated using Panel data techniques. All the variables are contemporaneous. In this case we include both firm and quarter fixed effects, and standard errors are clustered at the bank level.[42]

3.6 Empirical Results

Across the outputs of Table 4 the estimated sign on *DLR* in the models for *stdev* is always positive and statistically relevant. When parent firms are funding the equity of their subsidiaries in a larger proportion with respect to their own equity capital (high *DLR*), their stock returns become ultimately more volatile. For example, take the OLS output of Table 4-column (1): all else equal, a one-standard-deviation increase in *DLR* is associated with an increase of 0.029 standard deviations in risk-taking. In economic terms, this would lead risk to be the 22% bigger. We sustain that this outcome is in line with the prediction we formulated at the end of Section 2.

In the OLS specification of Table 4-Panel A the first lag of the dependent variable is highly and significantly positive, with the highest estimated coefficient among the regressors. The standard deviation at (*t-1*) is the variable which mostly captures the variability of the standard deviation at *t*. This path could be interpreted as a reflection of some "mean-reversion" in the volatility.[43]

[40] This is similar to Galloway, Lee, and Roden (1997).

[41] OLS specifications are tested in several papers examining risk-taking. For instance, Laeven and Levine (2009) perform OLS regressions on pooled observations while modelling the bank z-score. Lepetit et al. (2008) run OLS regressions on some cross-sections of banks and use alternative proxies for banks´ risk and insolvency.

[42] Empirical studies on banking risk-taking which implement panel regressions include, among others, Saunders, Strock, and Travlos (1990), Anderson and Fraser (2000), Konishi and Yasuda (2004), Stiroh and Rumble (2006), and Brandão-Marques, Correa, and Sapriza (2013).

[43] "Mean reversion" of volatility is a well-documented stylized fact in econometrics. When variance mean reverts, it has time-dependent, autoregressive dynamics. Given the relatively low absolute value in the lagged standard deviation though, we would cautious in making any claim on a second stylized fact of "clustering" behavior in the stand-

Concerning the remaining set of covariates, we note that, BHCs smaller in size and with high continuation value would be less induced to risk.[44] In Panel B-column (3) the negative and significant impact from *NONINTEREST INCOME* could hint that risk would be mitigated if the firm is doing some non-fee income generating activities.[45]

Double leverage and risk-taking become more correlated during the crisis period. Nonetheless the marginal impact from *DLR* remains significant also outside the crisis, and we cannot address the estimated pattern only to the recent turmoil.

As expected, risk is contained by the bank capital. The negative sign on the interaction term with *DLR* suggests that, BHCs endowed by lot of capital would display less variability in their equity, even if they are rising in the degree of double leverage.

3.7 Granger Causality Test

The timing in the events we assumed in the example of Section 2 is the following. In period (*t*) HC buys equity issued by S and determines *DLR*. Between (*t*) and (*t+1*) S undertakes a risky project. We showed how the quantity delta for shareholders was changing according to the payoff from the project. We might think that the measure for risk-taking computed at (*t+1*) is affected by the risky project undertaken the period earlier. Namely, we could admit that there is a lag-led relationship between the level of *DLR* and the succeeding risk-taking. If this idea holds, it might be meaningful to perform a Granger causality test (Granger (1969)). This can be a first attempt for pinning down problems of endogeneity which our specifications might suffer from. Testing for Granger causality we are asking whether we are better in predicting *stdev* using also the history of *DLR*, instead than using only its own past history.

Through a reiterative procedure, we calculate the Granger causality test for each BHC of the sample. The output is reported in Table 5. For the 14% of the firms we reject the null hypothe-

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ard deviation of stock returns. The idea of volatility clustering in financial returns goes back to Mandelbrot (1963), and has been heavily employed for the modeling of financial time series, especially starting with Engle (1982) and Bollerslev (1986).

[44] Demsetz and Strahan (1997) show that there exists a positive relationship between BHCs size and diversification, which, though, does not result in a negative relationship between BHC size and stock return variance.

[45] Evidence on the correlation between risk-taking and off-balance sheet activities is mixed. Papers arguing that off-balance-sheet activities increase risk are, among others, Wagster (1996), Angbazo (1997), Fraser, Madura, and Weigand (2002), and Haq and Heaney (2012). Other works do rather sustain that off-balance sheet activities reduce risk, for example Lynge and Lee (1987), Boot and Thakor (1991), Hassan, Karels, and Peterson (1994), Angbazo (1997), and Esty (1998). Further evidence about the implication from non-interest income on risk-taking can be found in DeYoung and Roland (2001), DeYoung and Rice (2004), Stiroh (2004 and 2006), and Lepetit et al. (2008).

sis that the lagged *DLR* is statistically equal to zero (thus, no causality in the sense of Granger), with a 5% level of statistical significance. Put differently, in the 14% of the cases *DLR* is Granger causal for risk, i.e. the current values of *DLR* help in forecasting the future decision on risk.

3.8 Discussion on the Way in which "Double Leverage" Affects the Measure for Risk-Taking

So far we measured the BHC risk-taking through the volatility of the parent firm stock returns. As already pointed out, measuring risk-taking may involve problems of measurement error. Still, the volatility of stock returns remains one of the most largely diffused proxies for risk-taking among banking studies.[46] We think there are several reasons which drive *stdev* to positively correlate to *DLR*.[47,48]

We claimed that, the shareholders of parent firms are benefitted by the risky projects undertaken by the participated subsidiaries. Those projects are likely to make the subsidiaries´ revenues more variable, and this will transfer on the consolidated income statement for the group, which combines the earnings of both parent and subsidiaries. If the stock of the holding company reflects fundamentals, then we should register a higher variability in the parent equity.

Another aspect to be appreciated is the following. Operations of double leveraging do imply some "dividend upstream." Typically, the holding company receives some dividends from the invested subsidiary, and uses such dividends in order to pay back the debt which was initially issued for the acquisition of the subsidiary stock.[49] The dividend amount is not specified on the underlying equity claim, differently than the payment of the debt interest. Dividends highly depend on the capability of the firm in generating significant earnings, and the resulting dividend

[46] We send to the literature mentioned in Section 3.

[47] We verified the year of establishment of our BHCs. For the sample during 2014q1, around the 47% of the firms has been established before or during the year 1990, which is the starting time of our sample. In this way we check that we are not looking at a large group of young firms, where the choices on risk might differ with respect to the same choices at later stages.

[48] Kahn and Winton (2004) describe how financial institutions assume often a "bipartite" structure, where safer assets are separated from the riskier loans which are instead managed by separated subsidiaries.

[49] Explicit claims on the dividend "upstream" can be found in two already cited documents from United States financial authorities. The first is the "Bank Holding Company Supervision Manual," 2012, from the Board of Governors of the Federal Reserve System, Division of Banking Supervision and Regulation (Section 4010.1 and Section 4060.9); the second is the "Holding Companies Handbook," 2009, from the Office of the Comptroller of the Currency, formerly The Office of Thrift Supervision (Section 720.1). A further citation on the dividend "upstream" is in Pozdena (1986).

flow is often volatile. Dividends declaration might also be restricted by regulation.[50] With these comments we might understand that the subsidiary dividend cannot be sufficient for the parent to regularly service the debt obligation, and it might look for higher risk-return profile projects.[51]

In turn, the dividend "upstream" would create some pressure on the subsidiary, as well. In order to pay regular dividends to the parent, the firm might choose to pursue riskier and more profitable strategies, which ultimately make the consolidated revenues more variable.[52]

We have clarified the reasons why we find plausible that, raising in double leverage the stock returns of the parent firm become more dispersed. Nonetheless, in order to make the discussion of the paper more robust, in Section 4.3 we test the impact from *DLR* on another diffused proxy for the BHC risk, namely the z-score.

3.9 Analysis on the BHCs with Double Leverage Ratio above 100%

3.9.1 The Sub-Sample and Ordinary Least Squared (OLS) Model

The United States supervisor asserts that, a group of firms has got some double leverage when the double leverage ratio is above 100% (Office of the Comptroller of the Currency formerly The Office of Thrift Supervision, 2009, "Holding Companies Handbook"). Indeed, when the double leverage ratio is above 100% the parent firm holds a participation into the subsidiaries which overcomes (in aggregated terms) its stand-alone equity capital. Hence, at least part of that acquisition has been done by using debt proceeds.

We refer to BHCs with *DLR* above 100% as "double levered" firms. We identify them by the variable *DLR_DUMMY*, which is a dichotomous variable assuming value one if the BHC has got *DLR* above 100%, while zero in the remaining cases.[53] Table 6-Panel A shows results from the univariate Wilcoxon test on the two sub-samples. BHCs with *DLR* above 100% have higher

[50] Limitations to banking dividends are imposed by Sections 5199(b) (12 United States Code 60) and 5204 (12 United States Code 56) of the United States Revised Statutes.

[51] Wall and Peterson (1988) say that "the danger in using double leverage is that the BHC parent becomes more dependent on its subsidiaries´ dividend to service its debt." The idea is that mismatching among the holding company cash flows might introduce some instability to the firm.

[52] The Office of the Comptroller of the Currency formerly The Office of Thrift Supervision (2009, "Holding Companies Handbook") affirms that, "[double leverage circumstances] can generate substantial pressure on the thrift to maintain its earnings to support future dividend payments, thereby increasing the temptation for the thrift to engage in higher risk operations." Nicodano and Regis (2014) say that the presence of Intercorporate Dividend Taxation (IDT) results in a double taxation to the ultimate shareholders, and study the effects from IDT on complex organizations´ leverage and financial stability.

[53] In Section 2 we have mentioned papers employing various measures for double leverage. None of those papers discusses whether these measures present cross-sectional differences.

risk and lower capital ratios. In particular, their stock price is about 31% more variable than in the other firms. We then perform on the two sub-samples the same type of OLS regression from the first column of Table 4-Panel A. The results are displayed in Table 6-Panel B. We discover that the significant effect from *DLR* on *stdev* is driven by those BHCs with *DLR* above 100%, for which the coefficient is always statistically significant, while it remains not relevant for the other BHCs.

These last results suggest that the estimated relationship is presenting a structural break. The impact from *DLR* on risk would be almost flat while *DLR* stays below 100%, while the risk function would start having a positive slope when *DLR* goes above 100%. We verify this view by performing the Chow test (Chow (1960)). The Chow test assumes that the break is known before looking at the data. As motivated few rows above, the ratio of 100% is the threshold in *DLR* which should identify excessive recourse to double leverage financing inside the group. This is why we expect a discontinuity at *DLR* equal to 100%. Consistently, the Chow test rejects the null hypothesis of no break, while it detects a structural break in the coefficients of the regressors explaining *stdev*. In Section 3.9.4 we test whether this discontinuity is confirmed by using a regression discontinuity (RD) approach.

3.9.2 Model with Endogenous Treatment Effects

The approach followed so far might not be properly dealing with some residual endogeneity in the outcomes. We detect a significant correlation between *stdev* and *DLR*, although we cannot exclude that our regressions suffer from problems of omitted variables or reverse causality. Potential endogeneity can be attenuated by the estimation of a model with endogeneous treatment effects. This type of modelling is appropriate when the treatment can be characterized by a dichotomous indicator, and the effect from the treatment is typically estimated with instrumental variables or variants of the control function approach, as motivated by Heckman (1978, 1979). For this purpose we use the dummy variable from the previous sub-section (*DLR_DUMMY*), which assumes value one if *DLR* is above 100%, while zero otherwise. Namely, the treated units are the BHCs where the intra-firm financing has led to an "excessive" degree of double leverage.

The model with treatment effects assumes that the errors in the equation for risk and in the equation for the double leverage dummy are bivariate normal $[0,0,\sigma_\epsilon,1,\sigma]$.[54] Under this assumption, Table 6-Panel C reports the coefficients estimated both with maximum likelihood and with a two-step procedure (Heckman (1976, 1978), and Maddala, 1983). The coefficient on *DLR_DUMMY* is the estimated average treatment effect - ATE. The ATE quantifies the expected gain in risk-taking from being double levered for a randomly selected unit from the population.[55] In both type of estimations, the ATE is positive and significant. The Wald test indicates that we can reject the null hypothesis of no correlation between the treatment errors and the outcome errors.

3.9.3 Propensity Score Matching

In this sub-section treatment effects are estimated by propensity score matching. Propensity score matching goes back to Rosenbaum and Rubin (1983), who propose the method for attenuating the bias in the estimation of treatment effects with observational data sets. Due to lack of randomization, in the context of an observational dataset, we could not make any causal inference from *DLR* to risk. Thus, we cannot know whether the difference in risk between treated and control (untreated) BHCs is due to the treatment, or is due to differences in other BHCs´ characteristics.

The treatment is again defined on the base of the severity in double leverage, i.e. treated units are firms with *DLR* above 100%. The propensity score works as a method for estimating the effect of receiving the treatment when a random assignment of the treatment to the subjects is not feasible. Treated and control units are matched if they have similar values in the propensity score and in other covariates, while remaining unmatched unites are discarded (Rubin (2001)). In this way, differences between the two groups should be accounted for, and not due to the observed covariates. For a certain BHC the propensity score is defined as the conditional probability of being double levered (the treatment) conditional on the observed covariates. We use the nearest neighbor *n-to-n* matching, where for each treated unit we look for the control unit with the closest propensity score (i.e. the nearest neighbor). Once that treated and control units are

[54] This is assumption is unverifiable. Little (1985) argues that the identification of the model depends upon non-linearities and the estimated parameters might not be reliable.

[55] In other terms, ATE is the average difference of the potential risk from double leverage and the potential risk from absence of double leverage. It is also called "average causal effect."

matched, the difference in *stdev* between the two groups is used for estimating the effect from the treatment on risk.

We have implemented several types of *n-to-n* matching, and decide to show the results where the matching has provided the best outfit among the several attempts. The matching is done with replacement and caliper, and the propensity scores are estimated using a probit model.[56] Table 7-Panel A tests the success of the matching on the covariates. The matching reduces the difference in the mean values of the exogenous variables considerably. The t-test indicates that, after the matching, the mean value of each variable is the same between treated and control group. The average bias after the matching is lower than 3%, hence the starting unbalancing has been satisfactorily reduced.[57] Figure 1 confirms that the common support assumption holds, since in each propensity score class there is a certain number of treated and non-treated firms.

Figure 2 illustrates the risk for the double levered (i.e. treated) firms and the matched not-double levered (i.e. not-treated) firms, as a function of the propensity score. For both groups we observe that *stdev* is rising in the propensity score. Across all propensity scores the risk associated to the matched not-double levered banks stays below the risk of the double levered firms. The estimated ATE is 0.478. Panel B shows also the average treatment effect on the treated – ATT, which is the gain in risk-taking due to the treatment for those units which were actually treated. In our case the ATT is close to the ATE.[58]

Finally, we perform the same type of regression of Table 4-Panel A on the matched sample. The coefficient on *DLR* is significantly positive. The quality of results from previous regressions is preserved. Based on the outputs from the matching exercise we affirm that an excessive double leverage seems to encourage BHCs to assume higher risk.

[56] The caliper equals to 0.00001. The low value of the caliper reduces significantly the subsample of matched observations, although using higher caliper values we could not get good matching, in terms of balancing of the covariates and reduction of bias after the matching. We further checked that, using a logit model for the estimation of the propensity score does not change the results. Recent applications of propensity score matching for the correction of self-selection bias on financial data include Drucker and Puri (2005), Bharath et al. (2009), Saunders and Steffen (2011), and Michaely and Roberts (2012).

[57] The standardised percentage bias is the percentage difference of the sample means in the treated and control subsamples as a percentage of the square root of the average of the sample variances in the treated and control groups (see Rosenbaum and Rubin (1985)).

[58] In the model of Table 6 ATE and ATT coincide since the treatment indicator variable has not been interacted with any of the outcome covariates. In other terms, the ATT is the average difference of the potential risk from double leverage and the potential risk from absence of double leverage on the BHCs which have *DLR* above 100%. In the majority of the studies evaluating policy interventions the ATT is the most important parameter of interest. According to Heckman (1997) the ATE would be less relevant, since it includes the effects on units for which the intervention was not intended.

3.9.4 Regression Discontinuity Design

Our approach is now the one of a regression discontinuity (RD) design. This method is alternative to the previous tools based on matching estimators and endogenous treatment effects, and is helpful for detecting causality in the data.[59] Our outcome variable is *stdev*, the assignment (or, treatment) variable is *DLR*, and the treatment is based on the 100% *DLR* cut-off. The idea behind the RD design is that, under certain conditions, in the neighbourhood of the cut-off a discontinuous jump in *stdev* can be attributed to the level of treatment. Near the discontinuity the treatment can be seen as if it would be assigned randomly. Thus, the assignment of a BHC to either the right or the left of the 100% cut-off would be random. We implement a sharp RD and the estimation is done using the non-parametric technique of triangle kernel regressions.[60]

Table 8 reports the Wald estimator computed at the optimal bandwidth, as well as at multiples (50 and 200 percent, namely half and twice) of the optimal bandwidth, which we check for robustness. The Wald estimator measures the jump in the outcome at the cut-off, when the jump in treatment is one. Namely, it measures the jump in risk occurring when *DLR* goes above 100%. This is the estimated causal impact from high double leverage (i.e. the treatment) on risk. The coefficient on the Wald test is highly positive and significant. The Panels of Figure 3 visualize the change in risk due to the treatment, plotting *stdev* as a function of the distance from the cut-off. In Panels A and B the estimated pattern is the one corresponding on the optimal bandwidth for the 100% cut-off, and the two graphs differ only in the number of points where the local linear regression is calculated. Using fewer points, Panel B is neater in showing that the two variables move in the same direction. The risk measure tends to increase while the firm ap-

[59] The RD design was first introduced by Thistlethwaite and Campbell (1960). We check discontinuities using non-parametric designs. The non-parametric way of estimating treatment effects in an RD design started with Hahn, Todd, and Van der Klaauw (2001). Researchers often use also parametric strategies in RD studies, for a review see Van der Klaauw (2008) and Cook (2008). Recent applications of RD on corporate finance studies include Rauh (2006) and Chava and Roberts (2008).

[60] According to this strategy, the analysis limits to observations that lie within the close vicinity of the cut-off point (the bandwidth). We follow Imbens and Kalyanaraman (2009) and the optimal bandwidth is the one that minimizes the mean squared error. On those observations within one bandwidth on either side of the threshold we estimate a kernel-weighted local regression using a triangle kernel.

proaches and overcomes the cut-off.[61] This trend is though discontinuous, and we note a jump in *stdev* corresponding on the 100% limit, which identifies an "excessive" double leverage.

Using the same approach, we further test whether there is a discontinuity corresponding to other percentiles in the distribution of *DLR*. On those other cut-off values the Wald estimator does not find a discontinuity, and from the Panels C-F of Figure 3 we cannot see evident jumps in risk.

Overall, these latter results based on the RD technique are consistent with the previous tests. We have further support that a causal relationship between double leverage and risk cannot be disconfirmed.

4. Furthers Tests

4.1 Disentangling the Effect on Risk from the Parent Investment in the Equity of Different Type of Subsidiaries

We test whether the risk-taking of the parent company varies depending on whether the firm invests into subsidiaries belonging to the banking industry rather than into subsidiaries operating in other industries.

The variable *EQUITY IN BANKING SUBS* in the ratio of the parent holdings of equity into affiliated banks and other bank holding companies, over the total parent equity. The variable *EQUITY IN NON-BANKING SUBS* instead comprises the equity holdings into firms not in the banking sector. In general, non-banking subsidiaries do not offer both lending and depository services. Typically, they instead offer non-bank products and services, such as insurance and investment advice, and do not provide Federal Deposit Insurance Corporation insured banking products.[62] In our sample parent firms have large participations inside banking firms, which are about the 105% of their equity, while maintain a smaller exposure to non-banking firms, corresponding to the 2% of their equity.[63] From the regression results in the two Panels of Table 4-

[61] The patterns in Figure 3 are consistent with the pattern we got from the matching exercise of Figure 2, in the sense that in both cases the two graphs display an increasing relationship between risk, which in both figures is on the y-axis, while the variables capturing the "severity" of the double leverage problem is on the x-axis.

[62] For the definition of "non-bank subsidiaries" see the Board of Governors of the Federal Reserve System, Instructions for Preparation of Quarterly Financial Statements of Nonbank Subsidiaries of Bank Holding Companies - Reporting Form FR Y–11Q, reissued March 2002.

[63] Note that, the values of *EQUITY IN BANKING SUBS*, and *EQUITY IN NON-BANKING SUBS* which we report in Table 3 do not sum to *DLR*, because not all our BHCs have participations in the equity of both banking and non-

column (4), we see a higher statistical significance on the coefficient of *EQUITY IN BANKING SUBS*.[64]

We can relate this outcome to the moral hazard problem of equity. If subsidiaries are not performing well, the holding company shareholders can shift part of their risk towards the subsidiary debtholders. If losses are huge, also the debtholders of the holding company can be asked to bear losses. In the case that subsidiaries are banking firms and their creditors are mostly insured depositors, equityholders might expect that they will rely on the protection from the insurance fund and will be less reactive to actions taken by the property. In these terms we might justify the observed pattern where the risk attitude of the parent shareholders seems to be amplified by investing into banking rather than non-banking firms.

4.2 Alternative Measures for the Parent Holdings of Subsidiaries Equity

We now change the denominator of *DLR* and construct two more variables, both capturing the exposure of the parent firm towards the subsidiaries´ equity. First, we calculate the ratio of the equity invested into subsidiaries over the parent total assets (*EQUITYINSUBS_TA*). Second, the quotient is computed over the parent total investment into subsidiaries (*EQUITYINSUBS_TINV*). In this latter case the denominator is the value of all the securities issued by subsidiaries and held by the parent on its balance sheet. These securities include equity plus loans, debt, and other receivables issued by subsidiaries.

The two Panels of Table 4-columns (5/6) do not estimate an important effect on the two variables we just constructed. Only when we use *DLR* as regressor we observe that *stdev* reacts in a significant way.

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banking firms. Wall (1987) works on a sample of BHCs during 1976-1984 and estimates that the investment in non-bank activities is the 7% of the total BHC investment in subsidiaries. Our measure *EQUITY IN NON-BANKING SUBS* is almost 4%, and the proportion is calculated with respect to the parent equity capital.

[64] Brewer, Fortier, and Pavel (1988) review those papers which question on the impact of non-banking subsidiaries on risk-taking. Among others, non-bank subsidiaries are found to be risk-moderating rather than risk-accentuating in the papers from Wall (1987), and Brewer (1989). Meinster and Johnson (1979) note that diversification into non-bank activities whose cash flows are not correlated with the cash flows from banking activities, may ultimately reduce the volatility of the overall firm cash inflow. Vander Vennet (2002) says that conglomerates diversifying into non-bank activities are more likely to have higher consolidated revenues, lower operating costs, and lower funding costs, this latter thanks to reputation effects or market power. On the other side, various papers sustain the opposite view that non-banking activities promote risky behaviours. These papers include De Young and Roland (2001), Stiroh and Rumble (2006), and Bebchuk and Spamann (2010). In a previous article Holland (1975) affirms that a source of instability brought by the development of BHCs is the riskier quality of assets that some non-bank affiliates might bring into the organization.

The test performed in this sub-section is important for the remark on what *DLR* can capture, and why the other two variables do not sort relevant effects. *DLR* tells how far the parent equity can respond in front of losses suffered from the subsidiary.[65] *DLR* can be seen as a rough measure for the sharing of capital between the two firms. *DLR* should inform on the measure in which the distressed subsidiary would rely on the parent capital. The most critical situation would be when the parent holds a huge participation in the subsidiary but has very low capital. The other two tested measures are not measures *vis-à-vis* the parent capital, and this might explain why they lack of explanatory power.

4.3 Effect of Tax Increases on the Double Leverage Ratio

In this sub-section we want to verify more deeply how changes in *DLR* do reflect information on intra-firm funding. We inspect the impact that an increase in the local corporate tax rate produces on double leverage. A higher tax rate enlarges the tax shield, and firms might will to use debt more extensively.[66] The parent company would find convenient to use debt proceeds for its own projects, but also for the acquisition of larger ownership into the subsidiaries. Our expectation is that, due to the increase in the tax rate, the parent reshuffles its capital structure and gives a larger weight to debt, in order to benefit from the enlarged tax shield, and, at the same time, so to save on the group-wide capital requirement thanks to the double leveraging.

We consider the tax changes analysed by Schandlbauer (2014). These are 13 tax increases occurred in 11 different countries of the United States (see Table 9-Panel A).[67] The change in taxation is used as the natural experiment for a difference-in-difference estimation, where we examine how the degree of double leverage of our BHCs responds to the intervention on taxes from the local government.

The sample restricts to the period 2000-2011, since we exploit the information on the tax changes occurred during that horizon. The majority of the tax changes are enacted on the 1st of

[65] The International Monetary Fund defines "double leveraging of capital" as "situations where related entities share capital (...) Entities are resting activity on the same pool of capital. When capital is double leveraged, the capital actually available to the group to meet unanticipated losses is less than the data implies" (International Monetary Fund (2004)).

[66] Schandlbauer (2014) shows that banks react to increases in the local corporate tax rate by adjusting both sides of their balance sheets. For the better capitalized firms of his sample the author observes that the tax increase relates to an increment in the non-depository leverage ratio of the firms.

[67] We consider the same changes in taxation examined by Schandlbauer (2014). Our Table 9-Panel A is taken from Schandlbauer (2014) and we send to the same paper for information of where the data on the tax changes are taken, and for information on the magnitude of the tax increases.

January, and we assume that the BHCs become subject to higher tax rates starting from the first quarter of the year of enactment. The treated units are the BHCs whose parent firm is incorporated in those countries where the local government has increased the corporate taxation. The control group is defined using propensity score matching, where the matching is done on the base of the same characteristics we used in the Section 3.9.3.[68] We work on the matched sample rather than on the entire sample in order to reduce the presence of confounding effects.[69] We estimate the following regression model:

$$\Delta DLR_{i,t} = \alpha + \beta * Tax\ Increase + \epsilon_{i,t} \qquad (1)$$

The dependent variable *ΔDLR* is the change in *DLR* from one quarter to the other. *Tax Increase* is an indicator variable equal to one if a tax increase occurred in a certain state and quarter, while is equal to zero in the other cases. The subscripts *i* and *t* indicate the BHC and the year quarter, respectively. The coefficient of *Tax Increase* measures the impact from the tax increase on the degree of double leverage. The first column of Table 9-Panel B shows that the estimated *ß* is positive and statistically relevant. This confirms our prediction that, if parent companies find more convenient to issue debt, then part of the proceeds from the issuance might be diverted to fund the affiliated firms.[70]

We also check whether the same tax changes sort an effect in the variation of the variable *EQUITYINSUBS_TA*, which weights the participation of the parent into the subsidiaries over the parent total assets. Consistently with the finding from the previous sub-section, in Table 9-Panel B there is no important effect from *Tax Increase* on *ΔEQUITYINSUBS_TA*.

The reason why *DLR* is more sensitive to the tax change than *ΔEQUITYINSUBS_TA* is motivated with the following example. Suppose that, after the tax change, the parent decides to issue

[68] We analyse the matched sample for which the matching procedure brings the initial bias to be lower than 4%. The treated units are matched with five control units, with no replacement in the sample.
[69] Carlson, Shan, and Warusawitharana (2013) survey the impact from regulatory capital requirements on bank lending, and advocate the benefits from the usage of matching procedures for dealing with the presence of confounding effects in the sample.
[70] The results remain qualitatively similar if we estimate the equation (1) using a panel approach with both quarter and BHC fixed effects. Note that, we observe a positive and significant sign on *ΔDLR* also on the first lag of *Tax Increase*.

some debt, while the equity share of the balance sheet remains fixed.[71] If all the newly issued debt goes to finance some new projects of the parent, than after the tax change we should observe no variation in the double leverage ratio, given that, both the participation in the subsidiary and the parent capital remain the same as before the tax change. On the other side, the expansion in assets decreases the weight of the participation over assets, and *EQUITYINSUBS_TA* would be lower. Differently happens when the newly issued debt is used for acquiring larger ownership into the subsidiaries. In that case, given that the parent capital stays constant, *ΔDLR* would be positive. We would also have changes in *EQUITYINSUBS_TA*, although *ΔEQUITYINSUBS_TA* would be higher than zero only when the fraction of the debt issuance devoted to the purchase of the subsidiaries equity is above a certain threshold.

The difference-in-difference analysis has showed that *DLR* reacts to changes in the corporate tax rate. Based on this result, we decide to use *Tax Increase* as an instrument for *DLR* in the equation for risk-taking. Using a two-stage least squares procedure (2SLS), we regress *stdev* on *NONBANK SUBS*, *DEPOSITORY SUBS*, and *DLR*, where *DLR* is instrumented by *Tax Increase*.[72] The instrumental variable (IV) approach is another way to deal with the potential endogeneity of *DLR*, and integrates the several methods implemented in the previous sub-sections. While the previous tests were based on the dichotomous variable *DLR_DUMMY*, in this subsection the IV approach uses the continuous version of *DLR*.

Table 9-Panel C reports the output from the two-stage least squares estimation. In the first stage regression we get the expected positive sign from *Tax Increase* on DLR.[73] The second stage regression estimates positive and significant coefficients on both *DLR* and *SIZE*. Diagnostic checks verify that *DLR* is endogeneous and that it is not a weak instrument in the equation of risk.[74] To conclude, in this sub-section we have discovered that tax changes have important im-

[71] Effectively, there might be some reduction in the parent capital with consequent increments in *DLR* if the parent firm, for instance, pays cash dividends or has got to cover some losses. We assume that none of these events happens between the point in time in which the tax changes, and the succeeding time, namely when we compute the variation in the firm capital structure.

[72] Note that, on the right hand side of the equation, we excluded *MKB* and *RISKBASED CAP* which we rather had in the OLS specification of Table 4-column (1). The reason is that we encounter some endogeneity problems also on these two variables. We prefer to omit them from the reduced form equation and use the IV approach for facing only the endogeneity of *DL*R in the equation of *stdev*.

[73] The first-stage regression *F* statistic is slightly below 10. Stock, Wright, and Yogo (2002) say that *F* statistics above 10 would indicate that the employed instruments are not weak, and that the inference based on the 2SLS estimator is reliable. According to the first-stage Angrist-Pischke *F* statistic our instrument is not too weak.

[74] In the *C*-test (or, "GMM distance" test) the null hypothesis is that the specified endogenous regressors can actually be treated as exogenous (see Baum, Schaffer, and Stillman (2007)). In this case we are largely rejecting the exog-

plications on risk-taking via the effect they have on the double leverage of our BHCs. These outputs integrate the previous results, offering a stronger support for the claims on causality in the inspected relationship.

4.4 Alternative Measure for Risk-Taking

We test the effect from *DLR* on an alternative proxy for the BHC risk, namely the z-score.[75] The z-score is computed as the return on assets plus the capital asset ratio, further divided by the standard deviation of the return on assets. Since we only have the quarterly values of the returns on assets, we pick the respective standard deviation along years, and the entire z-score is computed on an annual basis. It can be showed that the z-score is inversely related to the probability of insolvency. Thus, a low z-score denotes a high probability of distress. In other terms, the z-score indicates the number of standard deviations below the mean, by which profits would have to fall in a single period in order to eliminate equity, and thus for the firm to become insolvent. The average annual z-score in our sample is 85, and the positive skew reveals that the mass of the distribution is concentrated around relatively low values of insolvency probability.

The z-score is the dependent variable in Table 9. We discover a negative and significant relationship between *DLR* and *zscore*,[76] suggesting that situations of double gearing make the distress of groups more probable.

5. Discussion and Implication of the Empirical Outputs

eneity of *DLR*. With the Stock and Yogo test instead, we verify whether our instrument is weak. The test is based on the *F* statistic of the Cragg-Donald statistic. The null hypothesis is that the estimator is weakly identified, in the sense that it is subject to bias that the investigator finds unacceptably large. To reject the null, the Cragg-Donald *F* statistic must exceed the critical values tabulated by Stock and Yogo (2005). According to the Stock and Yogo test our equation would not to be weakly identified. For example, if we are willing to accept a rejection rate of at most 10%, than we reject the null of weak identification, since the Cragg-Donald *F* statistic is above the critical value, which in this case would be 16.38.

[75] The z-score is a proxy for banks´ risk-taking in the papers of Boyd and Graham (1988), Brewer (1989), Boyd, Graham, and Hewitt (1993), Stiroh and Rumble (2006), Lepetit et al. (2008), and Laeven and Levine (2009). Onali (2012) investigates the relationship between banks´ dividends and risk-taking. The author argues that the z-score includes at the numerator the ratio of equity to total assets, and this makes the z-score a more appropriate measure for the risk of banks as compared to the standard deviation of returns, because of the importance of equity inside banks.

[76] As done by Boyd and Graham (1988) we remark what follows. The computation of the z-score is done treating each BHC as a single consolidated organization which survives or fails as a unique company. In this sense we are ignoring the possibility that some subsidiaries might survive, while other subsidiaries are defaulting.

We now briefly sum up the main results from the empirical analysis and discuss how these outputs can contribute to the debate around some recent proposals advanced by financial authorities on the regulation of banking capital.

By implementing several different econometric methods, we get evidence suggesting that parent firms are incentivized to undertake higher levels of risk when the group double leverage is higher. The positive impact from *DLR* on *stdev* is observed while controlling for the firm regulatory capital. We retain that our results confirm the expectation formulated in Section 2.[77]

We now want to discuss in more detail the policy implications of our results. Our estimates suggest that the capital available to BHCs may not entirely absorb the perverse effect on risk-taking originated by double leverage techniques.[78] Our view is that this type of intra-firm funding can give firms opportunities to partially arbitrage their regulatory capital, in accordance to the opinions of Dierick (2004) and Yoo (2010).

The system of risk-based capital requirements developed under the Basel accords might have some pitfalls in capturing the effects proved by this paper. This opinion is close to Jackson (2005), who claims that the system of consolidated capital requirements under Basel II is not capturing subtle issues related to the risk of financial conglomerates. Elliot (2010) says that, the current enforcement powers of regulators over BHCs are weaker as compared to the same powers over single banks.

Supervisors should more carefully consider whether intra-firm funding relationships can end up in making complex institutions more fragile. The United States Office of Thrift Supervision (2009) sustains that the over-reliance of a group on double leverage should trigger more supervision on the institution. Van Lelyveld and Schilder (2003) argue that the existence of double leverage reflects some "regulatory inconsistency," and needs to be regulated. Our paper offers quantitative evidence to these latter views.

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[77] Our results would be consistent with the opinion of some older papers, claiming that, when the parent firm finances the subsidiaries with equity, this exacerbates a sort of "risk of affiliation" (Black, Miller, and Posner (1978) and Karna and Graddy (1984)). Karna and Graddy (1984) argue that the success of a double leverage strategy will "depend on whether double leverage has an independent effect on the risk structure of consolidated banks." Later on, the Unite States supervisor affirms a similar view and state that double leverage might reinforce the "risk of interdependence" (Board of Governors of the Federal Reserve System, Division of Banking Supervision and Regulation, 2012, Bank Holding Company Supervision Manual, Section 2010.1).

[78] "(…) The bank capital is put at risk due to the increased exposure of the organization, the risk is increased, since less "hard" capital is available for support" (Board of Governors of the Federal Reserve System, Division of Banking Supervision and Regulation, 2012, "Bank Holding Company Supervision Manual," Section 2010.1).

Ultimately, our outcomes can help in evaluating some recent interventions in the context of banking capital. Basel III would complement the risk-based capital requirements by a simpler non-risk based leverage ratio intended mainly to avoid destabilising deleveraging effects on the financial system.[79] United States Agencies have proposed to strengthen the leverage requirements for United States banking organizations (so-called 2013 rule) as compared to the Basel III final rules. Central to this proposal is the introduction of a more stringent system of leverage standards for certain Bank Holding Companies (so called "covered" Bank Holding Companies) and their Subsidiary Insured Depository Institutions.[80] The main reason is that the actions taken by banking groups have important consequences on financial stability.[81]

The discussion we dealt in the paper can be useful in appreciating this rule. If BHCs are restricted in their debt levels they might also be less tempted to exploit double leveraging, and this would have the ultimate effect of limiting the overall risk of the group. The new rule could induce also changes in the asset composition of the subsidiaries, since parent companies might decide to move some assets to the non-bank subsidiaries, although those transfers would be limited by the leverage requirement set at the BHC level.

Finally, we mention a recent intervention in the framework of the discipline of multinational banks. At the beginning of 2014 the Federal Reserve has approved new standards for the largest foreign banks operating in the United States via some subsidiaries. Those foreign firms will be forced to consolidate United States operations into a unique subsidiary, which will be subject to the same liquidity and capital requirements as the United States domestic peers. For the European banks operating in the United States this implies that they would have to meet higher capital levels within 2016. We wonder whether European banks could arbitrage the new rule introduced from the Federal Reserve by double leveraging. A European holding company might issue debt and inject capital into the United States subsidiary, so that the foreign entity would then be com-

[79] The general rule establishes a minimum tier 1 leverage ratio requirement of 4% applicable to all insured depository institutions and depository institution holding companies. In July 2013 the Fed proposed to impose covered BHCs to have a minimum leverage ratio of 5%, while the insured depository institutions of covered BHCs had to meet a 6% leverage ratio. See http://www.federalreserve.gov/newsevents/press/bcreg/20130709a.htm.

[80] According to the proposal covered BHCs will be imposed a supplementary leverage ratio of 5% (minimum 3% + 2% buffer), while insured depository institutions will be subject to a minimum 6% of leverage ratio. See http://www.federalreserve.gov/newsevents/press/bcreg/20130709a.htm

[81] "Maintenance of a strong base of capital at the largest, most systemically important institutions is particularly important because capital shortfalls at these institutions can contribute to systemic distress and can have material adverse economic effects" (FDIC Chairman Martin J. Gruenberg, 9 July 2013, https://www.fdic.gov/news/news/press/2013/pr13060.html)

pliant with the new standards. The United States and the European regulator (as well as regulators from other countries) should be concerned by this phenomenon. Evidently, further research is needed in order to support regulators in the set-up of efficient rules for multinational groups.

6. Conclusion

Working on a large sample of BHCs from the United States during the last more than 20 years, we showed that the risk-taking of BHCs is significantly increasing in their degree of double leverage. The standard deviation of the holding company stock returns approximates risk-taking, and is put into relation to the so-called "double leverage ratio." A high degree of "double leverage" identifies the circumstance in which the parent company holds large stakes of subsidiaries´ equity, while maintaining a relatively low *solo* capital. Overall, the discussion and the empirics from this article suggest that the risk-taking of banking groups might depend on the way in which parent companies are financing their subsidiaries; more specifically we show that BHCs are encouraged to risk when the intra-firm funding produces some double leverage.

The estimated pattern is significant while we control for the consolidated regulatory capital of our firms. Our view is that consolidated capital requirements might not fully offset the implications from double leverage on risk, and we cannot exclude that by double leveraging BHCs can circumvent regulatory capital standards.

Our evidence supports the Office of Thrift Supervision (2009) when it argues that the over-reliance of a group on double leverage should trigger more supervision on the same institution. The most important suggestion for policy making hinted by our research is that, the capital rules applied on financial groups should be designed in a way to more narrowly incorporate potential effects on the firm stability originated by intra-firm funding. Despite capital rules are applied on a consolidated basis, cross participations among related entities might create some distortions which can ultimately accentuate the risk profiles of firms. This is line with the view of Van Lelyveld and Schilder (2003), who state that the "regulatory inconsistency" reflected by double leverage opportunities needs to be regulated.

Michael Moore (2001) sustains that the development of mixed conglomerates which combines financial and non-financial entities tends to obscure the detection of double leveraging and makes the application of prudential and compliance rules more difficult. In his view the effec-

tive supervision of conglomerates should designate to separate authorities the supervision of financial *versus* non-financial entities, with some additional "firewalls." These latter "firewalls" include also a sliding capital approach at the holding company level, where the firm might be requested to adjust its capital on a sliding scale, for example increasing risk weights in a proportional way to the participation into the subsidiaries.[82]

Our discussion can be further related to the claims of some relatively older articles. We have pointed out that intra-firm financing of equity can generate frictions which can be seen as the reflection of some "affiliation" risk (Black, Miller, and Posner (1978), and Karna and Graddy (1984)), or "interdependence" risk (Board of Governors of the Federal Reserve System (1992)).

We have also noted that the term employed by financial authorities might become slightly misleading. Instead than emphasizing a "duplication" of leverage which is not straightforward to note, we rather suggest referring to an additional (or, second) level of leverage available to business groups as compared to single operating entities.

In order to draw attention on the potential effects stemming from double leverage we use a very simple representation of the balance sheets of two BHCs. We choose the items on the balance sheets of the two firms *ad hoc*. A more sophisticated modeling could offer a deeper understanding on the way in which intra-firm funding would interact with risk-taking. This is left for future research.

To conclude, the topic uncovered by this paper is important for the impact that the distress of large banking institutions has got on systemic risk. A strong base of capital at the largest, systemically important institutions is needed for preventing adverse economic consequences. Any regulatory proposals advanced for making the capital regulation of banking group more effective should take into considerations the issues pointed out by this paper.

[82] Michael Moore, "Conglomerates Supervision – Group Support, Double Leverage and Double Gearing," presentation held at the World Bank/International Monetary Fund/Federal Reserve System Seminar for Senior Bank Supervisors from Emerging Economies, October 17 - 28, 2011, Federal Reserve System Training Center, Washington.

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Appendix: Definition of Variables

Variable Name	Description
stdev (%)	Quarterly standard deviation of parent company stock returns
zscore	Annual z-score: (*ROA* + *CAP*) / Standard Deviation of *ROA*
DLR (%)	Parent company total equity investments in subsidiaries as a percent of the total equity capital of the parent company
DLR_DUMMY	Dummy variable assuming value 1 if *DLR*>100%, while assuming value 0 if *DLR*≤100%
CAP (%)	Total equity as a percent of total assets (from consolidated balance sheet)
RISKBASED CAP (%)	Total risk based capital ratio (consolidated): total capital (tier 1 core capital + tier 2 supplemental capital)/risk-adjusted assets For Call Report and FRY-9C filers, depending on institution attributes and time period, represents total risk-based capital reported under either the U.S. Basel III (B3) revised regulatory capital rules, Advanced Approaches rules or otherwise, or the General Risk-Based (GRB) regulatory capital rules. Preference between the GRB, B3 and B3-Post Parallel Run values is given based on the nature of the filing and the attributes of the various total capital ratios
MKBK (%)	Parent company price as a percent of book value per share
SIZE	Natural logarithm of parent company total assets
LOANS (%)	Net loans as a percent of total deposits (from consolidated balance sheet)
NONINTEREST INCOME (%)	Total non-interest income as a percent of total assets (from consolidated balance sheet)
NONBANK SUBS (# of)	Parent company total number of nonbank subsidiaries
DEPOSITORY SUBS (# of)	Parent company total number of federally insured banking or thrift subsidiaries owned
EQUITY IN BANKING SUBS (%)	Parent company equity investments in bank subsidiaries and associated banks (common and preferred stock) as a percent of the total equity capital of the parent company. Banking subsidiaries include: subsidiary banks and associated banks, subsidiary bank holding companies and associated bank holding companies.
EQUITY IN NON-BANK SUBS (%)	Parent company equity investments in nonbank subsidiaries and associated nonbank companies (common and preferred stock) as a percent of the total equity capital of the parent company

EQUITYINSUBS_TA (%)	Parent company equity investments in subsidiaries (common and preferred stock) as a percent of the total assets of the parent company.
EQUITYINSUBS_TINV (%)	Parent company equity investments in subsidiaries (common and preferred stock) as a percent of the total investments of the parent company in subsidiaries.

Table 1: Summary Statistics for Risk and Bank Holding Company (BHC) characteristics

Results refer to a total number of 465,115 BHC-quarter observations.
All the variables are winsorized at the 1st and 99th percentiles.

Name	Mean	Std dev	1st Quartile	Median	3rd Quartile
Dependent Variables					
stdev (%)	6.704	7.601	2.153	4.564	8.408
zscore (Annual)	85.377	123.369	24.534	54.397	104.126
Regressors					
DLR (%)	108.505	22.453	97.870	100.000	116.570
DLR_DUMMY	0.496	0.500	0.000	0.000	1.000
CAP (%)	9.305	2.939	7.470	8.960	10.650
RISKBASED CAP (%)	15.310	5.359	11.920	14.030	17.050
MKBK (%)	141.741	71.736	91.200	130.100	178.300
SIZE (Natural Log)	11.009	1.560	9.999	10.723	11.553
LOANS (%)	78.871	18.112	67.590	79.290	90.610
NONINTEREST INCOME (%)	1.245	2.492	0.580	0.880	1.300
NONBANK SUBS (N of)	1.582	5.258	0.000	0.000	1.000
DEPOSITORY SUBS (N of)	1.073	0.369	1.000	1.000	1.000
EQUITY IN BANKING SUBS (%)	105.225	25.546	95.611	99.962	115.031
EQUITY IN NON-BANK SUBS (%)	2.056	6.245	0.000	0.000	0.972
EQUITYINSUBS_TA (%)	91.054	14.284	89.236	95.694	98.809
EQUITYINSUBS_TINV (%)	97.493	6.899	98.959	100.000	100.000

Table 2: BHC Risk, Double Leverage Ratio and Risk-Based Capital by Years during 1990-2014

Year	*stdev* (%)	*DLR* (%)	*RISKBASED CAP* (%)
	(N of Observations)	(N of Observations)	(N of Observations)
1990	7.356 (357)	116.220 (1988)	14.374 (87)
1991	6.390 (388)	114.611 (2166)	14.572 (1444)
1992	6.097 (413)	112.650 (2343)	15.401 (1602)
1993	6.082 (451)	110.075 (2501)	16.468 (1745)
1994	6.068 (598)	103.632 (2049)	16.550 (1953)
1995	4.746 (877)	102.573 (2247)	16.509 (2151)
1996	4.381 (1068)	102.113 (1903)	16.277 (2421)
1997	5.057 (1298)	101.688 (2932)	16.170 (2806)
1998	6.300 (1553)	101.620 (3426)	16.068 (3310)
1999	5.589 (1763)	103.058 (3929)	15.595 (3813)
2001	5.731 (1940)	104.930 (4750)	14.815 (4664)
2002	5.263 (2012)	106.171 (5231)	15.097 (5163)
2003	4.557 (2100)	107.269 (5779)	15.329 (5734)
2004	4.661 (2220)	109.244 (6337)	15.342 (6266)
2005	4.279 (2355)	110.059 (6702)	15.125 (6608)
2006	3.817 (2448)	113.027 (2659)	13.972 (2662)
2007	5.137 (2537)	111.939 (3133)	13.750 (2759)
2008	10.637 (2616)	112.498 (3293)	13.400 (2882)
2009	11.997 (2644)	111.547 (3674)	14.065 (3182)
2010	9.380 (2669)	113.113 (3953)	14.922 (3404)

2011	9.323 (2688)	112.195 (4165)	15.829 (3585)
2012	7.554 (2701)	111.134 (4387)	16.231 (3734)
2013	6.241 (2737)	109.771 (4568)	16.233 (3899)
2014 (q1)	5.829 (692)	108.730 (1175)	16.258 (1006)

Table 3: Double Leverage Ratio by Level of BHC Risk

The Table reports the output from the Wilcoxon rank-sum test. * p < 0.10, ** p < 0.05, *** p <0.01

BHCs	Lower Risk (a)	Higher Risk (b)	Significance of Difference |a-b|	Prob {*DLR*(a) ≤ *DLR*(b)}
	stdev < 1st quartile	*stdev* ≥ 1st quartile		
DLR	103.811%	106.481%	***	55%
N	5712	21455		
	stdev < 2st quartile	*stdev* ≥ 2nd quartile		
DLR	104.222%	107.464%	***	55.4%
N	12947	14220		
	stdev < 3rd quartile	*stdev* ≥ 3rd quartile		
DLR	104.763%	109.384%	***	56.8%
N	20368	6799		

Table 4: The Determinants of Bank Holding Company (BHC) Risk

Panel A: Pooled OLS regression of *stdev* on BHC characteristics and quarter dummies (not reported) for 1990q1-2014q1. Panel B: Panel Regression of *stdev* on BHC characteristics, quarter and BHC dummies (not reported) for 1990q1-2014q1. Robust standard errors are clustered at the BHC level and are reported in parentheses.* p < 0.10, ** p < 0.05, *** p <0.01

	Panel A: *stdev* (Pooled OLS)					
	(1)	(2)	(3)	(4)	(5)	(6)
stdev (t-1)	0.314***	0.337***	0.320***	0.332***	0.321***	0.341***
	(0.019)	(0.022)	(0.021)	(0.028)	(0.020)	(0.028)
DLR (t-1)	0.029***	0.024***	0.080***			
	(0.006)	(0.008)	(0.022)			
SIZE (t-1)	0.107**	0.166***	0.201**	0.100*	0.090*	0.122*
	(0.048)	(0.054)	(0.084)	(0.060)	(0.053)	(0.069)
MKBK (t-1)	-0.007***	-0.009***	-0.006***	-0.008***	-0.007***	-0.008***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
RISKBASED CAP (t-1)	-0.094***		0.305**	-0.128***	-0.140***	-0.177***
	(0.021)		(0.139)	(0.030)	(0.021)	(0.028)
CAP (t-1)		-0.199***				
		(0.054)				
LOANS_DEPOSITS (t-1)			0.000			
			(0.005)			
NONBANK SUBS (t)			0.006			
			(0.013)			
DEPOSITORY SUBS (t)			-0.314*			

			(0.171)			
NONINTEREST INCOME (t-1)			-0.149*			
			(0.077)			
*DLR(t-1)*RISKBASED CAP (t-1)*			-0.004***			
			(0.002)			
*DLR(t-1)*CRISIS_DUMMY*			0.042**			
			(0.017)			
EQUITY IN BANKING SUBS (t-1)				0.028***		
				(0.007)		
EQUITY IN NON-BANKING SUBS (t-1)				0.035**		
				(0.014)		
EQUITYINSUBS_TA (t-1)					-0.010	
					(0.006)	
EQUITYINSUBS_TINV (t-1)						0.005
						(010)
Constant	1.852*	3.587*	-3.310	1.972	6.426***	4.687***
	(1.125)	(1.353)	(2.283)	(1.828)	(1.293)	(1.771)
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	20348	14880	17014	11306	20419	11253
R^2	0.296	0.327	0.312	0.301	0.293	0.295

	Panel B: *stdev* (Panel Analysis)					
	(1)	(2)	(3)	(4)	(5)	(6)
DLR	0.043***	0.014***	0.103***			
	(0.008)	(0.011)	(0.030)			
SIZE	-0.671*	-0.590	-0.916	-0.952*	-0.468	-1.286**
	(0.383)	(0.525)	(0.569)	(0.495)	(0.336)	(0.591)
MKBK	-0.013***	-0.021***	-0.014***	-0.019***	-0.013***	-0.019***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
RISKBASED CAP	-0.111***		0.362*	-0.150***	-0.176***	-0.209***
	(0.033)		(0.205)	(0.051)	(0.037)	(0.052)
CAP		-0.530***				
		(0.099)				
LOANS_DEPOSITS			-0.020*			
			(0.011)			
NONBANK SUBS			0.016			
			(0.043)			
DEPOSITORY SUBS			-			
NONINTEREST INCOME			0.071			
			(0.128)			
*DLR*RISKBASED CAP*			0.043***			
			(0.008)			

*DLR*CRISIS_DUMMY*			-0.671*			
			(0.383)			
EQUITY IN BANKING SUBS				0.041***		
				(0.009)		
EQUITY IN NON-BANKING SUBS				0.006		
				(0.017)		
EQUITYINSUBS_TA					-0.014	
					(0.009)	
EQUITYINSUBS_TINV						-0.009
						(0.020)
Constant	12.500***	17.572***	13.586*	18.865***	17.908***	28.104***
	(4.389)	(5.818)	(7.152)	(5.654)	(4.301)	(6.681)
Quarter Dummies	Yes	Yes	Yes	Yes	Yes	Yes
BHC Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	20630	15157	17345	11357	20702	11303
R^2 *(Overall)*	0.176	0.200	0.171	0.178	0.185	0.149

Table 5: Granger-Causality Tests from DLR to *stdev*

	H_0: *DLR* does not Granger cause *stdev*
F (Average)	2.669
P-val (Average)	0.425
N	548
P-val ≤ 10% (N of BHCs)	113
P-val ≤ 5% (N of BHCs)	78
P-val ≤ 1% (N of BHCs)	36

Table 6: Analysis on the BHCs with Double Leverage Ratio above 100%

Panel A: Output from the Wilcoxon rank-sum test. The two sub-samples are distinguished according the variable *DLR_DUMMY*. Panel B: Pooled OLS regression of *stdev* on BHC characteristics and quarter dummies (not reported) for 1990q1-2014q1 on the two-sub-samples distinguished by *DLR_DUMMY*. Panel C: Model with endogenous treatment effects for *stdev*. Column (1) estimates the model with maximum likelihood Maddala (1983); robust standard errors are clustered at the BHC level and reported in parentheses. Column (2) estimates the model using a two-step procedure Maddala (1983); standard errors are estimated asymptotically and are reported in parentheses. * p < 0.10, ** p < 0.05, *** p <0.01

Panel A

Variable	*DLR* ≤ 100% (a)	*DLR* > 100% (b)	Significance of Difference |a-b|	Prob {*x*(a) ≤ *x*(b)}
DLR	94.223%	123.022%	***	100.00%
stdev	5.773%	7.572%	***	58.30%
SIZE	10.857	11.159	***	55.00%
MKBK	157.711	148.742	***	44.80%
RISKBASED CAP	17.190%	13.382%	***	25.80%

	Panel B: *stdev* (Pooled OLS)	
	DLR ≤ 100	*DLR* > 100
stdev (t-1)	0.269***	0.335***
	(0.025)	(0.026)
DLR (t-1)	0.003	0.032***
	(0.008)	(0.011)
SIZE (t-1)	0.220***	0.104*
	(0.079)	(0.057)
MKBK (t-1)	-0.004**	-0.007**
	(0.002)	(0.002)
RISKBASED CAP (t-1)	-0.075***	-0.181***
	(0.016)	(0.052)
Constant	3.481**	4.253**
	(1.554)	(2.128)
Quarter Dummies	Yes	Yes
N	9302	10759
R^2	0.223	0.370
Chow Test for Structural Change		
H_0: Regression Coefficients are not stable at *DLR*=100%		
F(6, 19957)	16.31	
P-Val	0.000	

	Panel C: *stdev* (Model with Endogenous Treatment Effects)	
	Maximum Likelihood	Two-Step
DLR_DUMMY	2.195***	3.133***
	(0.468)	(0.823)
SIZE	0.009	-0.071
	(0.080)	(0.076)
MKBK	-0.009***	-0.008***
	(0.002)	(0.001)
RISKBASED CAP	-0.099***	-0.063*
	(0.024)	(0.034)
Constant	6.496***	6.296***
	(1.168)	(0.546)
Quarter Dummies	Yes	Yes
N	20619	20619
Wald Test(χ^2)	11.730***	
λ		-1.429***
		(0.498)

Table 7: Propensity Score Matching

Panel A: Quality of the *n-to-n* matching exercise. The matching is done with replacement and caliper equal to 0.00001. The second column of the panel reports the mean values of each variable for treated and control group, before and after the matching. The t-test in the third column tests whether the means are equal in the two samples. The fourth column computes the standardised percentage bias, as the difference of the sample means in the treated and control sub-samples as a percentage of the square root of the average of the sample variances in the treated and control groups (see Rosenbaum and Rubin (1985)). Panel B: Features of the matching and estimates of treatment effects. Figure 1: Histogram of the propensity score by treatment status. Figure 2: *stdev* as a function of propensity scores by treatment status. Panel C: Pooled OLS regression of *stdev* on the matched sample. Robust standard errors are clustered at the BHC level and are reported in parentheses. * p < 0.10, ** p < 0.05, *** p <0.01

Panel A

Variable	Before/After Matching	Mean		t-test	Bias (%)
		Treated	Control		
SIZE	Before	12.374	11.512	35.73***	55.6
	After	11.848	11.794	1.14	3.5
MKBK	Before	148.380	161.020	-11.13***	-17.2
	After	151.760	151.190	0.22	0.8
RISKBASED CAP	Before	13.524	15.639	-40.37***	-60.1
	After	13.996	13.920	0.82	2.2
CAP	Before	8.762	9.870	-38.06***	-57.8
	After	9.129	9.119	0.18	0.5
LOANS_DEPOSITS	Before	87.636	82.224	21.78***	33.2
	After	85.631	86.197	-1.02	-3.5
NONBANK SUBS	Before	4.238	1.416	23.86***	38.1
	After	1.947	1.862	0.49	1.1
DEPOSITORY SUBS	Before	1.251	1.146	12.50***	19.5
	After	1.152	1.138	0.83	2.6
NONINTEREST INCOME	Before	1.295	1.186	7.10***	10.9
	After	1.217	1.183	0.98	3.4
		Mean			
Bias (%)	Before	36.541			
	After	2.199			

Panel B

	On Support	Off Support	Total
Untreated	1466	6082	7548
Treated	1520	8277	9797
Total	2986	14359	17345
	Mean	Min	Max
Propensity Score	0.574	0.001	0.978
	Estimate		
ATT	0.453		
ATE	0.478		

Figure 1

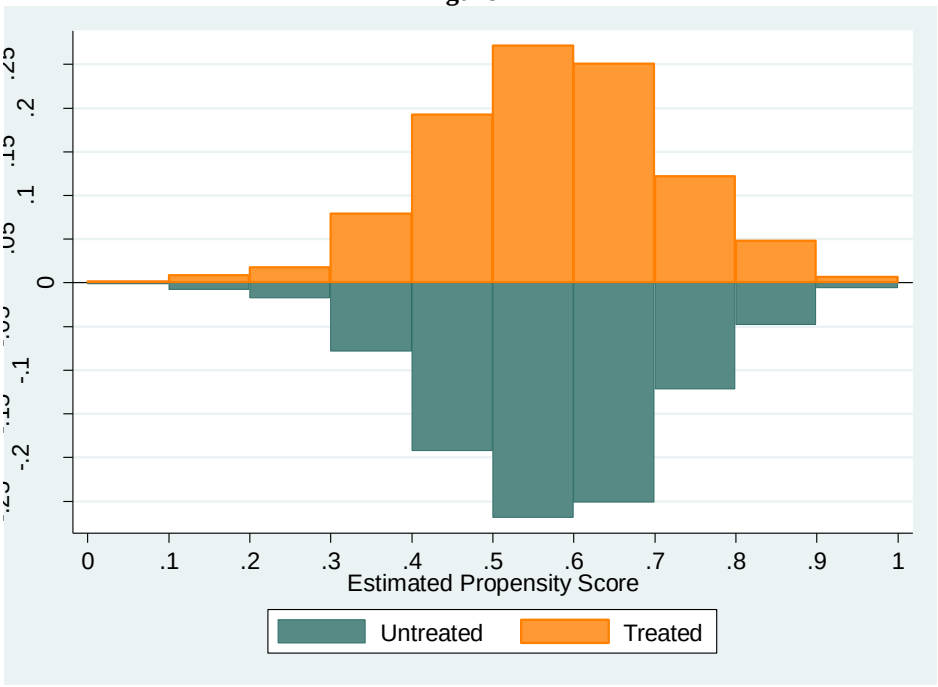
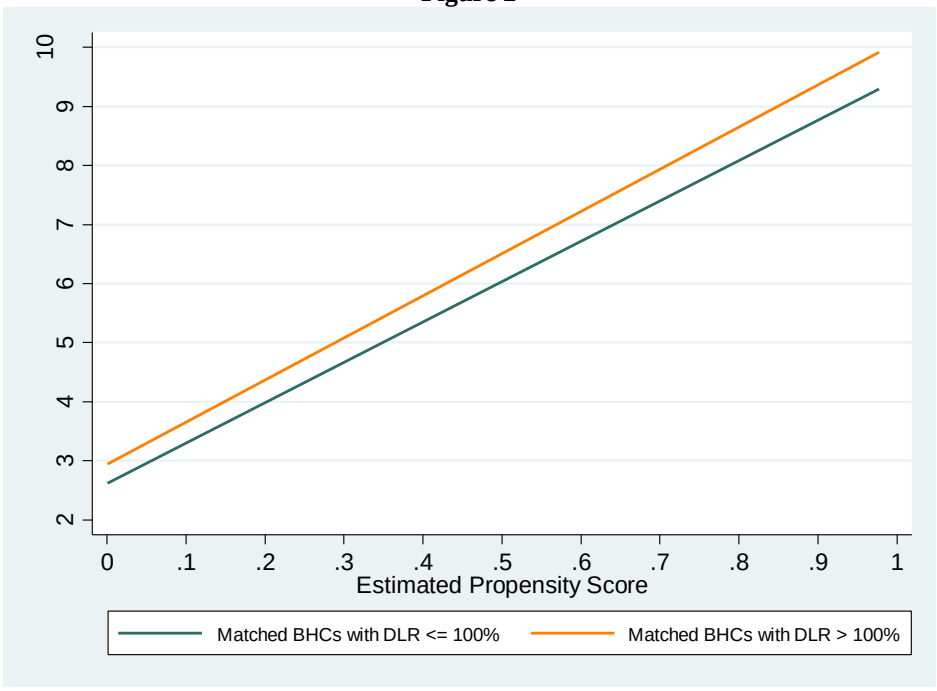


Figure 2



	Panel C: *stdev* (Pooled OLS on Matched Sample)	
	(1)	(2)
stdev (t-1)	0.299***	0.296***
	0.032	0.032
DLR_DUMMY (t-1)	0.567**	
	(0.253)	
DLR (t-1)		0.029***
		(0.009)
SIZE (t-1)	0.407***	0.454***
	(0.140)	(0.141)
MKBK (t-1)	-0.008***	-0.008***
	(0.003)	(0.003)
RISKBASED CAP (t-1)	-0.138**	-0.114**
	(0.058)	(0.057)
LOANS_DEPOSITS	0.003	0.004
	0.009	0.009
NONBANK SUBS	0.033	0.026
	0.031	0.031
DEPOSITORY SUBS	-0.641***	-0.673***
	0.242	0.245
NONINTEREST INCOME	-0.118	-0.102
	0.167	0.167
Constant	1.519	-2.064
	(1.756)	(2.140)
Quarter Dummies	Yes	Yes
N	2911	2911
R^2	0.290	0.293

Table 8: Regression Discontinuity

The Table reports the output from analyses based on regression discontinuity (RD) designs. The outcome variable is *stdev*, while the assignment (or, treatment) variable is *DLR*. Discontinuity is tested for the cut-off values in *DLR* reported in first column. The second column contains the bandwidth, where the optimal bandwidth is the one that minimizes the minimum squared error, as in Imbens and Kalyanaraman (2009). The remaining columns reports results from the local Wald estimation. Estimation is done using local triangle kernel regressions. Figure 2: *stdev* as a function of the distance in *DLR* from the cut-off. In Panel A and B the cut-off is 100%; in Panel A the local regressions are computed in 50 points, while in Panel B the local regressions are computed in 10 points. In Panels C-F the cut-offs are the values corresponding to the 10^{th}, 25^{th}, 75^{th}, and 90^{th} percentile of the distribution of *DLR*, respectively. The local regressions are computed in 50 points.

Cut-off in *DLR*	Bandwidth	Wald Estimator	Standard Error	P-value
100%	Optimal = 3.943	1.038	0.257	0.000
100%	50% of Optimal = 1.971	0.946	0.312	0.000
100%	200% of Optimal = 7.886	1.104	0.211	0.000
90.82%	Optimal = 5.100	-0.157	0.399	0.694
97.87%	Optimal = 2.693	-0.306	0.294	0.297
116.57%	Optimal = 5.176	0.044	0.504	0.931
135.58%	Optimal = 6.422	0.228	1.014	0.822

Figure 3

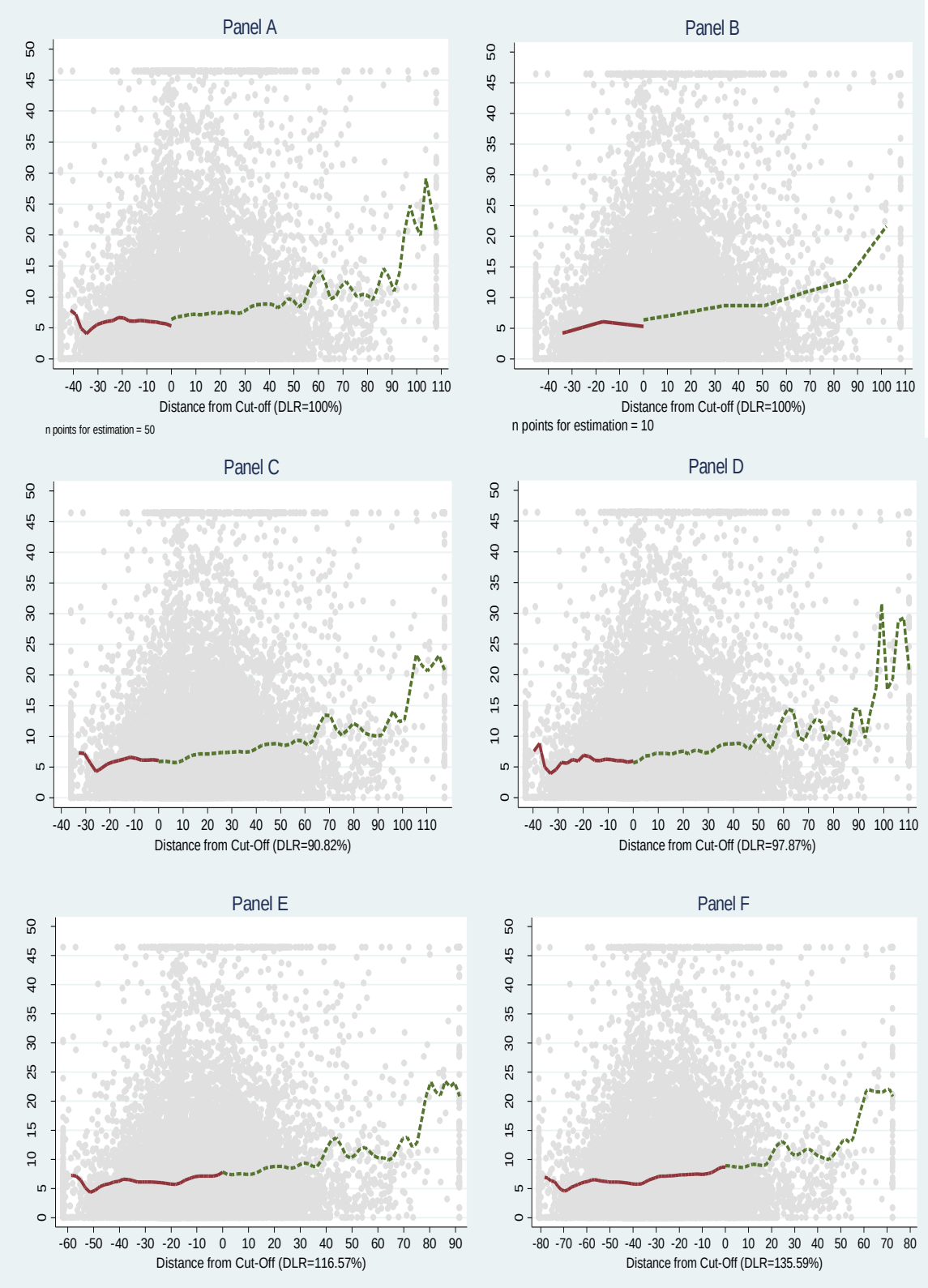

Panel A
Distance from Cut-off (DLR=100%)
n points for estimation = 50
Panel B
Distance from Cut-off (DLR=100%)
n points for estimation = 10
Panel C
Distance from Cut-Off (DLR=90.82%)
Panel D
Distance from Cut-Off (DLR=97.87%)
Panel E
Distance from Cut-Off (DLR=116.57%)
Panel F
Distance from Cut-Off (DLR=135.59%)

Table 8: The Effect of the Double Leverage Ratio on BHCs Risk – *zscore* as Alternative Measure for Risk

The Table reports the output from the pooled OLS regression of zscore on BHC characteristics and year dummies (not reported) for 1990-2014. The initial quarterly variables are now employed in their average value across year. Robust standard errors are clustered at the BHC level and are reported in parentheses. * p < 0.10, ** p < 0.05, *** p <0.01

	zscore (Pooled OLS on Annual Averages)
DLR	-0.723***
	(0.138)
SIZE	2.129
	(1.731)
MKBK	0.282***
	(0.055)
RISKBASED CAP	1.158
	(1.320)
Constant	137.428***
	(38.030)
Year Dummies	Yes
N	14012
R^2	0.099

Table 9: Effect of Tax Increases on the Double Leverage

Panel A: Increases in the corporate tax rates of United States countries during 2000-2011. The Panel resembles Table 1 of Schandlbauer (2014). Panel B: Pooled OLS regression of *ΔDLR* and *ΔEQUITYINSUBS_TA* during 2000-2011 on the matched sample. *Tax Increase* is an indicator variable assuming value one if a tax rate increase occurred in a certain country and quarter, while is zero in the other cases. The treated units are the BHCs incorporated in countries experiencing a tax increase during the quarter, and are identified by *Tax Increase* equal to one. The matched control units are determined by propensity score matching. Each treated unit is matched with five control units, without replacement, and on the base on the same BHC characteristics used for the matching exercise of Table 7-Panel A. Panel C: Two-Stage Least Square Regression for *stdev*. *DLR* is instrumented by *Tax Increase*. The critical values for the Cragg-Donald Wald *F* Statistic are taken by Stock and Yogo (2005). Robust standard errors are clustered at the BHC level and are reported in parentheses. * p < 0.10, ** p < 0.05, *** p <0.01

Panel A

State	Year of Enactment	Type of Tax Change
AL	2001	Income Tax Increase
NH	2001	Income Tax Increase
TN	2002	Income Tax Increase
MD	2008	Income Tax Increase
OR	2009	Income Tax Increase
IL	2011	Income Tax Increase
AR	2003	Introduction of Surcharge Tax
CT	2003	Introduction of Surcharge Tax
CT	2004	Increase of Surcharge Tax
NJ	2006	Introduction of Surcharge Tax
MI	2008	Introduction of Tax on Net Capital
CT	2009	Introduction of Surcharge Tax
NC	2009	Introduction of Surcharge Tax

Panel B

	ΔDLR	*ΔDLR*	*ΔEQUITYINSUBS_TA*	*ΔEQUITYINSUBS_TA*
Tax Increase (t)	0.855*		-0.050	
	(0.464)		(0.823)	
Tax Increase (t-1)		1.019**		-0.082
		(0.519)		(0.268)
Constant	-0.424	-0.424	1.677**	1.677**
	(0.451)	(0.451)	(0.825)	(0.825)
Quarter Dummies	Yes	Yes	Yes	Yes
N	1361	1361	1360	1360
R^2	0.085	0.085	0.084	0.084

Panel C		
	First Stage	Second Stage
	DLR	*stdev*
DLR		0.809**
		(0.381)
SIZE	-0.096	0.545*
	(0.403)	(0.314)
DEPOSITORY SUBS	0.771	-1.168
	(1.742)	(1.403)
NONBANK SUBS	0.227***	-0.200*
	(0.080)	(0.105)
Constant	106.693***	-84.268**
	(4.562)	(40.421)
Instrument:		
Tax Increase	4.694*	
	(2.400)	
N	22410	22410
F Statistic	9.15***	1.96*
Angrist-Pischke *F* Statistic	3.83*	
C Test		19.986***
Cragg-Donald Wald *F* Statistic		22.4
Critical Values for Cragg-Donald Wald F Statistic	10% max size distortion	16.38
	15% max size distortion	8.96
	20% max size distortion	6.66
	25% max size distortion	5.53

The Interplay between Payout Policies and Debt inside Banking Firms

Abstract

The paper studies the interplay between the payout policies and the leverage structures of financial firms. For a large sample of United States commercial banks we find that our firms are more likely to pay dividends and have larger payout ratios when they rise in non-deposit leverage. Conversely, when banks increase in deposit leverage they pay out less of their earnings. By receiving huge dividends equityholders shift some of their risk towards the non-deposit creditors. This pattern reveals in the data after the crisis of 2007-2008. Banks started to rely more strongly on deposit funding, while the same depositors were viewing their funds more "at risk." Commercial banks avoided expropriating retail creditors from the dividend value in order to preserve stability. We do not observe a significant interplay between leverage and the payout associated to share repurchases.

Keywords: Banks, Dividends, Leverage

JEL Classification: G21, G35

1. Introduction

During the global crisis of 2007-2009 financial firms experienced severe shocks on their funding, which had implications on other corporate decisions.

One rather controversial aspect in the behavior of financial firms during the recent crisis concerns their dividend policies. Acharya et al. (2012) show that, while huge credit losses were depleting the common equity of banks, the same firms continued to pay out large dividends. Dividends benefit owners in violation of the priority of debt over equity. Indeed, when losses can be anticipated, dividends represent an "extraction" (or "expropriation") of value from debtholders.

Several papers sustain that, by paying out earnings firms do intensify moral hazard, and shareholders might leave debtholders with an "empty shell" (Black (1976), Myers (1977), Smith and Warner (1979), Easterbrook (1984), and Leuz, Deller, and Stubenrath (1998), Akerlof and Romer (1993), Haq and Heaney (2012), and Kanas (2013)).

The moral hazard of banks might be amplified also by changes in the capital structure. Acharya et al. (2012) argue that, during the crisis banks were bringing severe agency costs by assuming higher leverage (measured as total assets over common equity).[1] The high dividends observed in their sample are affirmed to reflect a form of risk shifting (or, asset substitution) from equityholders to debtholders.[2]

We depart from the discussion of Acharya et al. (2012) and inspect more deeply the relationship occurring between leverage and dividends inside banks. The two policies carry some agency costs which might juxtapose, ultimately affecting stability.[3] The focus on the banking industry makes the discussion and the empirics of the paper relatively articulated,

[1] A high leverage makes the cost of the financial distress more expensive, as well. The costs of bankruptcy might be larger for financial firms because of the following two facts. First, bankruptcy deters the bank from issuing new liabilities, such as demand deposits and lending commitments, so that it is unable to provide critical services to customers as credit, payments, and market timing. Secondly, given the interconnectedness among banking institutions, the failure of one bank may weaken other banks which have exposures to the failed one (Thomas F. Huertas, LSE Financial Markets Group Seminar on Modigliani - Miller in Banking, 18 January 2010).

[2] In a subsequent paper Acharya, Le, and Shin (2013) propose a model which can explain this behavior. The argument relies on the franchise value of banks. The argument predicts that when the bank leverage is sufficiently high and the franchise value of the firm is below a certain critical level, equityholders have larger benefits from receiving cash today through the dividend, rather than maintaining the equity option on the franchise value. Our empirical results would be consistent with this prediction in what regards the effect estimated on the non-deposit debt, which the type of debt for which we affirm to have higher agency costs and higher dividend expropriation.

[3] According to Admati et al. (2013) bank capital regulation can enhance social benefits to the economy. Better capitalized (i.e. less levered) banks have more retained earnings and can expand their lending at lower costs, whereas when leverage is excessive equityholders ask for huge dividends, since they will get larger gains from a certain payout over equity.

contributing to a better understanding on the decisions taken by financial firms. One feature which characterizes our approach with respect to previous empirical studies is that we relate dividend choices to banks´ leverage distinguishing effects from deposit and non-deposit leverage. Thus, we give emphasis to the layered composition of debt structures, which is specific to banking firms as compared to non-financial firms. We further note that moral hazard problems can be more acute for banks given the presence of implicit and explicit guarantees such as deposit insurance (Bhattacharya and Thakor (1993)) and the ease of risk manipulation (Myers and Rajan (1998)).

The article of Acharya et al. (2012) is a purely descriptive study. The authors present several statistics on capital raises and dividends from 25 financial institutions, out of them 13 firms are from the United States, including both investment and commercial firms. We instead examine a large sample of United States commercial banks during 2000-2011 and perform several types of regression analyses.

We measure dividend policies by looking at the probability that firms pay dividends during the quarter, and at the relative dividend payout ratio. We study how these two variables change with both deposit leverage (retail funding) and non-deposit leverage (wholesale funding), computed as the book value of deposit and non-deposit debt as ratio over total assets, respectively.[4]

We estimate a significant pattern after October 2008, while during the previous time frame the estimated coefficients are not statistically important. More precisely, when banks raise in non-deposit leverage they are more likely to pay out earnings and have also larger payout ratios. Oppositely, when banks have more deposits they are also more restrictive in their dividend policies. We interpret this pattern arguing that, dividends allow owners to accomplish some risk-shifting on non-deposit creditors, while we cannot argue to get evidence of some dividend "expropriation" against depositors.

Besides performing OLS regressions, we show outputs where the model for the dividend payout is estimated following, alternatively, the method of Arellano and Bond (1991) for dynamic panel data (DPD), and the approach of Honoré (1992) for censored normal regression (Tobit) models with fixed effects. To our knowledge we are among the first to

[4] A standard classification distinguishes between wholesale and retail debt funding. In general, the former includes central bank liquidity, interbank loans, other short-term debt, most notably repurchase agreements (repos) and commercial paper (CP), and longer-term debt. Retail debt funding is essentially funding through customer deposits, such as current, savings and term deposits (Martel, Van Rixtel, and González Mota (2012)). Note that the measures we employ for the banking leverage are based on balance sheet data and do not include effects from positions on derivative contracts.

implement the procedure of Honoré (1992) on a sample of financial corporations. We further report estimates from a simultaneous system of equation where banks determine jointly dividends and capital structures. These latter techniques are helpful for the attenuation of potential endogeneity in our baseline outcomes.

In the final part of the paper we characterize the total payout policy of our firms analyzing share repurchases. In general, we do not see a strong linkage between shares repurchase activities and leverage.

We interpret the reasons why see a tighter interplay between dividends and debt policies during the turmoil and in the aftermath. The global financial crisis revealed the risk in using certain wholesale debt instruments (as repos), so that banks had often to adjust their funding models. In the United States firms were observed raising equity capital and replacing with deposits other secured and unsecured wholesale debt securities (Oura et al. (2013)).[5] At the same time, the crisis affected the behavior of depositors, as long as they started to perceive some risk in the availability of their funds, despite the presence of deposit insurance schemes (Mora (2010)). Depositors were no longer net suppliers of liquidity and firms were active in soliciting deposits (Acharya and Mora (2012)). The amount of deposits above the deposit insurance limit was high, and the FDIC fund dramatically fell by August 2009.

These facts help to explain the estimated pattern. During the freeze of credit in the markets, banks which could raise in deposit leverage preferred to smooth and/or reduce their dividends, so to avoid potential withdrawals from depositors. The same did not happen with non-deposit creditors. When the share of non-demandable debt was increasing, owners violated the priority of debt over equity by receiving larger dividends. Huge dividends eroded the common equity of the firms and the consequences from the distress were shifted on non-deposit creditors.

With this paper we provide an explanation to the so-called "dividend puzzle" sustaining that banks pay dividends in response to the contrasting interests among their stakeholders.[6]

[5] Since the 1990s, banks have increasingly used wholesale funding to supplement retail deposits (Feldman and Schmidt (2001)). Before the crisis researchers retained it was advantageous that banks had sophisticated business models (Calomiris and Kahn (1991), Rochet and Tirole (1996), Flannery (1998), and Calomiris, (1999)), yet the outbreak of the crisis revealed that wholesale funding was a severe source of instability. Evidence has showed that banks funded more by wholesale funding fared worse during the crisis (Huang and Ratnovski (2009), Shin (2009), Demirgüç-Kunt and Huizinga (2010), Goldsmith-Pinkham and Yorulmazer (2010), Beltratti and Stulz (2012), and Vazquez and Federico (2012)), and most of United States and European banks shifted their funding structures towards a larger use of deposit funding, in order to face the freezing of liquidity on financial markets (among others, see Oura et al. (2013), and Martel, Van Rixtel, and González Mota (2012)).

[6] The seminal paper on the "dividend puzzle" is Black (1976).

In particular, we have put emphasis on the heterogeneity among banks´ debtholders, since we show that different sources of debt imply differently on payouts. This result can be of interest also for more theoretical research, when interested in modelling banks´ behaviours.

The outcomes are discussed in relation to the recent crisis, contributing to the understanding of the reaction of firms towards the turmoil. In the conclusion of the paper we address policy implications where we relate our findings to the debate about sanctions of dividends during crises.

The paper develops as follows. In Section 2 we present the most relevant research on firms´ dividends, with a focus on those papers which deal with the dividends of financial firms. Section 3 analyzes a large panel of United States commercial banks. Econometric techniques relate the dividend policies of our firms to their leverage structures. We distinguish between deposit and non-deposit leverage, and further separate the sub-sample of relative stability (before 2006) from the period of financial turmoil (after Summer 2007). This split allows discussing the way in which the financial crisis might have driven the estimated pattern. Section 4 and Section 5 perform several other tests in order to verify the plausibility of the interpretation. Section 6 implements econometric methods in order to verify that endogeneity problems are not severely affecting our results. Section 7 explores decisions on share repurchases. Section 8 concludes the paper.

2. Related Literature

The article deals with corporate dividend policies. So far academic research has largely concentrated on non-financial firms and several theories have attempted to explain the reasons inducing firms to pay dividends. Among the most diffused there are signaling arguments, free cash flow hypothesis, agency-based models, and other opinions emphasizing issues on taxes and transaction costs. A huge empirical literature tests whether these theories are consistent with empirical evidence. Surveys on this type of research include Allen and Michaely (2003), DeAngelo, DeAngelo, and Skinner (2008), Baker (2009), and Farre-Mensa, Michaely, and Schmalz (2014). Ben-David (2010) integrates these surveys reviewing the behavioural theories of dividends. Despite the numerous contributions, there is still no consensus among researchers on the interpretation of dividends, which remain a “puzzle” (Black (1976)).

Our paper concentrates on the dividend policies of financial firms. There is little knowledge on how financial firms decide on their dividends. Dickens, Casey, and Newman

(2002) and Kleff and Weber (2005) identify the factors which explain the decisions on dividends for samples of banks. These factors are found to be size, risk and profitability. Casey and Dickens (2000) study effects on banks´ dividends from tax changes. Finally, Basse et al. (2014) and Boldin and Legget (1995) ask on the signaling properties of dividends.[7]

The knowledge on banking dividends is relatively scarce and lot of issues remain unsolved. Our paper contributes to this topic, examining the type of interplay existing between the dividend policies of banks and their debt levels, more precisely questioning whether the leverage of a bank is a driver of primary order for the choice of the firm on dividends.

We get hints on the type of correlation existing between banks´ dividends and debt from the following papers.[8] Gropp and Heider (2010) survey the determinants of the capital structures inside United States and European banks during 1991-2004 using a model similar to Frank and Goyal (2009) on industrial firms. The effect from a dummy variable denoting the payment of an annual dividend is to reduce banks´ market and book leverage, consistently with the findings from Frank and Goyal (2009). Differently than Gropp and Heider (2010), Octavia and Brown (2010) find that for banks in developing countries during 1996-2005 the payment of dividends tend to raise the book leverage.

In the final part of the paper we analyze the share repurchases of our sample. This completes our study characterizing the entire payout policy of our firms. Among others, we send to Grullon and Ikenberry (2000) and Allen and Michaely (2003) for some stylized facts on stock repurchases, and for a review of recent research on the topic. Academics have often attempted to explain stock buybacks and have compared them to dividends (among others, see Grullon and Michaely (2002)). Little attention has been given to the share repurchases inside banks. One example is Hirtle (2004),who shows that by repurchasing stocks bank holding companies can improve their financial performance. With our results we can offer new and recent evidence on banks´ share repurchases.

[7] Eriotis, Vasiliou, and Zisis (2007) look at the dividends of Greek banks during 1997-2001. Hirtle (1998) describes the pattern in United States banks during 1997, when financial firms were seen to dramatically fall in capital while simultaneously increase in dividend payouts. Banks were returning to shareholders the earnings accumulated during the previous years of high profitability and cash holding.

[8] More papers give suggestions on the interplay between dividends and debt inside non-financial firms. In Jensen (1986) dividends and debt can reduce agency costs of free cash flows. Articles which relate dividends to funding policies are Dhrymes and Kurz (1967), Fama (1974), McCabe (1979), and Jensen, Solberg, and Zorn (1992). Finally, dividends are affected by debt maturity in Barclay and Smith (1995) and by creditors´ rights in Brockman and Unlu (2009).

3. Empirical analysis

3.1 Data

We use data from SNL Financial LC.[9] We collect balance sheet information and market data on all the United States publicly listed institutions classified as "bank," which SNL Financial defines as "a company whose primary business is to accept deposits and make loans." The sample includes operating independent banks and bank holding companies, while acquired or defunct companies are excluded. We inspect the time horizon which goes from the first quarter of 2000 till the third quarter of 2011 (2000q1-2011q3). In every quarter we have data on 981 institutions and our sample is built by a total of 46,107 bank-quarter observations.

3.2 Variables for the Bank Dividend Policy

The task is to relate the dividend policies of our banks to the leverage of the same firms, conditional on further aspects which we think can importantly influence dividends. We identify the dividend policy of our banks with the following two decisions: (i) paying or not some dividends during the quarter, and (ii) the amount to pay out via dividends with respect to the available resources.

Decision (i) is measured by a dummy variable (*DIVIDEND_DUMMY*) assuming value one if the firm has reported to have paid positive dividends during the year-quarter, while is zero if during the same time period the reported dividends are zero. Two alternative measures capture the decision (ii). The first measure is the so-called dividend payout ratio (*DIVIDEND_EARNINGS*), defined as dividends in percentage to earnings per share. This is the same dividend payout ratio employed by Rozeff (1982) and Braggion and Moore (2010). The second measure divides dividends by the average common equity per share (*DIVIDEND_EQUITY*). Onali (2012) focuses on this same quantity and argues that *DIVIDEND_EQUITY* is a more reliable payout measure, given the importance of equity capital in banking.[10]

[9] SNL Financial LC is a financial information firm headquartered in the United States, which covers more than 50,000 private and public international companies operating in the most relevant market sectors. See http://www.snl.com/.

[10] The quality of results we get on *DIVIDEND_EQUITY* is very similar to the empirical output we get when we run the same regression on the so-called dividend yield, defined as the most recent dividend, annualized and expressed as a percent of the security´s price. The dividend yield is used as dependent variable in the studies of Barclay and Smith (1995) and Mercado-Mendez and Willey (1995). We do not report in the paper the outcomes on the dividend yield for not overloading the set of results.

Table 1 reports means, standard deviations and various percentiles of the variables mentioned so far.[11] Note that *DIVIDEND_EARNINGS* is much more volatile than *DIVIDEND_EQUITY*, and this is likely to be due to the larger volatility of earnings. Table 2 computes the same statistics for the dividend declaring banks, i. e. those banks which were paying some dividends to their shareholders. On average, those firms have distributed more than the half of their profits to owners, given that *DIVIDEND_EARNINGS* for the dividend declaring banks is about 54.4%, while on the entire sample the value is about 35.3%.

In order to detect some patterns in the behavior of dividends along time, Table 3 shows for each year of the sample the percentage of banks which are paying dividends and the associated average payout ratio. The vast majority of our banks are seen to distribute dividends during the very first years of the sample. Till 2008 the proportion of dividend paying banks is above the 65%. During 2010-2011 instead, this number goes below 55%. In 2009 we observe the peak in *DIVIDEND_EARNINGS*, when half of the earnings were allocated to dividends, while it drops during the last two years of the sample. *DIVIDEND_EQUITY* is more stable and is progressively decreasing along time.[12]

3.3 Variables for the Bank Leverage

The bank leverage is alternatively measured by the following four variables. The total leverage is *DEP&NONDEP_TA*, computed as the sum of deposits and non-deposits normalized by total assets. We disentangle the two separate contributions on leverage from deposit and non-deposit debt with the variables *DEPOSITS_TA* and *NONDEPOSITS_TA*. We also compute the ratio of non-deposits over the total amount of deposit plus non-deposit liabilities (*NONDEPOSITS_TL*).[13]

Deposit liabilities are almost the 79% of total assets and largely overcome the non-deposit leverage, which is almost the 9% of total assets (see Table 1). Table 2 shows that the dividend declaring banks have a slightly larger fraction of non-deposit liabilities, given that *NONDEPOSITS_TA* and *NONDEPOSITS_TL* are on average 11.3% and 12.7%, respectively,

[11] Our data source reports only the positive values of *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY*, in the sense that the two payout ratios are not computed for banks reporting negative earnings and/or negative equity. The banks of our sample which report negative earning are about the 16% of the total year-quarter observations with not missing reported earnings, while the banks of our sample which report negative equity are about the 0.53% of the total year-quarter observations with not missing reported equity.

[12] On the entire sample *DIVIDEND_EQUITY* is 4.02% in 2000 and decreases to 1.42% in 2011q3. By deeply inspecting the data, we see that the average equity of our banks is increasing along time, and this might partially determine the downward path of *DIVIDEND_EQUITY*.

[13] We consider as "liabilities" what banks include in the difference between the assets and the equity capital of the balance sheet.

while on the entire sample the values are 9.4% and 10.5%, respectively. Table 4 reports the pair-wise correlation between the variables for dividends and for leverage. In general, dividends are positively correlated with non-deposit leverage while negatively correlated to deposit leverage. This correlation in absolute terms goes never above 0.223.

3.4 Additional Control Variables

The estimated specifications include a set of regressors which controls for other bank characteristics which might be linked to dividends.

Two relevant features are size and profitability, which we measure by the natural logarithm of total assets (*SIZE*) and by the return on assets (*ROA*), respectively. We expect that both sort a positive effect on dividends, because larger and more profitable organizations should have larger flows of funds which can be partially diverted to shareholders. Consistent with this view are the papers from Jensen, Solberg, and Zorn (1992), Barclay and Smith (1995), and Kleff and Weber (2010).

Investment opportunities are proxied by the market-to-book-ratio (*MTBV*): growth options would bid up the market value of the firm relative to its book value, and we would see *MTBV* increasing in investment opportunities. If profits are largely employed to finance prospective investments, then a higher *MTBV* goes together with lower payouts. This argument is sustained by Barclay and Smith (1995) and Theis et al. (2010).

We control for equity (*EQUITY_TA*) and cash (*CASH_TA*), both normalized by total assets. The prediction on these two variables is relatively mixed, as in DeAngelo, DeAngelo, and Stulz (2006). We further consider the business model of the bank by including loans over assets (*LOANS_TA*), and the ratio of risk weighted assets over total assets (*RWA_TA*). Issues on taxation enter the specification via *INCOME_TAX_TA*, which divides income tax payments by total assets. Employees´ compensation might matter, as well. Our data provider includes an index for compensation (*EMPL_COMP*), calculated as the ratio of the employees´ compensation and benefits over the average full-time equivalent employees.[14] Regulatory capital requirements affect the activities of financial firms. *CAPRATIO* denotes the risk adjusted total capital ratio, namely the sum of tier 1 and tier 2 capital over risk

[14] Compensation and benefits include salaries, wages, bonuses, commissions, changes in reserve for future stock option expense, and other employee benefit costs, also related to employment or retirement benefits, whether paid or deferred, recognized during the period. If the company does not report the average full-time equivalent employees for the period, this is calculated by SNL Financial.

weighted assets.[15] If capital requirements force banks to retain much of their earnings, then we should observe that they are inversely associated to dividends.

3.5 Empirical Strategy

We estimate a separate univariate model for the three variables on dividends, where each of them is explained by leverage and by the other covariates presented in the two previous sub-sections. The specification for *DIVIDEND_DUMMY* is the following logit model in (1):

$$
\begin{aligned}
&Prob\left(DIVIDEND\_DUMMY_{i,t} = 1\right) \\
&\quad = F\Bigg(\alpha_1 LEVERAGE_{d,i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 ROA_{i,t} + \alpha_4 EQUITY\_TA_{i,t} \\
&\quad + \alpha_5 CASH\_TA_{i,t} + \alpha_6 MTBV_{i,t} + \alpha_7 LOANS\_TA_{i,t} + \alpha_8 RWA\_TA_{i,t} \\
&\quad + \alpha_9 INCOME\_TAX\_TA_{i,t} + \alpha_{10} EMPL\_COMP_{i,t} + \alpha_{11} CAPRATIO_{i,t} \\
&\quad + \sum_i bank_i + \sum_t quarter_t + \varepsilon_{i,t}\Bigg) \qquad (1)
\end{aligned}
$$

$$
where\ d = DEP\&NONDEP\_TA, NONDEPOSITS\_TA, DEPOSITS\_TA, NONDEPOSITS\_TL
$$

We are pooling data over time and across firms, therefore we include quarter and bank fixed effects. Standard errors are clustered at the bank level, since observations might be correlated across time. The logit model allows interpreting the coefficients on the regressors as the impact from the associated variables on the probability that the bank is paying some positive dividends. We run four versions of equation (1) which differ only in the variable measuring the bank leverage.[16] The Panel A of Table 5 reports the results.

For the two variables measuring the relative dividend payout we estimate the following generalized partial adjustment model in (2):[17]

[15] The mean capital ratio for our sample is 16.497%, hence above the minimum required capital ratio of 10% established under the Basel II agreement. The tendency of banks in holding capital buffers higher than the regulatory minimum is commented, among others, by Berger et al. (2008).

[16] Note that *NONDEPOSITS_TA* and *DEPOSITS_TA* are highly negatively correlated. As reported in Table 4 the correlation on the entire sample is about -0.76. The same correlation on the time-frame 2007q4-2008q3 is about -0.68, while on the time-frame 2008q4-2011q3 is about -0.82. In order to overcome that potential multicollinearity might spoil the results, the specifications are estimated including the leverage variables in a separate way.

[17] In the seminal paper of Lintner (1956) dividends follow a partial adjustment model.

$$DIVIDEND\_PAYOUT_{p,i,t}$$
$$= \alpha_0 + \alpha_1 DIVIDEND\_PAYOUT_{p,i,(t-1)} + \alpha_2 LEVERAGE_{d,i,t} + \alpha_3 SIZE_{i,t}$$
$$+ \alpha_4 ROA_{i,t} + \alpha_5 EQUITY\_TA_{i,t} + \alpha_6 CASH\_TA_{i,t} + \alpha_7 MTBV_{i,t}$$
$$+ \alpha_8 LOANS\_TA_{i,t} + \alpha_9 RWA\_TA_{i,t} + \alpha_{10} INCOME\_TAX\_TA_{i,t}$$
$$+ \alpha_{11} EMPL\_COMP_{i,t} + \alpha_{12} CAPRATIO_{i,t} + \sum_i bank_i + \sum_t quarter_t$$
$$+ \varepsilon_{i,t} \qquad (2)$$

$$where\ p = DIVIDEND\_EARNINGS, DIVIDEND\_EQUITY$$

$$where\ d = DEP\&NONDEP\_TA, NONDEPOSITS\_TA, DEPOSITS\_TA, NONDEPOSITS\_TL$$

The set of covariates stays the same as in equation (1); time and bank fixed effects are included, and standard errors are clustered at the firm level. The Panels B-C of Table 5 display results where the leverage variable is made changed.

Both model (1) and model (2) are estimated across three sub-samples, differing in their time length. The first sub-sample goes from 2000q1 till 2007q3. We regard this time frame as a relative stable period for the United States banking industry. The quality of results stay the same also if we drop from the sub-sample the quarters of 2007. From the end of 2007 onwards instead, the effects from the crisis of 2007-2008 is involving our banks. The second sub-sample extends from 2007q4 till 2008q4, namely after the first disorders due to the collapse of the subprime mortgage market till the failure of Lehman Brothers in September 2008. Finally, the third sub-sample spans from 2008q3 till 2011q3, namely includes the peak of the crisis in fall 2008 and its progressive reabsorption. During this period some big investment banks were re-organized and the United States Government decided to intervene through provisions as the Troubled Asset Relief Program (TARP). All the Panels of Table 5 distinguish the estimated results across the three sub-samples.

3.6 Results

We look at Table 5 and focus on the coefficients estimated on the variables for leverage across the three sub-periods of each panel. From 2000 till 2006 there are no significant coefficients on the two payout measures, while there is weak evidence of a positive effect from non-deposit leverage on *DIVIDEND_DUMMY*. Between 2007 and 2008 we never encounter relevant signs.

In statistical terms our outputs are more evidently interesting during the last part of the sample, namely from the end of 2008 till the end of 2011. During and in the aftermath of the crisis banks are deciding on their dividends in accordance to their debt structures. We observe that the effect sorted from the bank leverage is heterogeneous. In general, after a marginal increase in non-deposit leverage our banks are more likely to pay out dividends and tend to pay out more of the available resources. Deposit leverage instead has got negative sign on the dependent variables. On *DIVIDEND_EARNINGS* the negative effect from *DEPOSITS_TA* is stronger than the effect from *NONDEPOSITS_TA*, which is instead positive although not significant. On *DIVIDEND_EQUITY* we register a similar and more significant pattern. In economic terms, a one-standard-deviation increase in *DEPOSITS_TA* reduces *DIVIDEND_EQUITY* by almost 44%.[18]

Concerning the other regressors, the main findings are shortly summarized as follows. The variability in the two payout measures is largely captured by their values the period before, given the high and significant coefficients on the first lags.[19] This holds till end of 2008. In general, investment opportunities favor the distribution of dividends. Finally, after fall 2008 there is a more pronounced size effect which improves the dividend payout.[20]

3.7. Interpretation of the Results

We now interpret our empirical results. As already stressed, by paying dividends shareholders can extract value from debtholders. In our sample this seems to occur with respect to non-deposit debtholders, given that the estimated sign on dividends from non-deposit leverage is positive. On the other side instead, the estimated coefficient on deposit

[18] Since the standard deviation of *DEPOSITS_TA* is around 9.685, the impact on *DIVIDEND_EQUITY* would be equal to (9.685)*(-0.045) = 43.583%.

[19] In the seminal adjustment model of Lintner (1956) the coefficient estimated on the lagged dependent payout ratio is informative on the speed of adjustment of dividends towards their target. The main result of Lintner (1956) is that corporations tend to "smooth" their dividends and adjust them towards a long-run target payout level. In our generalized partial adjustment model (2) the speed of adjustment coefficient would be computed as one minus the coefficient estimated on the lagged dependent variable. Given that the lagged *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* are negative estimated during the pre-crisis period the speed of adjustment would be larger than one. This suggests that banks were adjusting their dividends relatively quickly and we would not observe a certain stickiness in dividends as was in Lintner (1956).

[20] Some of the control variables have opposite coefficients on the two payout variables which are often of high magnitude. This might be due to how the variables are computed and could be a consequent from the construction of those measures. Indeed, we keep a unique specification for the two alternative dividend payout variables. *ROA* tends to be negative on *DIVIDEND_EARNINGS*, while positive on *DIVIDEND_EQUITY*. Note that the firm´s earnings are at the denominator in *DIVIDEND_EARNINGS*, while at the numerator in *ROA*. We also checked that the same negative effect on *DIVIDEND_EARNINGS* is estimated measuring profitability through the Return On Equity (ROE) or the Return On Capital (ROC). Similarly happens for *EQUITY_TA*, which tends to be negative on *DIVIDEND_EQUITY*, while positive on *DIVIDEND_EARNINGS*. The firm´s equity is at the numerator of *EQUITY_TA*, while at the denumerator of *DIVIDEND_EQUITY*.

leverage is always negative. We cannot say that owners are expropriating value from non-deposit creditors. It appears that demandable debt can limit the moral hazard of owners accomplished by dividends.[21]

This pattern is statistically significant only after fall 2008.[22] During and in the aftermath of the global crisis the funding structure of banks became an important determinant for the dividend policies of the same firms. We interpret this interplay stressing some of the features of the recent crisis which might have induced financial firms to review their funding models, and which might ultimately have driven the observed effect on dividends.[23]

Before the crisis, banks in the United States and in Europe could expand their assets by a large use of wholesale debt. The outbreak of the crisis revealed the risk of certain wholesale debt instruments (as repos), and several large banks experienced distress. If banks wanted to face the consequences of the turmoil and restore more stable conditions they had to adjust their funding models. In particular, companies in the United States were observed raising equity capital and replace secured and unsecured wholesale debt securities with deposits (Oura et al. (2013)).[24]

[21] The properties of debt in terms of agency and liquidity provision are debated. Our results would be more consistent with the view that "senior" deposit debt constrains the type of asset-substitution realized through dividends, as compared to the more "junior" non-deposit debt. Myers (1977) and Stulz and Johnson (1985) say that underinvestment problems might be overcome issuing more senior debt, while according to Smith and Warner (1979) seniority is also beneficial for asset-substitution. In the United States the Federal Deposit Insurance Corporation (FDIC) introduced in 1993 the "depositor preference," claiming the priority of deposits versus non-deposit liabilities. See the Omnibus Budget Reconciliation Act of August 10, 1993, P.L. 103-166, Section 3001. For an opposite view that bank debt cannot relieve agency problems see Admati and Hellwig (2013).

[22] We retain that fall 2008 coincides with the peak of the crisis. The failure of Lehman Brothers in September 2008 was followed by a period of panic and contagion in the markets (Beltratti and Stulz (2012)). Hoggarth, Mahadeva, and Martin (2010) study the reaction of European banks after the collapse of Lehman Brothers. European banks suffered the reduction in lending from United States mutual funds and foreign monetary authorities. They reacted mostly raising local deposits, swapping them into dollars.

[23] The link between financial crises and bank funding may be stronger during banking crises (Van Rixtel and Gasperini). Adrian and Shin (2011) sustain that the phase of the financial cycle reflects on the composition of banks´ balance sheets. Wholesale funding is more diffused during expansions, while reduces during recessions.

[24] Oura et al. (2013) describe the funding structures of banks in the run-up and after the recent crisis, and distinguish the pattern observed in advanced and emerging markets economies. Evidence on the changes in bank funding of European banks can be found in Van Rixtel and Gasperini (2013). Martel, Van Rixtel, and González Mota (2012) analyse the impact of the crisis on the business models of 22 world-wide systemically important financial institutions (SIFIs). Among both the commercial and investment banks of this list, they notice a larger recourse to deposit financing after 2008, mostly at the expenses of short-term wholesale funding. One interesting finding is that the firms with a business model more oriented to commercial banking, thus which had also a greater reliance on deposit funding, proved to be the most resilient institutions. After 2008, the banks more active in investment banking activities were seen to shift towards a more commercial banking model. Figure 1 depicts the behavior of deposits in our sample. Deposit leverage decreases between 2007q1 and 2008q2. In 2009q1 firms recover to the same deposit leverage they had in Summer 2007 (slightly above 78%), progressively increasing till 2011q1, when is more than 82%.

By collecting deposits, banks could hoard the liquidity that was rapidly drying up, especially in the unsecured interbank market (Heider, Hoerova, and Holthausen (2009)).[25] Banks manage their liquidity taking into account of their funding sources, as capital and deposits. Berrospide (2012) studies the determinants for the liquidity hoarding of banks during the recent crisis. Banks that chose to hoard more liquidity at the onset of the crisis were also the firms which had greater inflows of core deposits. For small banks in particular, core deposits are claimed to allow easier purchases of government securities and mortgage-backed securities, since those firms have more restricted access to other funding sources as interbank markets and the central bank´s discount window. During the height of the crisis in fall 2008 though, the liquidity hoarding banks are seen to undergo to a reduction in core deposits. The argument from Berrospide (2012) is that depositors started losing confidence towards banks, and this materialized through withdrawals.

Episodes of turmoil inside financial markets do often affect the behavior of banks´ depositors. Gatev, Schuermann, and Strahan (2007) study the way in which banks managed systematic liquidity risk during 1998. The authors argue that during the crisis of 1998 depositors became net suppliers of liquidity and viewed banks as safe havens, replacing other investment opportunities for depositing funds in the *equally safe* banks. Martinez Peria and Schmuckler (2001) examine how banking crises interact with market discipline and deposit insurance. Financial disorder may act as *wake-up* for depositors, which perceive higher risk of their deposits. Moreover, financial crises can bring to a depletion of deposit insurance funds. These two facts end up in raising the market discipline of depositors, and this is confirmed by finding higher levels of withdrawals and deposit interest rates during the crises experienced by Argentina, Chile, and Mexico during the 1980s and 1990s.

The sample we analyze includes the global crisis of 2007-2009. The turmoil departed from the banking sector and the fragility exhibited by several important institutions led deposits to be seen as a risky. Banks were no more regarded as *safe heavens* and passive recipient of funds as it was during previous crises, but were rather active in seeking deposits (Mora (2010) and Acharya and Mora (2012)).[26] Acharya and Mora (2012) point out the following facts on deposit funding during the latest crisis. First, there was a high amount of

[25] Boyson, Helwege, and Jindra (2014) sustain that banks can avoid fire sales of assets due to liquidity shocks suffered during crises by deposit funding and cutting dividends.

[26] Funding illiquidity may arise for two main reasons. One is that the liquidity providers have to withdraw resources for their own needs, and the second is that depositors withdraw money since they perceive an increase in the firm solvency risk. This latter is the more frequent and severe source of funding illiquidity (Calomiris and Kahn (1991) and Calomiris (2012)).

deposits above the deposit insurance limit, hence not explicitly guaranteed in case of failure. Second, the drop of the FDIC ratio of reserves to insured deposits made depositors more uncertain about the availability of their money. Furthermore, we note that during 2008 and onwards, the FDIC took control over an increasing number of failing institutions, to the extent that banks were asked to make additional payments to the fund in order to insure their deposits.[27]

These facts convey the idea that it was important for banks to have a strong basis of deposits in order to remain solid during the crisis. We retain that this had implications on the dividend policies of the same firms, thus is something that our estimated pattern is reflecting. If banks were willing to attract new depositors and didn´t want to trigger huge withdrawals from the existing depositors, then they also preferred to retain earnings and avoid impairing liquidity by paying out cash.

On the other side the estimated coefficient on dividends from the non-deposit leverage is positive. Owners were asking for larger dividends when firms were issuing more non-deposit type of debt. Namely, dividends reduce the value and shift risk on non-deposit creditors. We retain that, for our sample of commercial banks the majority of the liquidity needs rely on deposit financing.[28] As already remarked, the crisis led both commercial and investment banks to more largely resort on retail funding.[29] There is ample evidence that banks funded more by non-deposit liabilities fared worse during the crisis (Huang and Ratnovski (2009), Shin (2009), Demirgüç-Kunt and Huizinga (2010), Goldsmith-Pinkham and Yorulmazer (2010), Beltratti and Stulz (2012), and Vazquez and Federico (2012)). Our paper is now showing that inside those firms funded more by non-deposit debt, there was also lower retention of earnings.

[27] Due to bank failures during 2008-2009, the FDIC fund fell to $0.648 billion by August 2009. Subsequent failures of financial firms almost bankrupted the FDIC, so that it demanded a 3 year pre-payment from banks to shore up its capital. At the close of 2009, a total of 140 banks became insolvent. This is the largest number of bank failures in a year since 1992, when 179 institutions failed.

[28] In our sample the weight of non-deposit debt over the total banking liabilities (*NONDEPOSITS_TL*) declines progressively. It is around 12.9% in the second quarter of 2008 and then decreases till about 7.7% at the beginning of 2011.

[29] The claim holds for those investment banks which have regulatory authorization to collect deposits. Martel, Van Rixtel, and González Mota (2012) note that, the five United States investment banks which existed before the crisis - Goldman Sachs, Morgan Stanley, Merrill Lynch, Lehman Brothers and Bear Stearns - did not have deposit taking business. Goldman Sachs and Morgan Stanley changed their official status from investment bank to traditional bank holding companies in October 2008.

4. Testing Two Other Arguments for the Interplay between Dividends and Leverage

The interpretation of results in the previous section is based on an agency argument, where by paying dividends firms exacerbate the conflict of interests between shareholders and debtholders. In this section we test whether some other theories motivating the interplay between dividends and leverage, have some residual explanatory power in our data. We formulate two arguments. The first argument is based on signaling, while the second argument relies on disciplining effects.

4.1 Arguments Based on Signaling

Dividends and debt are both ascribed of having signaling properties.[30] If managers are asymmetrically more informed on future prospects than outside investors, they might want to signal future profitability by paying out cash or by raising debt. One interpretation for the interplay between dividends and debt can be that firms use the two policies as substitutes for signaling actions. In that case we would expect that the estimated sign of leverage in the dividend equation would be negative.

We can debate whether the argument is plausible. We can accept that inside a standard non-financial firm a high leverage might convey information about good prospects. This might be less evident for a bank, whose business is by far based on the issuance of short-term demandable debt.

We verify whether our data exclude that such interpretation has still some residual power. As already stressed, we observe a different effect on dividends from different types of liabilities. The signaling hypothesis would predict a negative sign on leverage which we obtain only on the deposit leverage. On the other side the non-deposit leverage has got positive sign, and we have no valid arguments to motivate different signaling properties between the two debt types.

Table 6 includes among the set of regressors the product between the leverage variable and the profitability indicator. The interaction term reveals whether there are some cross-relationships from the two variables in their effects on dividends, namely whether the leverage effect changes when the profitability indicator is marginally changing as well. The interactions are never significant. We do not improve our previous interpretations by considering actions of signaling.

[30] Signalling models for dividends have been developed, among others, by Bhattacharya (1979), Miller and Rock (1985), and John and Williams (1985). The idea of debt signalling goes, among others, to Ross (1977), Leland and Pyle (1977), Heinkel (1982), Myers and Majluf (1984), and Harris and Raviv (1991).

4.2 Arguments Based on Disciplining

There is a second circumstance in which we could admit that dividends and leverage are negatively related. This is the case in which debt can replace dividends in disciplining managers. The argument departs from the existence of a "free cash flow problem" to the firm. Managers might be tempted to use the exceeding funds for pursuing their own objectives. Issuing debt might be a way to concentrate managers in running the firm more efficiently, since they will have to put effort in keeping the firm solvable without destroying value. In alternative, the exuberant cash might be returned to shareholders through dividends.[31] If dividends and debt are substitutes in disciplining managers we expect a negative coefficient on the leverage variable.

As in the previous sub-section, we first discuss the plausibility of the argument. It would be arguable whether banks experience problems of "free cash flow" in the same measure of non-financial firms.[32] Admati et al. (2013) and Admati and Hellwig (2013) say that financial firms are more concerned by theft and risk management rather than by episodes of management wasting resources, which are instead more frequent inside non-financial firms. In addition, we note that bankers do often receive equity-based compensation (like stock options and share grants) or retention schemes, which can incentivize them to work efficiently.

To test whether issues on managerial discipline are involved in our results, we look at the share of insider ownership. When managers own a substantial fraction of the firm, they should be more aligned with the interest of equityholders and might prefer to use earnings in order to create value rather than wasting resources. We look at the sample starting from 2008q4 and use the information on insider ownership as measured on 2011q3.[33] *LOW_INSIDER_DUMMY* is a dummy variable denoting with value one whether the bank has insider ownership below the mean (which equals 18.2%). Banks with low insider ownership should be more likely in experiencing agency problems and might need a stronger monitor of managers. We let interact *LOW_INSIDER_DUMMY* with deposit and non-deposit leverage. Table 7 shows that the interaction terms are never statistically relevant. Inside those banks where managers might be less disciplined, dividends are not significantly related to leverage.

[31] Jensen (1986) explains how debt can substitute dividends in reducing agency costs of free cash flows.
[32] This type of agency problem would be more likely to interest so-called "cash cow" firms as in Jensen (1986).
[33] Our data source provides data on insider ownership in relation to the only last date of observation, hence we assume that firms did not change significantly their property structure.

Surveying the governance structure of our banks does not improve our previous interpretations.

5. Additional Tests

5.1 Disentangling Effects on Dividends from Different Type of Deposits

In this sub-section we disentangle the contribution on dividends from various layers of deposits. From Table 8 we see that our banks cover more than the 50% of assets through "time deposits" (*JUMBOTIMEDEP_TA* and *RETAILTIMEDEP_TA*) and current accounts (*CURRENTACC_TA*). These are followed by money market accounts (*MONEYMKTACC_TA*) and saving accounts (*SAVINGACC_TA*). Foreign deposits (*FOREIGNDEP_TA*) and other unclassified deposits (*OTHERDEP_TA*) have marginal weight. With "time deposits" we mean deposited funds which can be withdrawn only after a contractually specified date, typically ranging from three months to six years. "Time deposits" of "jumbo" type have balance of at least $100,000 and do not have the FDIC insurance protection, hence entail higher investment risk. "Retail time deposits" instead are FDIC protected in full.

In Table 9 we estimate models (1) and (2) replacing the single variable for the deposit leverage with the disentangled layers of deposits. Except very few exceptions, we see that all types of deposits have important negative effects on both *DIVIDEND_DUMMY* and the two payout measures. Note that the insured "retail time deposits" are not sorting a weaker effect in constraining dividends as compared to "jumbo time deposits," which do not offer the same degree of protection in case that the institution fails.[34] In general, our results suggest that the presence of deposit insurance is not enough for encouraging bankers to pay larger dividends once that funds are deposited to the firm.[35]

5.2 Disentangling the Effect on Dividends from the Change in Deposits

Depositors can withdraw funds upon demand. For the banks of our sample we compute the change in deposits across quarters, termed as "delta" in Table 9, Columns 3-4. A firm with a negative delta might have experienced some withdrawals which have reduced the

[34] Martinez Peria and Schmuckler (2001) sustain that deposit insurance schemes are not always fully credible and do not decrease market discipline, especially during crises. Both insured and uninsured deposits can be sensitive and respond to banks´ risk-taking.

[35] Our view is closer to the opinion of Calomiris and Kahn (1991) the possibility of early withdrawals helps to solve the "incentive" problem between bankers and depositors, since depositors can "vote with their feet" and force more prudent actions from managers.

aggregate deposits from one quarter to the other. A dichotomous variable assumes value one if delta is negative and is included as regressor in (1) and (2) in place of the variable for deposit leverage. The sign estimated on the dichotomous variable is negative, although relevant only on *DIVIDEND_DUMMY*.

We get more important outputs as soon as we consider bank deposits subtracted from time deposits. Thus, we create a dummy variable based now on the change in deposits different than time deposits, namely current accounts, money market accounts, saving accounts, foreign and other type of deposits. We now get significantly negative coefficients from the dummy on both *DIVIDEND_DUMMY* and *DIVIDEND_EQUITY*. We can understand this evidence noting that non-time deposits can be withdrawn more easily from customers than time deposits, consequently quickly subtracting liquidity from the firm. This might explain why our data show that changes in non-time deposits are more strictly correlated to dividends.

5.3 Disentangling Effects on Dividends from Non-Deposit Debt of Short-Term

The short-term financing of banks can rely on some non-deposit liabilities of short duration. We test effect on dividends from non-deposit debt of short-term. We want to see whether the rolling-over of the non-deposit short-term debt would ultimately contain the distribution of dividends.[36]

For this purpose we construct the following two measures. *SHORTTERM_NONDEP_TA* computes the ratio of short-term borrowings over total assets. It includes claims with a maturity of one year or less and does not include repurchase agreements (repos). In practice though, in the short-term banks do often finance through repos; for this reason *REPOS_TA* disentangles the contribution from repurchase agreements over total assets. In Table 10 we add these two latter variables to the models for dividends. Both have positive estimated sign, although it is never statistically significant. Controlling for short-term debt is not adding much information on our study.

5.4 Controlling for Regulatory Interventions during the Recent Financial Crisis

Some of the banks in the sample were involved by the Troubled Asset Relief Program (TARP) pursued by the United States Government starting from October 2008, with the task

[36] Among others, short-term debt is a stronger monitoring device than long-term debt according to Diamond (1991), Datta, Iskandar-Datta, and Raman (2005), and Kisgen (2006).

of giving strength to the financial sector which was gravely hit by the consequences of the subprime mortgage crisis. The banks participating to the TARP Capital Purchase Program were imposed to have some restrictions on their dividends. More specifically, they could neither pay nor increase their dividends before having completed the other payments on the senior preferred stock held by the United States Department of Treasury (UST), while for other payments of dividends the decision had to be approved by the UST itself.[37]

In this section we want to verify whether there are some TARP effects on our outcomes. The TARP funds restored the capitalization of banks reducing their leverage. At the same time participating banks had to contain their dividends.

In Table 11 we focus on the sample starting from 2008q4. In the regressions (1) and (2) we add several controls for the TARP provisions: Column (1) includes the amount of equity issued under the TARP normalized by total assets (*TARPEQUITY_TA*); Column (2) includes a dichotomous variable denoting with one that the bank has obtained some TARP equity (*TARPEQUITY_DUMMY*); finally Column (3) interacts *NONDEPOSITS_TA* with *TARPEQUITY_DUMMY*. We observe that only *DIVIDEND_DUMMY* is changing with the TARP. As expected, firms taking part to the program and receiving more TARP equity were less likely to pay out dividends. On the dividend payout we do not see significant effects from none of the three TARP controls. We claim that the TARP influence on our outcomes is not very strong.

We finally check whether the empirical pattern so far stays the same also for the so-called "too-big-to-fail" institutions. In Table 12 leverage is interacted with a dummy variable (*TOOBIGTF_DUMMY*) denoting with value one whether the bank is one of the eight United States headquartered banks defined by the Financial Stability Board as "systemically important financial institutions."[38] The interaction terms are never significant on dividends, and the marginal effect from the bank leverage remains the same of Table 5.

6. Tests for the Robustness of the Results towards the Type of Econometric Modeling

6.1 Simultaneous System of Equations

[37] On the TARP Capital Purchase Program see http://www.treasury.gov/initiatives/financial-stability/TARP-Programs/bank-investment-programs/cap. Millon Cornett, Li, and Tehranian (2013) provide results relating the health of banks in the pre-crisis to the probability of missing dividends on the TARP funds.

[38] We consider the list from the Financial Stability Board dated November 4, 2011. Among the 29 worldwide banks defined as "systemically important financial institutions" we select the following United States headquartered institutions: Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, State Street, and Wells Fargo.

There might be some endogeneity in our results due to simultaneity. The firm might determine jointly dividends and capital structure. This means that not only the flow of causality goes from leverage to dividends, but changes in dividends determine changes in leverage, as well. In this case the error term in equations (1) and (2) would not be uncorrelated with the right-hand side variables. We now estimate a bivariate system of equation which model the simultaneous choice on dividends and leverage as follows:

$$DIVIDEND\_EQUITY_{i,t} = \alpha_0 + \alpha_1 DIVIDEND\_EQUITY_{i,(t-1)} + \alpha_2 LEVERAGE_{d,i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 ROA_{i,t} + \alpha_5 EQUITY\_TA_{i,t} + \alpha_6 CASH\_TA_{i,t} + \alpha_7 MTBV_{i,t} + \alpha_8 LOANS\_TA_{i,t} + \alpha_9 RWA\_TA_{i,t} + \alpha_{10} INCOME\_TAX\_TA_{i,t} + \alpha_{11} EMPL\_COMP_{i,t} + \alpha_{12} CAPRATIO_{i,t} + \sum_i bank_i + \sum_t quarter_t + \varepsilon_{i,t}$$

$$LEVERAGE_{d,i,t} = \alpha_0 + \alpha_1 DIVIDEND\_EQUITY_{i,t} + \alpha_2 SIZE_{i,t} + \alpha_3 ROA_{i,t} + \alpha_4 MTBV_{i,t} + \sum_i bank_i + \sum_t quarter_t + \vartheta_{i,t} \quad (3)$$

$$where\ d = DEP\&NONDEP\_TA, NONDEPOSITS\_TA, DEPOSITS\_TA$$

The dependent variable in the dividend equation is the dividend payout *DIVIDEND_EQUITY*.[39] Similarly to what we did in the previous univariate analyses, we estimate across two separate time horizons three different systems of equations, which differ in the leverage equation. We distinguish the total leverage of the firm, from deposit, and non-deposit leverage. The time horizons are 2000q1-2008q2 and 2008q3-2011q1, respectively. The set of covariates in the dividend equation is the same as in equation (2). The regressors in the leverage equation are dividends, size, profitability, and investment opportunities.[40] We include quarter and firm dummies and fit each system of equation

[39] The same type of simultaneous equations systems are estimated using, alternatively, *DIVIDEND_EARNINGS* and *DIVIDEND_DUMMY* as dependent variables for the dividend equation. These results are not reported in the paper for not overloading the results. In particular, we verify that the not-reported outputs are similar to the outputs of Table 13 in what concerns sign and statistical significance of the leverage variable in the dividend equation during the last part of the sample.

[40] Similar characteristics are used by Gropp and Heider (2010) as explanatory factors for both book and market leverage of banks.

following the approach implemented by Zellner (1962), Zellner and Huang (1962), and Zellner (1963).[41]

Table 13 displays results. Till 2008q2 the three leverage measures entering the payout equation across the systems have not important coefficients. In most of the cases the Breusch-Pagan test suggests that the two equations are independent, namely that their respective error terms are not importantly correlated. During 2008q3-2011q4 instead, the Breusch-Pagan test rejects the null hypothesis of no correlation and we get significant signs on debt, where the pattern is similar to the same pattern we had in the previous section. The dividend payout decreases with deposit leverage, while increases in non-deposit leverage. Thanks to the split of the two leverage components we discovered an important linkage in the way in which firms take simultaneously decisions on debt and cash payments.

To conclude, the approach of using simultaneous equations confirms the existence of a relevant although heterogeneous interplay between dividends and leverage.

6.2 Use of Lagged Values of Leverage

One very mild way which can help in attenuating endogeneity on our outcomes can be to use lags of the leverage variables in the equations (1) and (2). Thus, dividends at time *t* are related to leverage computed at time *t-1*. When the bank decides on dividends at time *t*, it can no longer modify the structure of balance sheet from the previous time.

In Table 14 the first and the second lag of *NONDEPOSITS_TA* and *DEPOSITS_TA* replace the corresponding contemporaneous values in (1) and (2). The quality of the results is similar in sign and magnitude as when we used the contemporaneous variables. Although this exercise might have only mild power towards the endogeneity concern, we think it can still offer a further piece of evidence that the main outcomes of this paper are not seriously compromised by endogeneity troubles.

6.3 Alternative Estimation Methods for the Dividend Payout

6.3.1 Model for Dynamic Panel Data

The dividend payout in the equation (1) follows a dynamic panel data (DPD) model. In the context of DPD there is a serious difficulty arising in the estimation of fixed effects

[41] We follow the approach for fitting so-called seemingly-unrelated regression (SUR) models developed with Zellner (1962). The estimation is performed according to the one-way random effect estimation of seemingly-unrelated regressions implemented by Nguyen (2010). We also check that results are similar if we estimate the systems according to the approach from Biorn (2004) for the estimation of seemingly-unrelated regressions in unbalanced panel data sets.

models, especially in the case of panels with a large number of units and few periods. Nickell (1981) shows that the presence of the lagged dependent variable determines a bias in the coefficients estimated on both the lagged dependent variable as well as on other regressors included in the model. Arellano and Bond (1991) popularized the work from Holtz-Eakin, Newey and Rosen (1988) and propose a method offering more efficient estimates of DPD models which is based on a Generalized Method of Moments (GMM) approach.

Table 15 (Columns 1-2) estimates the effect from deposit leverage on the dividend payout using the procedure of Arellano and Bond (1991). While we are taking care of the dynamic structure of the payout equation, we still continue to observe a statistically significant negative coefficient on the banks´ deposit leverage. For brevity, we do not report the output for the non-deposit leverage and the output on the previous sample period. This latter set of results remains in line with Table 5.[42]

6.3.2 Tobit Model

We change the type of econometric modeling for the payout measure. The dividend payout follows now a corner solution model, which we estimate via a censored normal regression (or Tobit model).[43] The reason is that for some banks the optimal payout coincides with the corner solution of paying zero dividends. The use of a Tobit model on Panel data is not straightforward. The estimation of censored regression models with fixed effects remains an issue not entirely solved, since there is no sufficient statistic allowing the fixed effects to be conditioned out of the likelihood. For this reason we adopt the same approach of Honoré (1992), which is based on a semiparametric estimator for fixed-effect Tobit models.

The task is to see whether using a censored regression approach we get results consistent to the previous OLS setting. The empirical corporate finance literature has never applied the procedure of Honoré (1992) on some datasets, and we think this improves our set of empirical outcomes. Table 15 presents the results. In this case the estimators are based on

[42] This patter is statistically relevant only after 2008q4. The estimator of Arellano and Bond (1991) was modified later on from Arellano and Bover (1995) and Blundell and Bond (1998). The original estimator is often entitled "difference" GMM, while the expanded estimator is commonly termed "system" GMM. We checked that using the system GMM estimator provides results consistent to the one reported in Table 15 based on the difference GMM estimator.

[43] Among others, for the estimation of Tobit models see Wooldridge (2010). Sigelman and Zeng (1999) sustain that Tobit models should not be used for corner solution applications.

the absolute error loss function and the standard errors are estimated by the bootstrap. Banks´ deposits are found to have a substantial decreasing effect on dividend payouts. The Tobit specification estimated following Honoré (1992) leads also to higher absolute value of the coefficients as compared to the coefficients estimated with OLS (see Table 5).

7. Share Repurchases

7.1 Share Repurchase Activity in the Sample

The company can divert resources to the property not only by paying dividends, but also re-acquiring stocks. In that case, owners tender some of their shares and benefit from the premia at which shares are sold. We send to Allen and Michaely (2003) for a review on the literature about this topic.

To our knowledge, there is no recent paper which gives a quantitative overview on the buyback activity inside banks.[44] In this section we offer new evidence on this. We construct two variables which measure share repurchases and compare their behavior to the behavior of dividends. With this final section of the paper, we can characterize the *entire* payout policies of our firms.

REPURCHASE_DUMMY is a dichotomous variable assuming value one if the bank has bought-back some of its stock during the quarter. The relative repurchase payout is defined as the ratio of the common stock repurchased over net income (*REPURCHASE_INCOME*).[45] Table 16 reports descriptive statistics. Almost the 29% of the banks has re-acquired stock, thus less than half of the banks paying dividends, which are almost 65%. The repurchase payout is on average 19%. Repurchases are highly volatile, a fact which would be consistent with the evidence that corporations smooth dividends rather than repurchases (among others, see Allen and Michaely (2003)). Figure 2 compares the repurchase payout to the dividend payout across the years of the sample.[46] In 2007 there is an evident jump in

[44] Hirtle (1998) describes the payout policy of the largest United States bank holding companies in 1997, commenting the path in their dividend payments and their share repurchases.

[45] With respect to open-market repurchases, Stephens and Weisbach (1998) point out that there might be errors in measuring the reacquired shares, because they cannot be directly observed and measured at the time of the transaction. For this reason Stephens and Weisbach (1998) test alternative measures for open-market share repurchases. Among those alternatives, Allen and Michaely (2003) sustain that using the cash flow spent on repurchases would provide less biased estimates of the effective repurchases. In our analysis we employ data on the common stock repurchased as-reported from the cash flow statement for the period. Banyi, Dyl, and Kahle (2008) compare the accuracy of several procedures for the estimation of firms' repurchases of common stock used in earlier studies. The most accurate measure is found to be the Compustat measure based on the purchase of common stock.

[46] Note that the denominator of the two payout variables is different. *DIVIDEND_EARNINGS* divides by earnings per share, while *REPURCHASE_INCOME* divides by net income. Despite of this, by comparing the

REPURCHASE_INCOME.[47] One interesting feature is that during the three year time 2007-2009 repurchases were diminishing while dividends were rising. Figure 3 is based on the only institutions which were paying dividends and simultaneously were repurchasing shares. For this sub-sample the repurchase payout peaks in 2007, when kit seems to slightly overcome the dividend payout. After 2007 instead, the same firms are always distributing more resources through dividends.

7.2 Interpretation for the Behaviour of Banks´ Share Repurchases and Dividends

The literature has dealt with the interaction between dividends and repurchases and many papers have tried to motivate the preference of firms for dividends. The descriptive statistics in the previous sub-section seems to confirm this tendency. In this sub-section we want to discuss more this attitude, in order to interpret the pattern revealed from the data.

The repurchase of shares might be connected to signalling.[48] Bhargava (2010) says that firms which are regularly paying dividends may be reluctant in lowering dividends for repurchasing shares, since they don´t want to send ambiguous signals to investors. According to Ofer and Thakor (1987), buybacks carry high signaling expenses and companies might want to repurchase stocks only when they suffer from severe undervaluation of their equity. In our sample repurchases decline after 2007. With the disorder brought by the subprime crisis, it might be that banks didn´t want to send further ambiguous signals to the capital markets by repurchasing shares.

Finally, we should consider two more aspects motivating the larger use of dividends with respect to the activity of share repurchases. The first aspect is that dividends are less flexible to adjust in their timing than repurchases, and often are related to clientele preferences. A second fact to note is that repurchases can be sensitive to employees´ stock options plans. When stock prices are high, employees can gain value if they exercise their stock options, while at the same time this has got a dilution effect on the current stock value. If the firm

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two we still think that we can detect some interesting features on the way in which our banks managed their dividends and their share repurchases.

[47] Although not reported, we have inspected the behavior of the variables for repurchases along quarters. The highest values of *REPURCHASE_INCOME* are observed during 2007q2 and 2007q3, when *REPURCHASE_INCOME* is always above 20%. Kahle and Stulz (2010) note a similar trend in the shares repurchased by United States industrial firms. In their sample the ratio of repurchases over assets peaks in the third quarter of 2007, while falls in the first quarter of 2009, which coincide with the highs and the lows of the stock market.

[48] We send to Allen and Michaely (2003) for a more detailed discussion on the interaction between dividends and repurchases. The preference between the two is addressed to adverse selection mechanisms in the articles from Barclay and Smith (1988), Brennan and Thakor (1990), and Allen, Bernardo, and Welch (2000).

repurchases part of its equity though, such dilution can be off-set. Evidences on this behavior inside non-financial firms are documented by Kahle (2002) and Bens et al. (2003). During the recent crisis and the collapse of stock prices, bankers didn't find profitable to exercise any high-strike option.[49] Fahlenbrach and Stulz (2011) show that during the crisis banks´ CEOs suffered losses on their shares and on their option holdings. This might contribute to our observation that the repurchases inside our banks are very low during the last part of the sample.

7.3 Leverage Effects on Share Repurchases

As an ultimate test we verify whether our banks link in a significant way their share repurchases to leverage structures. Models similar to (1) and (2) are now estimated for *REPURCHASE_DUMMY* and *REPURCHASE_INCOME*. Table 17 reports the results. We restrict on the horizon 2008q4-2011q3 and keep the same set of covariates as in the regression models for dividends.

We note a statistically significant effect from leverage only on *REPURCHASE_DUMMY*. Banks are more likely to buy back shares when they have higher non-deposit leverage. The coefficients on the repurchase payout are never significant, although the estimated signs display that the effects from leverage on the repurchase payout has got the same direction as on dividends.[50]

To conclude, the banks´ policies on stock repurchases are less strongly related to leverage, as compared to the policies on dividend payments.

8. Conclusion

The paper proves the existence of an important empirical relationship between the dividend policies of banks and the leverage structures of the same firms. Working on a large sample of commercial banks from the United States, we observe that after fall 2008 our banks pay out larger dividends when they are raising in non-deposit leverage (i.e. the ratio of non-deposit debt over total assets), whereas with deposit leverage (i.e. the ratio of deposits over total assets) the same firms behave in the opposite way and reduce their dividend payments.

[49] Some authors say that banks have lower incentives in paying executives through stocks or options (among others, see Houston and James (1995) and Adams and Mehran (2003)).

[50] We also tested effects from leverage on an alternative payout measure for share repurchases calculated as the ratio of stock repurchases over total equity, although no statistically interesting result emerges from the estimation.

We interpret this pattern claiming that huge dividends allow banks´ owners to shift some of their risk towards the non-deposit creditors. We cannot argue that owners can expropriate also the deposit creditors from the dividend value.

This outcome is statistically significant only for the sub-sample going from fall 2008 till the beginning of 2011, namely during the most acute phases of the global crisis and afterwards. We broadly decompose the debt of our banks into deposits and non-deposits, and interpret how the different debt sources might have impacted dividends. During the turmoil deposit type of funding was crucial for banks in order to face liquidity shocks and freezing of wholesale funding. For this reason we think that firms didn´t want to shift risk on depositors by paying out cash, since they wanted to restrain the risk of withdrawals, or even runs.

The paper discusses several aspects of the crisis and the reaction of banks towards the turmoil. Based on our outputs we derive some suggestions for policy makers in order to handle those reactions. Some commenters assert that during the crisis regulators and governments should have intervened more firmly on troubled financial institutions by limiting huge outflows of dividends (among other, see Admati et al. (2013)). The undesirable nature of dividends during crises has been sustained by Scharfstein and Stein (2008) and Wessel (2008), among others.[51] According to Rosengren (2010) the suspension of dividends should be a first and prompt step for dealing with a banking crisis.[52] Brunnermeier et al. (2009) argue that sanctions on dividends should be part of a "laddered" response in front of a firm which is not satisfying certain capital and liquidity requirements.[53]

In the United States the Prompt Corrective Action introduced in 1991 by the Federal Deposit Insurance Corporation permitted regulators to introduce restrictive measures on the activities of distressed institutions. These measures include limits to dividend distributions.[54]

[51] Scharfstein, D. S., and J. C. Stein, 2008, "This Bailout Doesn't Pay Dividends," The New York Times, October 20; Wessel, D., 2008, "Brainstorming about Bailouts" Wall Street Journal, March 13.

[52] Rosengren, E., 2010, "Dividend Policy and Capital Retention: A Systemic "First Response," speech delivered at the Rethinking Central Banking conference, Washington DC, October 10, available at http://www.bos.frb.org/news/speeches/rosengren/2010/101010/101010.pdf.

[53] Precisely, Brunnermeier et al. (2009) say that when the institution has got capital and liquidity requirements by 2% below the target value, then the firm should be subject to more supervision and it should be forbidden of paying out dividends. Among others, dividend restrictions in bad times are sustained by Acharya, Mehran and Thakor (2010), Goodhart et al. (2010), Admati et al. (2012), Admati et al.(2013), Acharya et al. (2012), and Acharya, Le, and Shin (2013).

[54] "Examples of the restrictions to banks' actions are: limits to dividends payments and compensation to senior managers; increased monitoring; restrictions to asset growth; restrictions to interaffiliate transactions; required authorization for acquisitions and new business lines; required authorization to raise additional capital; limits to credit for highly leveraged transactions; and in the most extreme cases, receivership. A common element of these restrictions is that they are intended to prevent moral hazard by limiting cash diversion and gambling for resurrection increasing asset size or by taking on more risky loans" ((Freixas and Parigi (2008)).

Under the current capital discipline, a bank which is not "adequately capitalized" (assessed when the sum of tier 1 plus tier 2 capital over risk weighted assets is below 8%) has to prepare a capital restoration plan and regulators might impede dividend payments. In the framework of the Basel III accord, the Committee aims at reducing the procyclicality of capital by promoting countercyclical buffers.[55] In order to preserve the buffers in line with the required levels, the Committee discourages the discretion of banks with depleted capital to distribute earnings.

We share the opinion claiming that restrictions on banking dividends would contain the consequences of the distress. This would help firms to remain more strongly capitalized and can ultimate translate into more stable lending and credit growth (Admati et al. (2013)).

Our results do further suggest to policy makers to carefully evaluate the restoration plans submitted by banks, taking into account of the possible interactions which may arise between the instruments which the firm uses for funding, and the future dividends. The reason is the following. Banks can partially restore the depleted capital by issuing certain type of non-deposit debt. The Basel framework allows subordinated debt instruments with at least a five year maturity to be counted as tier 2 capital, where those securities are meant to provide an additional capital buffer for the protection of depositors.

Our results hint the following comment. If all else equal, a bank increasingly issuing non-deposit subordinated debt wants also to distribute more cash through dividends, then the effect from the debt securities of improving the regulatory capital standard could be reduced by the curtailment of common equity due to the dividend. Thus, the funding structure chosen by the firm might reveal certain instability in the future. Our recommendation to regulators is to control that these two combined effects do not ultimately undermine the solidity of the firm.

[55] See the Basel Committee (2010).

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Appendix

In this appendix we list the variables used in our empirical analysis. Some variables are used in the same form as we obtained them from our data source, and we report the KeyField and the definition as provided by SNL Financial LC. Some other variables have been constructed manually. In this latter case we define them sending to the KeyFields of the variables involved in the computation.

CAPRATIO [SNL KeyField: 131990]: Risk-weighted Capital Ratio

CASH_TA: Cash and cash equivalents [SNL KeyField: 131920] as a percent of total assets [SNL KeyField: 131929]

CURRENTACC_TA: Current Accounts [SNL KeyField: 132471] as a percent of total assets [SNL KeyField: 131929]

DEPOSITS_TA: Total deposits from customers [SNL KeyField: 132480] as a percent of total assets [SNL KeyField: 131929]

DEP&NONDEP_TA: Total deposits from customers [SNL KeyField: 132480] plus total debt [SNL KeyField: 131935] as a percent of total assets [SNL KeyField: 131929]

DIVIDEND_DUMMY: Dummy variable assuming value one if the company has got a positive value of regular dividends paid [SNL KeyField: 132933], while zero if the same field is equal to zero

DIVIDEND_EARNINGS [SNL KeyField: 131981]: Dividend payout ratio. Dividends declared per common share during the period as a percent of earnings per share

DIVIDEND_EQUITY [SNL KeyField: 132911]: Dividend/Average Book Value. Dividends declared per common share during the period as a percent of average common equity per share

EMPL_COMP [SNL KeyField: 133387]: Compensation/Average employees. Employee compensation and benefits as a multiple of average full-time-equivalent employees

EQUITY_TA: Total equity [SNL KeyField: 131939] as a percent of total assets [SNL KeyField: 131929]

FOREIGNDEP_TA: Foreign Deposits [SNL KeyField: 132478] as a percent of total assets [SNL KeyField: 131929]

INCOME_TAX_TA: Income taxes paid [SNL KeyField: 132981] as a percent of total assets [SNL KeyField: 131929]

JUMBOTIMEDEP_TA: Jumbo time deposits [SNL KeyField: 132476] as a percent of total assets [SNL KeyField: 131929]

LOANS_TA: Net loans to customers [SNL KeyField: 131923] as a percent of total assets [SNL KeyField: 131929]

LOW_INSIDER_DUMMY: Dummy variable assuming value of one in correspondence of a firm insider ownership [SNL KeyField: 221550] lower or equal than 18.231%

MONEYMKTACC_TA: Principal amounts in money-market accounts in domestic offices [SNL KeyField: 132472] as a percent of total assets [SNL KeyField: 131929]

MTBV [SNL KeyField: 132027]: Price/Book. Price as a percent of book value per share. Book value is calculated using financial period end common equity and common shares outstanding values

NONDEPOSITS_TA: Total debt [SNL KeyField: 131935] as a percent of total assets [SNL KeyField: 131929]

NONDEPOSITS_TL: Total debt [SNL KeyField: 131935] divided by the sum of Total Debt [SNL KeyField: 131935] plus Total Deposits from Customers [SNL KeyField: 132480]

OTHERDEP_TA: Other Deposits [SNL KeyField: 243741] as a percent of total assets [SNL KeyField: 131929]

REPOS_TA: Securities that are sold under a corresponding agreement that those securities will be repurchased by the original holder on a specified future date and at an agreed-upon price [SNL KeyField: 132309]

REPURCHASE_INCOME: Common stock repurchased [SNL KeyField: 133872] as a percent of net income after taxes [SNL KeyField: 142046]. The common stock repurchased is as-reported from the cash flow statement for the period. It includes fractional and dissenting shares redeemed on the cash flow statement. This should include all purchases of company stock for treasury stock, compensation plans, recognition and retention plans and acquisitions of common stock by Employee Stock Ownership Plan (ESOP)

REPURCHASE_DUMMY: Dummy variable assuming value one if the company has got a positive value on shares repurchased [SNL KeyField: 133870] while zero if the same field is equal to zero.

RETAILTIMEDEP_TA: Retail Time Deposits [SNL KeyField: 132475] as a percent of total assets [SNL KeyField: 131929]

ROA [SNL KeyField: 132004]: ROAA. Return on average assets; net profit as a percent of average assets

RWA_TA [SNL KeyField: 226936]: Risk-weighted assets/assets. Risk-weighted assets as a percent of assets

SAVINGACC_TA: Principal amounts in non money-market savings accounts in U.S. offices [SNL KeyField: 132473] as a percent of total assets [SNL KeyField: 131929]

SHORTTERM_NONDEP_TA: Borrowings with a maturity of one year or less, not already included in repurchase agreements, notes payable, or subordinated debt [SNL KeyField: 233865]

SIZE: Natural logarithm of total assets [SNL KeyField: 131929]

TARPEQUITY_DUMMY Dummy variable assuming value one if the company has got a positive value of TARP Preferred Equity [SNL KeyField: 218432], while zero if the same field is equal to zero

TARPEQUITY_TA: TARP preferred equity [SNL KeyField: 218432] as a percent of total assets [SNL KeyField: 131929]

TOOBIGTF_DUMMY: Dummy variable assuming value of one in correspondence of "too-big-to-fail" institutions (classified according to the Financial Stability Board, November 2011)

TOTALTIMEDEP_TA: Total time deposits [SNL KeyField: 132477] as a percent of total assets [SNL KeyField: 131929]

Table 1: Variables for Banks´ Dividend Policy, Leverage, and Additional Control Variables

The table reports the average value of the variables during the sample period 2000q1-2011q3. For *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* the value reported in the table is the average positive *DIVIDEND_EARNINGS* and the average positive *DIVIDEND_EQUITY*.

Variable	N (as of 2011q3)	Mean	Median	5%	25%	75%	95%	Std. Dev
Dividend Policy								
DIVIDEND_DUMMY (%)	981	64.859	100	0.000	0.000	100	100	0.477
DIVIDEND_EARNINGS (%)	981	35.286	28.000	0.000	0.000	47.630	102.170	55.049
DIVIDEND_EQUITY (%)	981	2.869	2.120	0.000	0.000	4.840	8.830	3.563
Leverage								
DEP&NONDEP_TA (%)	981	88.297	89.569	80.309	87.550	91.044	93.071	6.379
DEPOSITS_TA (%)	981	78.928	80.980	62.340	74.690	85.470	89.820	9.685
NONDEPOSITS_TA (%)	981	9.365	7.870	0.000	2.790	13.880	24.530	8.381
NONDEPOSITS_TL (%)	981	10.522	8.798	0.000	3.148	15.502	27.438	9.540
SHORTTERM_NONDEP_TA (%)	981	0.841	0.000	0.000	0.000	0.378	4.971	2.304
REPOS_TA (%)	981	2.479	0.923	0.000	0.000	3.479	9.648	4.188
Control Variables								
SIZE (log of Assets)	981	13.174	12.912	11.096	12.148	13.866	18.756	1.610
ROA (%)	981	0.430	0.830	-2.220	0.370	1.170	1.690	2.295
MTBV (%)	981	139.801	131.100	43.500	90.400	176.900	266.200	70.970
EQUITY_TA (%)	981	10.457	9.340	6.030	7.930	11.190	17.620	5.935
CASH_TA (%)	981	7.743	5.421	1.808	3.270	9.383	20.756	7.738
LOANS_TA (%)	981	66.144	67.945	41.880	59.740	74.870	83.440	12.840
RWA_TA (%)	981	72.084	72.730	52.100	64.650	80.150	90.220	11.864
INCOME_TAX_TA (%)	981	0.086	0.057	0.000	0.000	0.142	0.299	0.181
EMPL_COMP	981	61.550	56.315	37.310	47.020	70.190	103.23	22.169
CAPRATIO (%)	981	16.497	13.960	10.540	12.150	16.890	28.130	13.124

Table 2: Variables for Dividend Policy and Leverage for the Banks of the Sample Paying Dividends

The table reports the average value of the variables during the sample period 2000q1-2011q3. For *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* the value reported in the table is the average positive *DIVIDEND_EARNINGS* and the average positive *DIVIDEND_EQUITY*.

Variable	Dividend paying banks (*DIVIDEND_DUMMY*=1)							
	N(as of 2011Q3)	Mean	Median	5%	25%	75%	95%	Std. Dev
Dividend Policy								
DIVIDEND_EARNINGS (%)	284	54.404	41.500	13.790	29.270	58.820	127.030	60.267
DIVIDEND_EQUITY (%)	284	4.990	4.470	1.260	3.060	6.200	10.140	3.376
Leverage								
DEP&NONDEP_TA (%)	284	88.992	89.608	84.403	87.960	90.886	92.585	4.014
DEPOSITS_TA (%)	284	77.656	79.260	61.680	73.090	84.160	88.910	9.256
NONDEPOSITS_TA (%)	284	11.318	10.090	0.130	5.030	15.920	26.350	8.429
NONDEPOSITS_TL (%)	284	12.729	11.302	0.171	5.651	17.877	29.547	9.579

Table 3: Variables for Dividend Policy of Banks along Years of the Sample

The table reports the average value of the variables during the sample period 2000q1-2011q3. For *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* the value reported in the table is the average positive *DIVIDEND_EARNINGS* and the average positive *DIVIDEND_EQUITY*. The last two columns refer to the only dividend paying banks, selected by having *DIVIDEND_DUMMY* equal to one.

Year	All sample			Dividend paying banks (*DIVIDEND_DUMMY*=1)	
	DIVIDEND_DUMMY	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*
	(%)	(%)	(%)	(%)	(%)
2000 (Q1-Q4)	77.25	35.795	4.015	46.338	5.406
2001 (Q1-Q4)	74.01	35.498	3.760	47.962	5.276
2002 (Q1-Q4)	69.37	31.491	3.556	45.399	5.191
2003 (Q1-Q4)	67.35	32.316	3.508	47.979	5.283
2004 (Q1-Q4)	65.79	33.364	3.457	50.714	5.358
2005 (Q1-Q4)	66.69	31.768	3.403	47.635	5.320
2006 (Q1-Q4)	65.19	33.672	3.254	51.653	5.275
2007 (Q1-Q4)	65.63	37.930	3.157	57.790	5.229
2008 (Q1-Q4)	65.06	47.366	2.765	72.802	5.104
2009 (Q1-Q4)	62.24	50.539	1.877	81.207	4.338
2010 (Q1-Q4)	54.21	30.630	1.566	56.502	3.829
2011 (Q1-Q3)	50.34	22.744	1.420	45.179	3.399

Figure 1: Deposit Leverage along Quarters

The figure depicts the variable *DEPOSITS_TA* along the quarters of the sample period 2007q1-2011q3. The average value of *DEPOSITS_TA* computed on the entire sample of banks is distinguished from the average *DEPOSITS_TA* computed only on dividend paying banks.

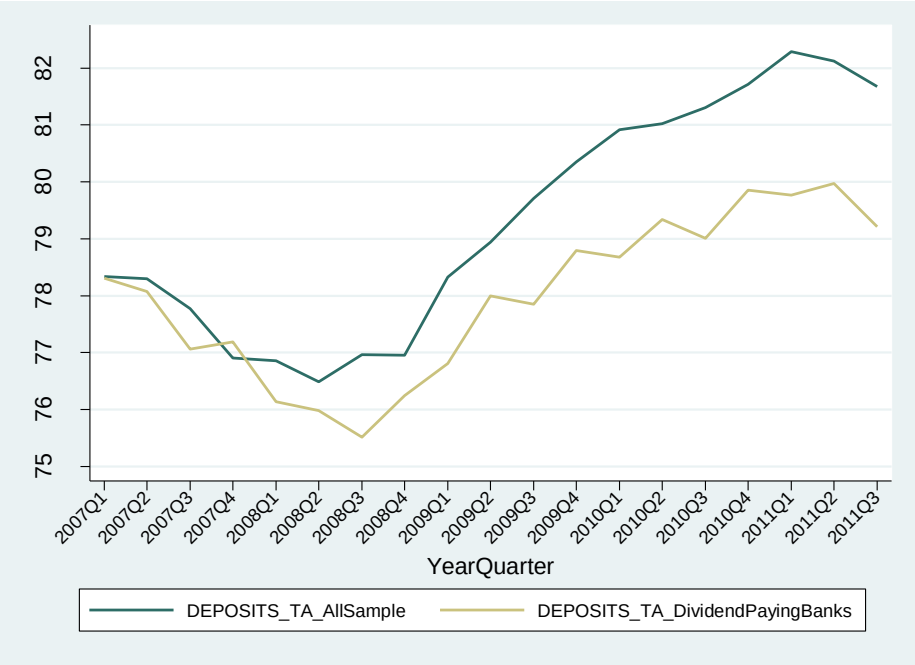

Table 4: Pair-Wise Correlation between the Variables for Dividend Policy and the Variables for Leverage

The table reports the pair-wise correlation between the set of variables measuring the dividend policy of the banks and the set of variables measuring the leverage of the same firms. The sample period is 2000q1-2011q3. Observations with negative *DIVIDEND_EARNINGS* and negative *DIVIDEND_EQUITY* are excluded from the sample. * p < 0.10, ** p < 0.05, *** p <0.01

Pair-wise correlation	*DIVIDEND_DUMMY*	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*	*DEP&NONDEP_TA*	*NONDEPOSITS_TA*	*DEPOSITS_TA*
DIVIDEND_DUMMY	1.000					
DIVIDEND_EARNINGS	0.472***	1.000				
DIVIDEND_EQUITY	0.656***	0.582***	1.000			
DEP&NONDEP_TA	-0.002	-0.023***	0.055***	1.000		
NONDEPOSITS_TA	0.223***	0.102***	0.190***	0.166***	1.000	
DEPOSITS_TA	-0.209***	-0.105***	-0.143***	0.517***	-0.759***	1.000

Table 5: The Effect from Leverage on Banks´ Dividend Policies during three Time Horizons

Each panel estimates regression models across the following three sample periods: 2000q1-2007q3; 2007q4-2008q3; 2008q4-2011q3. Panel A: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY* on the variables for leverage, the additional control variables, and a set of dummies for banks and quarters, which is not reported. For each period, the columns differ in the variable which measures the effect from the banks´ leverage. Standard errors are reported in parentheses. Panel B: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS* on the variables for leverage, the additional control variables, the lagged value of *DIVIDEND_EARNINGS*, and a set of dummies for banks and quarters, which is not reported. For each period, the columns differ in the variable which measures the effect from the banks´ leverage. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Panel C: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY* on the variables for leverage, the additional control variables, the lagged value of *DIVIDEND_EQUITY*, and a set of dummies for banks and quarters, which is not reported. For each period, the columns differ in the variable which measures the effect from the banks´ leverage. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

Panel A	*DIVIDEND_DUMMY*											
	2000Q1-2007Q3				*2007Q4-2008Q3*				*2008Q4-2011Q3*			
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
DEP&NONDEP_TA	-0.009			-0.005	2.999				-0.820**			
	(0.130)			(0.132)	(3.074)				(0.376)			
NONDEPOSITS_TA		-0.054*				-0.052				0.132*		
		(0.032)				(0.252)				(0.074)		
DEPOSITS_TA			0.053*				0.078				-0.165**	
			(0.031)				(0.259)				(0.074)	
NONDEPOSITS_TL				-0.048*				-0.051				0.125*
				(0.029)				(0.226)				(0.066)
SIZE	3.610***	3.815***	3.840***	3.816***	-116.550*	-85.368*	-84.722*	-85.310*	1.913	1.385	1.253	1.320
	(0.747)	(0.754)	(0.756)	(0.758)	(65.276)	(49.201)	(48.725)	(49.030)	(1.914)	(1.978)	(1.983)	(1.979)
ROA	0.484	0.536	0.550*	0.538	6.260*	5.210*	5.269*	5.222*	0.688*	0.785**	0.775**	0.784**
	(0.324)	(0.327)	(0.328)	(0.328)	(3.223)	(2.884)	(2.920)	(2.892)	(0.388)	(0.394)	(0.395)	(0.394)
EQUITY_TA	0.153	0.114	0.162	0.124	3.493	0.418	0.492	0.427	0.082	1.017***	0.863**	1.013***
	(0.168)	(0.125)	(0.123)	(0.170)	(3.566)	(1.889)	(1.932)	(1.893)	(0.518)	(0.352)	(0.351)	(0.353)
CASH_TA	-0.017	-0.030	-0.029	-0.030	-1.926*	-1.934*	-1.908*	-1.932*	-0.005	0.010	0.017	0.011
	(0.040)	(0.040)	(0.040)	(0.040)	(1.083)	(0.997)	(0.990)	(0.995)	(0.059)	(0.060)	(0.060)	(0.060)
MTBV	0.008***	0.008***	0.008***	0.008**	0.314**	0.263***	0.265***	0.264***	0.015**	0.013*	0.013*	0.013*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.136)	(0.100)	(0.100)	(0.100)	(0.007)	(0.007)	(0.007)	(0.007)
LOANS_TA	-0.020	-0.026	-0.024	-0.025	-0.025	0.039	0.065	0.044	-0.112	-0.110	-0.110	-0.110
	(0.029)	(0.029)	(0.029)	(0.029)	(0.519)	(0.539)	(0.541)	(0.540)	(0.074)	(0.078)	(0.077)	(0.078)
RWA_TA	0.021	0.019	0.018	0.018	-2.775**	-2.247**	-2.277**	-2.254**	0.045	0.026	0.027	0.025
	(0.029)	(0.035)	(0.035)	(0.035)	(1.242)	(0.902)	(0.919)	(0.907)	(0.081)	(0.087)	(0.085)	(0.086)
INCOME_TAX_TA	0.062	0.106	0.100	0.107	-25.827**	-19.900**	-19.730**	-19.890**	1.629	0.978	1.127	0.991
	(0.757)	(0.758)	(0.757)	(0.758)	(12.462)	(9.689)	(9.513)	(9.627)	(1.478)	(1.477)	(1.475)	(1.478)
EMPL_COMP	0.005	0.008	0.008	0.008	-0.278	-0.204	-0.204	-0.204	-0.004	-0.006	-0.007	-0.006
	(0.013)	(0.013)	(0.013)	(0.013)	(0.211)	(0.174)	(0.174)	(0.174)	(0.024)	(0.024)	(0.024)	(0.024)
CAPRATIO	-0.047	-0.031	-0.032	-0.032	-16.040**	-12.376**	-12.419**	-12.392**	-0.648***	-0.716***	-0.719***	-0.721***
	(0.080)	(0.081)	(0.081)	(0.081)	(7.320)	(4.996)	(5.002)	(4.995)	(0.248)	(0.251)	(0.252)	(0.252)
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo-R^2	0.170	0.173	0.172	0.173	0.656	0.643	0.644	0.644	0.180	0.175	0.179	0.176
Observations	1361	1361	1363	1363	106	106	106	106	578	578	578	578

Panel B	*DIVIDEND_EARNINGS*											
	2000Q1-2007Q3				*2007Q4-2008Q3*				*2008Q4-2011Q3*			
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
DIVIDEND_EARNINGS(t-1)	-0.205***	-0.206***	-0.206***	-0.205***	-0.422***	-0.421***	-0.422***	-0.422***	0.023	0.024	0.023	0.023
	(0.040)	(0.041)	(0.041)	(0.041)	(0.094)	(0.094)	(0.094)	(0.094)	(0.051)	(0.051)	(0.051)	(0.051)
DEP&NONDEP_TA	-1.031				-3.243				-4.730*			
	(1.153)				(2.903)				(2.602)			
NONDEPOSITS_TA		-0.184				-0.725				1.031		
		(0.201)				(0.698)				(0.727)		
DEPOSITS_TA			0.084				-0.578				-1.332*	
			(0.199)				(0.701)				(0.729)	
NONDEPOSITS_TL				-0.154				-0.663				0.960
				(0.183)				(0.628)				(0.651)
SIZE	-6.745	-5.657	-6.173	-5.721	-16.792	-13.960	-14.062	-13.866	58.601***	59.358***	60.041***	59.289***
	(4.528)	(4.580)	(4.583)	(4.578)	(41.751)	(41.657)	(41.464)	(41.705)	(21.779)	(21.743)	(21.708)	(21.716)
ROA	-35.911***	-35.984***	-35.907***	-35.968***	-53.751***	-53.487***	-53.379***	-53.453***	-26.312***	-25.900***	-26.076***	-25.943***
	(5.360)	(5.331)	(5.320)	(5.329)	(14.765)	(14.590)	(14.564)	(14.593)	(4.005)	(3.943)	(3.961)	(3.948)
EQUITY_TA	0.678	1.485**	1.642***	1.514**	-2.605	-0.250	0.493	-0.168	-6.222	-0.425	-1.409	-0.466
	(1.238)	(0.670)	(0.623)	(0.661)	(5.336)	(4.604)	(4.432)	(4.585)	(4.882)	(4.296)	(4.241)	(4.281)
CASH_TA	0.129	0.094	0.120	0.096	0.099	-0.189	-0.179	-0.200	0.873	0.935	0.994	0.944
	(0.243)	(0.251)	(0.248)	(0.252)	(0.961)	(0.929)	(0.940)	(0.935)	(0.625)	(0.634)	(0.634)	(0.634)
MTBV	0.028*	0.026*	0.027*	0.026*	0.067	0.068	0.067	0.068	0.128*	0.124*	0.124*	0.124*
	(0.016)	(0.016)	(0.016)	(0.015)	(0.066)	(0.066)	(0.066)	(0.066)	(0.068)	(0.067)	(0.067)	(0.067)
LOANS_TA	-0.015	-0.042	-0.036	-0.041	0.914	0.761	0.750	0.748	-0.914	-0.894	-0.877	-0.895
	(0.167)	(0.173)	(0.172)	(0.173)	(1.455)	(1.472)	(1.477)	(1.473)	(0.610)	(0.632)	(0.633)	(0.632)
RWA_TA	-0.109	-0.120	-0.116	-0.120	-0.817	-0.843	-0.839	-0.844	1.784***	1.653**	1.637**	1.645**
	(0.159)	(0.159)	(0.160)	(0.159)	(1.112)	(1.116)	(1.114)	(1.117)	(0.679)	(0.693)	(0.690)	(0.693)
INCOME_TAX_TA	-2.836	-2.795	-2.797	-2.791	-0.320	-0.302	-0.314	-0.302	10.182	8.101	8.092	8.036
	(4.043)	(4.046)	(4.044)	(4.046)	(0.406)	(0.415)	(0.417)	(0.416)	(8.647)	(8.540)	(8.552)	(8.541)
EMPL_COMP	0.112	0.128	0.127	0.129	-0.404	-0.354	-0.358	-0.351	0.044	0.131	0.130	0.131
	(0.104)	(0.102)	(0.102)	(0.101)	(0.501)	(0.503)	(0.499)	(0.500)	(0.122)	(0. 224)	(0. 224)	(0. 224)
CAPRATIO	-0.954	-0.906	-0.939	-0.912	-5.342	-5.370	-5.384	-5.391	0.960	0.496	0.364	0.444
	(0.586)	(0.583)	(0.583)	(0.579)	(3.774)	(3.787)	(3.783)	(3.785)	(2.015)	(1.200)	(1.997)	(1.998)
Constant	255.443*	145.746**	141.772**	146.111**	749.287	418.944	360.786	-418.132	-378.069	-864.534***	-748.972**	-862.397***
	(132.240)	(65.753)	(69.430)	(65.679)	(767.491)	(657.122)	(661.803)	(657.103)	(403.914)	(335.648)	(332.206)	(334.918)
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.164	0.164	0.164	0.164	0.280	0.280	0.280	0.280	0.150	0.149	0.151	0.150
Observations	5292	5292	5294	5292	887	887	887	887	2403	2403	2403	2403

Panel C	*DIVIDEND_EQUITY*											
	2000Q1-2007Q3				*2007Q4-2008Q3*				*2008Q4-2011Q3*			
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
DIVIDEND_EQUITY(t-1)	-0.387***	-0.387***	-0.387***	-0.387***	-0.424***	-0.424***	-0.424***	-0.424***	-0.075	-0.078	-0.078	-0.078
	(0.043)	(0.043)	(0.043)	(0.043)	(0.077)	(0.076)	(0.076)	(0.076)	(0.064)	(0.063)	(0.064)	(0.063)
DEP&NONDEP_TA	-0.042				-0.141				-0.021			
	(0.032)				(0.111)				(0.015)			
NONDEPOSITS_TA		-0.001				-0.028				0.049***		
		(0.011)				(0.033)				(0.014)		
DEPOSITS_TA			-0.004				0.018				-0.045***	
			(0.011)				(0.031)				(0.012)	
NONDEPOSITS_TL				0.001				0.028				0.044***
				(0.010)				(0.029)				(0.013)
SIZE	-0.391	-0.366	-0.389	-0.366	2.271*	3.070*	3.050*	3.099*	1.075***	1.177***	1.124***	1.170***
	(0.324)	(0.339)	(0.340)	(0.338)	(1.605)	(1.683)	(1.688)	(1.693)	(0.310)	(0.314)	(0.314)	(0.314)
ROA	-0.005	-0.008	-0.005	-0.008	0.038	0.036	0.034	0.036	0.040***	0.041***	0.040***	0.041***
	(0.062)	(0.063)	(0.063)	(0.063)	(0.057)	(0.057)	(0.057)	(0.057)	(0.011)	(0.011)	(0.011)	(0.011)
EQUITY_TA	-0.096**	-0.057**	-0.059**	-0.057**	-0.237*	-0.105	-0.083	-0.105	0.028	0.071	0.028	0.066
	(0.041)	(0.029)	(0.029)	(0.029)	(0.129)	(0.070)	(0.072)	(0.070)	(0.046)	(0.046)	(0.046)	(0.045)
CASH_TA	-0.011	-0.012	-0.011	-0.012	-0.031*	-0.042	-0.041	-0.043	0.032***	0.037***	0.038***	0.037***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.027)	(0.029)	(0.029)	(0.029)	(0.012)	(0.012)	(0.012)	(0.012)
MTBV	0.005***	0.005***	0.005***	0.005***	0.011***	0.011***	0.011***	0.011***	0.007***	0.007***	0.007***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
LOANS_TA	-0.008	-0.010	-0.009	-0.010	0.068*	0.060	0.060	0.060	0.015	0.014	0.020	0.015
	(0.012)	(0.012)	(0.012)	(0.012)	(0.041)	(0.040)	(0.040)	(0.040)	(0.011)	(0.010)	(0.011)	(0.011)
RWA_TA	0.006	0.007	0.007	0.007	0.005	0.007	0.008	0.008	0.007	0.009	0.005	0.008
	(0.011)	(0.011)	(0.011)	(0.011)	(0.042)	(0.042)	(0.042)	(0.042)	(0.015)	(0.014)	(0.014)	(0.014)
INCOME_TAX_TA	-0.078	-0.071	-0.075	-0.071	0.018	0.019	0.018	0.019	0.442**	0.399*	0.436**	0.401*
	(0.257)	(0.256)	(0.256)	(0.256)	(0.017)	(0.017)	(0.017)	(0.017)	(0.212)	(0.208)	(0.209)	(0.208)
EMPL_COMP	-0.008	-0.008	-0.008	-0.008	0.007	0.008	0.008	0.008	0.002	0.002	0.002	0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)
CAPRATIO	-0.005	-0.004	-0.003	-0.004	0.066	0.073*	0.071	0.073*	-0.060*	-0.069**	-0.070**	-0.070**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.042)	(0.043)	(0.043)	(0.043)	(0.034)	(0.034)	(0.034)	(0.034)
Constant	13.978**	9.679**	10.231**	9.677**	-25.573	-43.706*	-45.347*	-44.068*	-11.858**	-16.230***	-11.170**	-16.108***
	(5.724)	(4.665)	(5.079)	(4.667)	(26.518)	(25.811)	(26.887)	(25.935)	(4.984)	(5.070)	(4.878)	(5.081)
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (within)	0.167	0.167	0.167	0.167	0.256	0.255	0.255	0.256	0.137	0.142	0.142	0.142
Observations	5647	5647	5650	5647	1146	1146	1146	1146	3945	3945	3945	3945

Table 6: The Effect from Leverage on Banks´ Dividend Policies, Including the Interaction between Leverage and Profitability

Each column estimates regression models during the sample period 2008q4-2011q3. Columns 1-2: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Columns 3-4: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses.
Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY		*DIVIDEND_EQUITY*	
	(1)	(2)	(3)	(4)
NONDEPOSITS_TA	0.105 (0.082)		0.049*** (0.015)	
DEPOSITS_TA		-0.119 (0.082)		-0.045*** (0.013)
ROA	0.561 (0.496)	6.146 (4.483)	0.042* (0.023)	-0.041 (0.121)
*NONDEPOSITS_TA*ROA*	0.041 (0.058)		-0.000 (0.002)	
*DEPOSITS_TA*ROA*		-0.066 (0.054)		-8.20eˆ^06 (0.002)
Control Variables	Yes	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.176	0.182	0.142	0.142
Observations	578	578	3945	3945

Table 7: The Effect from Leverage on Banks´ Dividend Policies, Including the Interaction between Leverage and Insider Ownership

Each column estimates regression models during the sample period 2008q4-2011q3. *LOW_INSIDER_DUMMY* is a dichotomous variable which assumes value one if the bank has got insider ownership smaller or equal than the mean insider ownership across the sample (equal to 18.231%). Columns 1-2: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Columns 3-4: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Columns 5-6: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY		*DIVIDEND_EARNINGS*		*DIVIDEND_EQUITY*	
	(1)	(2)	(3)	(4)	(5)	(6)
NONDEPOSITS_TA	0.192*		0.265		0.021	
	(0.110)		(1.355)		(0.021)	
DEPOSITS_TA		-0.270**		-0.607		-0.029*
		(0.112)		(1.346)		(0.015)
NONDEPOSITS_TA* *LOW_INSIDER_DUMMY*	-0.116		0.932		0.032	
	(0.123)		(1.369)		(0.026)	
DEPOSITS_TA* *LOW_INSIDER_DUMMY*		0.176		-0.829		-0.016
		(0.121)		(1.336)		(0.019)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.176	0.184	0.161	0.162	0.155	0.155
Observations	521	521	2258	2258	3657	3657

Table 8: The Composition of Banks´ Deposit Leverage

The table reports the average value of the variables in percentage terms during the sample period 2000q1-2011q3.

Variable	N (as of 2011Q3)	Mean	Median	5%	25%	75%	95%	Std. Dev
DEPOSITS_TA	981	78.928	80.980	62.340	74.690	85.470	89.820	9.685
JUMBOTIMEDEP_TA	981	14.589	12.984	4.376	8.742	18.930	30.077	8.133
RETAILTIMEDEP_TA	981	19.204	19.121	3.510	12.216	25.685	35.841	9.746
MONEYMKTACC_TA	981	14.952	12.872	2.354	7.583	20.267	34.648	10.149
SAVINGACC_TA	981	8.558	5.962	0.233	2.451	11.730	27.086	8.554
CURRENTACC_TA	981	21.831	21.063	7.189	14.723	27.808	39.535	9.962
FOREIGNDEP_TA	981	0.230	0.000	0.000	0.000	0.000	0.000	2.300
OTHERDEP_TA	981	0.021	0.000	0.000	0.000	0.000	0.000	0.837

Table 9: The Effect from the Components of Deposit Leverage on Banks´ Dividend Policies

Each column estimates regression models during the sample period 2008q4-2011q3. The variables for the type of deposits are defined in the Appendix. *ΔDEPOSITS* is the difference in the amount of banks´ deposits across quarters. Column 1: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Column 2: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Column 3: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses.

Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*
	(1)	(2)	(3)
Type of Deposits:			
JUMBOTIMEDEP_TA	-0.362**	-2.166*	-0.049**
	(0.182)	(1.483)	(0.022)
RETAILTIMEDEP_TA	-0.640***	-2.453*	-0.084***
	(0.236)	(1.440)	(0.024)
MONEYMKTACC_TA	-0.375**	-2.464	-0.042**
	(0.181)	(1.630)	(0.021)
SAVINGACC_TA	-1.193**	-3.031*	-0.079**
	(0.482)	(1.583)	(0.035)
CURRENTACC_TA	-0.403*	-3.489**	-0.046**
	(0.226)	(1.401)	(0.022)
FOREIGNDEP_TA	-4.728	-2.237	-0.248*
	(5.87e^04)	(3.679)	(0.136)
Control Variables	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes
Dummy for:			
ΔDEPOSITS < 0	-0.538**	-0.075	-0.084
	(0.254)	(2.137)	(0.051)
*ΔDEPOSITS (*Excluded *TIME DEPOSITS) < 0*	-0.738***	-1.016	-0.139**
	(0.275)	(2.381)	(0.065)
Control Variables	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes

Table 10: The Effect from Short-Term Non-Deposit Leverage on Banks´ Dividend Policies

Each column estimates regression models during the sample period 2008q4-2011q3. Column 1: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Column 2: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Column 3: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*
	(1)	(2)	(3)
SHORTTERM_NONDEP_TA	-0.281	0.121	0.032
	(0.203)	(1.155)	(0.038)
REPOS_TA	0.102	2.552	0.028
	(0.174)	(1.896)	(0.038)
Control Variables	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.177	0.141	0.130
Observations	512	2173	3596

Table 11: The Effect from Leverage on Banks´ Dividend Policies, Controlling for Equity Issued Under the Unite States Treasury's Troubled Asset Relief Program (TARP)

Each column estimates regression models during the sample period 2008q4-2011q3. Columns 1-3: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE, ROA, EQUITY_TA, CASH_TA, MTBV, LOANS_TA, RWA_TA, INCOME_TAX_TA, EMPL_COMP, CAPRATIO*, and a set of dummies for banks and quarters. The three columns differ in the variables which are included in the specification in order to control for the effects from Treasury's Troubled Asset Relief Program (TARP). Standard errors are reported in parentheses. Columns 4-6: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1), SIZE, ROA, EQUITY_TA, CASH_TA, MTBV, LOANS_TA, RWA_TA, INCOME_TAX_TA, EMPL_COMP, CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. The three columns differ in the variables which are included in the specification in order to control for the effects from Treasury's Troubled Asset Relief Program (TARP). Standard errors are clustered at the bank level and are reported in parentheses. Columns 7-9: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1), SIZE, ROA, EQUITY_TA, CASH_TA, MTBV, LOANS_TA, RWA_TA, INCOME_TAX_TA, EMPL_COMP, CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. The three columns differ in the variables which are included in the specification in order to control for the effects from Treasury's Troubled Asset Relief Program (TARP). Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY			*DIVIDEND_EARNINGS*			*DIVIDEND_EQUITY*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NONDEPOSITS_TA	0.189** (0.074)	0.175** (0.075)	0.250*** (0.093)	1.076 (0.734)	1.095 (0.733)	1.099 (0.818)	0.048*** (0.014)	0.048*** (0.014)	0.040*** (0.015)
TARPEQUITY_TA	-1.176*** (0.333)			-1.698 (3.250)			0.036 (0.056)		
TARPEQUITY_DUMMY		-3.090*** (0.927)	-1.703 (1.226)		-4.976 (5.973)	-4.868 (13.087)		0.066 (0.128)	-0.175 (0.204)
NONDEPOSITS_TA* *TARPEQUITY_DUMMY*			-0.140 (0.092)			-0.009 (0.829)			0.020 (0.015)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.209	0.209	0.214	0.150	0.150	0.150	0.142	0.142	0.143
Observations	578	578	578	2396	2396	2396	3933	3933	3933

Table 12: The Effect from Leverage on Banks´ Dividend Policies, Including the Interaction between Leverage and a Dichotomous Variable Denoting "Too-Big-To-Fail" Institutions

Each column estimates regression models during the sample period 2008q4-2011q3. *TOOBIGTF_DUMMY* is a dichotomous variable which assumes value one if the bank is classified as a "systemically important financial institution." The banks headquartered in the United States which the Financial Stability Board classifies (as on November 2011) as "systemically important financial institutions" are the following: Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JPMorgan Chase, Morgan Stanley, State Street, Wells Fargo. Columns 1-2: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Columns 4-6: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Columns 7-9: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY		*DIVIDEND_EARNINGS*		*DIVIDEND_EQUITY*	
	(1)	(2)	(3)	(4)	(5)	(6)
NONDEPOSITS_TA	0.142*		1.060		0.047***	
	(0.075)		(0.731)		(0.014)	
DEPOSITS_TA		-0.170**		-1.359*		-0.043***
		(0.075)		(0.734)		(0.012)
NONDEPOSITS_TA* *TOOBIGTF_DUMMY*	-1.418		-5.294***		0.268	
	(1.137)		(0.100)		(0.168)	
DEPOSITS_TA* *TOOBIGTF_DUMMY*		0.204		2.946		-0.244
		(0.359)		(2.551)		(0.240)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.183	0.180	0.150	0.151	0.145	0.144
Observations	578	521	2403	2403	3945	3945

Table 13: Simultaneous System of Equations for the Banks´ Dividend Payout and Leverage

Panel A and B of the table estimate the simultaneous system of equations in (3) on the two sample periods 2000q1-2008q3, and 2008q4-2011q3, respectively. On each panel, Columns 1, 3, and 5 report the coefficients estimated on the equation for dividends, which are measured by *DIVIDEND_EQUITY*. Columns 2, 4, and 6 report the coefficients estimated on the equation for leverage, which is measured, alternatively by *DEP&NONDEP_TA*, *NONDEPOSITS_TA*, and *DEPOSITS_TA*. The estimation is performed according to the one-way random effect estimation of seemingly-unrelated regressions implemented by Nguyen (2010).

Panel A (2000q1-2008q3)	*DIVIDEND_EQUITY*	*DEP&NONDEP_TA*	*DIVIDEND_EQUITY*	*NONDEPOSITS_TA*	*DIVIDEND_EQUITY*	*DEPOSITS_TA*
	(1)	(2)	(3)	(4)	(5)	(6)
DIVIDEND_EQUITY		0.000**		0.024		-0.001
		(0.000)		(0.021)		(0.022)
DIVIDEND_EQUITY(t-1)	-0.077***		-0.077***		-0.077***	
	(0.009)		(0.009)		(0.009)	
DEP&NONDEP_TA	-2.716					
	(2.108)					
NONDEPOSITS_TA			0.004			
			(0.007)			
DEPOSITS_TA					-0.004	
					(0.007)	
SIZE	-0.162	0.014***	-0.158	5.241***	-0.156	-3.866***
	(0.141)	(0.001)	(0.144)	(0.246)	(0.143)	(0.261)
ROA	0.035	0.003***	0.041	0.377***	0.041	0.632***
	(0.032)	(0.000)	(0.032)	(0.057)	(0.032)	(0.060)
EQUITY_TA	0.083***		0.046**		0.047**	
	(0.029)		(0.021)		(0.021)	
CASH_TA	-0.009		-0.010		-0.009	
	(0.008)		(0.008)		(0.009)	
MTBV	0.005***	0.000***	0.005***	0.001	0.005***	0.005***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
LOANS_TA	-0.015**		-0.017**		-0.016**	
	(0.008)		(0.007)		(0.008)	
RWA_TA	0.013		0.014*		0.015*	
	(0.008)		(0.008)		(0.008)	
INCOME_TAX_TA	-0.002		-0.002		-0.003	
	(0.095)		(0.095)		(0.095)	
EMPL_COMP	-0.004		-0.004		-0.004	
	(0.003)		(0.003)		(0.003)	

CAPRATIO	0.006 (0.012)		0.006 (0.012)		0.005 (0.012)	
Constant	5.880 (3.645)	0.662*** (0.026)	3.021 (3.001)	-64.762*** (5.067)	3.384 (3.125)	131.059*** (5.386)
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.725	0.866	0.725	0.866	0.725	0.866
Observations	7382	7382	7382	7382	7387	7387
Breusch-Pagan Test ($\chi 2$)	1.121		0.324		0.000	

Panel B (2008q4-2011q3)	*DIVIDEND_EQUITY* (1)	*DEP&NONDEP_TA* (2)	*DIVIDEND_EQUITY* (3)	*NONDEPOSITS_TA* (4)	*DIVIDEND_EQUITY* (5)	*DEPOSITS_TA* (6)
DIVIDEND_EQUITY		0.000* (0.000)		0.208*** (0.026)		-0.172*** (0.031)
DIVIDEND_EQUITY(t-1)	0.009 (0.010)		0.007 (0.010)		0.007 (0.010)	
DEP&NONDEP_TA	-1.098 (1.731)					
NONDEPOSITS_TA			0.087*** (0.010)			
DEPOSITS_TA					-0.065*** (0.009)	
SIZE	0.924*** (0.260)	0.019*** (0.003)	1.014*** (0.258)	-0.170 (0.379)	1.007*** (0.258)	2.092*** (0.457)
ROA	0.039*** (0.011)	-0.001*** (0.000)	0.040*** (0.011)	-0.024 (0.018)	0.037*** (0.011)	-0.056*** (0.021)
EQUITY_TA	0.018 (0.038)		0.061* (0.035)		0.020 (0.035)	
CASH_TA	0.030*** (0.009)		0.035*** (0.009)		0.036*** (0.009)	
MTBV	0.007*** (0.001)	0.000* (0.000)	0.007*** (0.001)	-0.001 (0.001)	0.007*** (0.001)	0.003** (0.002)

LOANS_TA	0.015 (0.010)		0.014 (0.009)		0.019** (0.010)	
RWA_TA	0.004 (0.011)		0.005 (0.011)		0.002 (0.011)	
INCOME_TAX_TA	0.402** (0.181)		0.356** (0.179)		0.393** (0.179)	
EMPL_COMP	0.001 (0.003)		0.001 (0.003)		0.002 (0.003)	
CAPRATIO	-0.056** (0.026)		-0.064** (0.026)		-0.065** (0.026)	
Constant	-12.310** (5.085)	0.536*** (0.055)	-17.026** (4.694)	23.958*** (6.465)	-10.450** (4.717)	29.587*** (7.798)
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.783	0.860	0.783	0.925	0.784	0.915
Observations	3857	3857	3857	3857	3857	3857
Breusch-Pagan Test ($\chi 2$)	0.710		16.682***		7.796***	

Table 14: The Effect from Leverage on Banks´ Dividend Policies, Including Lagged Values of Leverage

Each column estimates regression models during the sample period 2008q4-2011q3. Columns 1-4: Coefficients estimated by a Logit model for *DIVIDEND_DUMMY*. The specification controls also for the following variables, which are not reported in the table: *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, and a set of dummies for banks and quarters. Standard errors are reported in parentheses. Columns 5-8: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EARNINGS*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EARNINGS (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EARNINGS* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Columns 9-12: Coefficients estimated by an Ordinary Least Squares (OLS) model for *DIVIDEND_EQUITY*. The specification controls also for the following variables, which are not reported in the table: *DIVIDEND_EQUITY (t-1)*, *SIZE*, *ROA*, *EQUITY_TA*, *CASH_TA*, *MTBV*, *LOANS_TA*, *RWA_TA*, *INCOME_TAX_TA*, *EMPL_COMP*, *CAPRATIO*, a constant, and a set of dummies for banks and quarters. *DIVIDEND_EQUITY* is winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_DUMMY				*DIVIDEND_EARNINGS*				*DIVIDEND_EQUITY*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NONDEPOSITS_TA(t-1)	0.102 (0.064)				0.869 (0.576)				0.039*** (0.014)			
NONDEPOSITS_TA(t-2)		0.080 (0.058)				1.296** (0.635)				0.026** (0.013)		
DEPOSITS_TA(t-1)			-0.412** (0.062)				-1.026* (0.569)				-0.036*** (0.011)	
DEPOSITS_TA(t-2)				-0.097* (0.055)				-1.222** (0.592)				-0.020** (0.009)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo- R^2 / R^2 (within)	0.173	0.172	0.180	0.175	0.149	0.151	0.151	0.151	0.141	0.139	0.141	0.139
Observations	578	578	578	578	2403	2402	2402	2400	3945	3940	3944	3941

Table 15: The Effect from Deposit Leverage on Banks´ Dividend Payouts: Output from Tobit Model, and Dynamic Panel Data Model

Columns 1-2: Coefficients estimated by a Tobit model during the sample period 2008q4-2011q3. The estimation follows the technique of Honoré (1992). Both *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* are winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* are excluded from the sample. Standard errors are estimated by the bootstrap, and are reported in parentheses. Columns 3-4: Coefficients estimated according to the method for dynamic panel data developed by Arellano and Bond (1991). Both *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* are winsorized at the 1% and 99% level, and observations with negative *DIVIDEND_EARNINGS* and *DIVIDEND_EQUITY* are excluded from the sample. Robust standard errors are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	DIVIDEND_EARNINGS	*DIVIDEND_EQUITY*	*DIVIDEND_EARNINGS*	*DIVIDEND_EQUITY*
	(1)	(2)	(3)	(4)
Dependent variable (t-1)	-0.015	-0.186**	-0.062	-0.220***
	(0.057)	(0.078)	(0.050)	(0.070)
DEPOSITS_TA	-2.142**	-0.079**	-1.863**	-0.137***
	(1.041)	(0.033)	(0.732)	(0.019)
SIZE	83.816**	3.885***	-10.084	0.077
	(34.081)	(0.714)	(25.861)	(0.522)
ROA	-127.438***	0.075*	-31.218***	0.046***
	(17.593)	(0.042)	(5.009)	(0.013)
EQUITY_TA	3.944	0.025	-9.314**	-0.064
	(6.138)	(0.124)	(3.866)	(0.061)
CASH_TA	1.553	0.060**	0.231	0.080***
	(1.060)	(0.028)	(0.685)	(0.025)
MTBV	0.261***	0.017***	-0.111*	0.009***
	(0.098)	(0.003)	(0.065)	(0.002)
LOANS_TA	-0.303	0.035	-3.312***	0.109***
	(0.847)	(0.023)	(1.081)	(0.023)
RWA_TA	1.999**	0.037	3.023***	-0.008
	(0.913)	(0.029)	(1.137)	(0.025)
INCOME_TAX_TA	25.131	1.126**	1.559	0.300
	(15.729)	(0.515)	(7.836)	(0.233)
EMPL_COMP	-0.156	-0.003	0.516***	-0.008*
	(0.402)	(0.010)	(0.196)	(0.005)
CAPRATIO	-0.820	-0.057	0.008	-0.091**
	(3.362)	(0.091)	(2.113)	(0.045)
Firm Effects	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	No	No
$\chi 2$	192.010***	285.090***	80.840***	113.860***
Observations	2403	3945	1958	3615

Table 16: Variables for Banks´ Share Repurchases.

The table reports the average value of the variables during the sample period 2000q1-2011q3. For *REPURCHASE_INCOME* the value reported in the table is the average positive *REPURCHASE_INCOME*.

Variable	Mean	Median	5%	25%	75%	95%	Std. Dev
REPURCHASE_DUMMY	28.816	0.000	0.000	0.000	100	100	0.453
REPURCHASE_INCOME	19.080	0.000	0.000	0.000	1.079	63.704	547.725

Figure 2: Payout through Share Repurchases and Payout through Dividends along Years

The figure is based on data excluding from the sample observations with negative *DIVIDEND_EARNINGS* and negative *REPURCHASE_INCOME*. *DIVIDEND_EARNINGS* and *REPURCHASE_INCOME* are winsorized at the 1% and 99% level.

Figure 3: Payout through Share Repurchases and Payout through Dividends along Years, for Banks Simultaneously Paying Dividends and Repurchasing Shares

The figure is based on data excluding from the sample observations with negative *DIVIDEND_EARNINGS* and negative *REPURCHASE_INCOME*. *DIVIDEND_EARNINGS* and *REPURCHASE_INCOME* are winsorized at the 1% and 99% level.

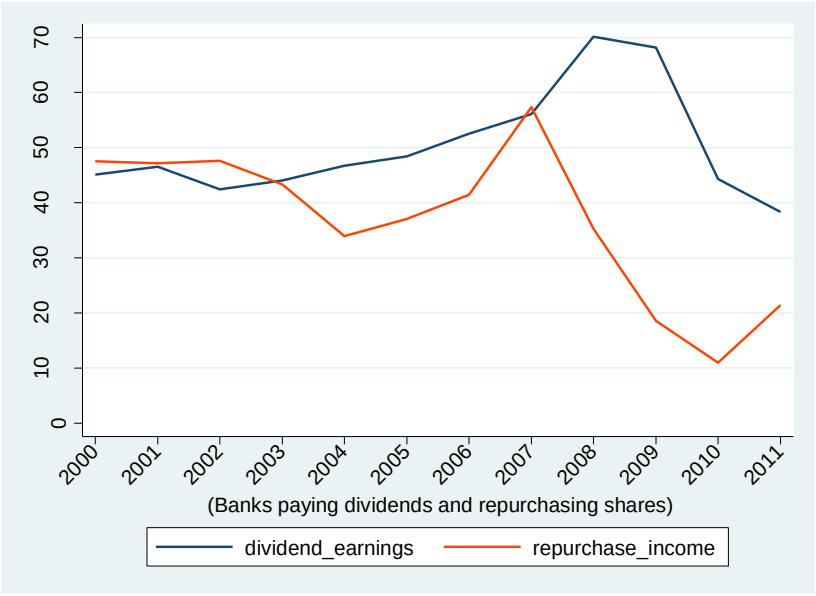

Table 17: The Effect from Leverage on Banks´ Share Repurchases

Each column estimates regression models during the sample period 2008q4-2011q3. Columns 1-2: Coefficients estimated by a Logit model for *REPURCHASE_DUMMY*. The specification controls also for a set of dummies for banks and quarters, which is not reported. Standard errors are reported in parentheses. Columns 3-4: Coefficients estimated by an Ordinary Least Squares (OLS) model for *REPURCHASE_INCOME*. The specification controls also for a set of dummies for banks and quarters, which is not reported. *REPURCHASE_INCOME* is winsorized at the 1% and 99% level, and observations with negative *REPURCHASE_INCOME* are excluded from the sample. Standard errors are clustered at the bank level and are reported in parentheses. Significance: * p < 0.10, ** p < 0.05, *** p <0.01

	REPURCHASE_DUMMY		*REPURCHASE_INCOME*	
	(1)	(2)	(3)	(4)
REPURCHASE_INCOME (t-1)			-0.002***	-0.002***
			(0.001)	(0.000)
NONDEPOSITS_TA	0.075*		0.360	
	(0.042)		(0.248)	
DEPOSITS_TA		-0.077*		-0.278
		(0.042)		(0.188)
SIZE	2.110	2.184*	13.477*	12.982*
	(1.326)	(1.328)	(6.948)	(6.791)
ROA	0.151	0.148	0.015	0.012
	(0.100)	(0.100)	(0.073)	(0.074)
EQUITY_TA	-0.176	-0.252	0.494	0.204
	(0.181)	(0.177)	(0.402)	(0.366)
CASH_TA	-0.060	-0.058	0.079	0.079
	(0.043)	(0.043)	(0.109)	(0.110)
MTBV	-0.008*	-0.008*	0.007	0.007
	(0.004)	(0.005)	(0.010)	(0.010)
LOANS_TA	0.047	0.049	0.183	0.217
	(0.049)	(0.049)	(0.125)	(0.132)
RWA_TA	-0.023	-0.022	-0.029	-0.055
	(0.053)	(0.052)	(0.106)	(0.110)
INCOME_TAX_TA	-1.379*	-1.363*	-1.860*	-1.583
	(0.714)	(0.712)	(1.117)	(1.132)
EMPL_COMP	0.028	0.027	-0.030	-0.026
	(0.019)	(0.019)	(0.036)	(0.036)
CAPRATIO	0.098	0.098	-0.236	-0.241
	(0.127)	(0.127)	(0.290)	(0.294)
Constant			-197.370*	-162.348*
			(107.015)	(97.566)
Firm and Time Effects	Yes	Yes	Yes	Yes
Pseudo-R^2 / R^2 (within)	0.144	0.144	0.028	0.028
Observations	1061	1061	3590	3590

International Review of Financial Analysis 32 (2014) 109–122

Contents lists available at ScienceDirect

International Review of Financial Analysis

Health status and portfolio choice: Is their relationship economically relevant?

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ARTICLE INFO

Article history:
Received 17 December 2013
Received in revised form 8 January 2014
Accepted 10 January 2014
Available online 31 January 2014

JEL classifications:
D8
E2

Keywords:
Household portfolios
Health status

ABSTRACT

Recent empirical work on individual portfolio choice focuses on the role of the individual's health in making financial decisions. The key idea is that, through precautionary saving or reducing investors' time horizon, health issues make people choose safer financial portfolios. This paper questions the empirical relevance of the link between health and portfolio choice, measured as stockownership and overall fraction of risky securities held. We handle with caution the findings from previous papers and ask whether data from the first wave of the Survey of Health, Aging and Retirement in Europe (SHARE) are able to clarify some of our doubts. We find that only poor self-reported health negatively impacts the portfolio choice, while other health measures (chronic conditions, limitations in daily activities of life, mental health) are irrelevant for investment decisions.

1. Introduction

The Modern Portfolio Theory (MPT) postulates that risk averse investors choose their investment portfolios in order to maximize their expected return for a predetermined level of risk. The optimal portfolio chosen by the investor will depend on the shape of her utility function. In recent years, the basic assumptions of MPT have been widely challenged by the behavioral finance approach, which has thrown new insight onto investment decision theory. Behavioral finance evaluates risk mostly based on laboratory experiments and surveys or questionnaire instruments, and concentrates on beliefs, attitudes and risk perception in particular circumstances. Among other factors, an individual's health status has recently gained attention as a potential determinant of risk perception and security holdings. Recent literature has developed a portfolio choice theory which includes the presence of "background" risk, defined as an uninsurable component of individuals' income risk which decreases additional financial risks (Gollier, 2001; Guiso, Jappelli, & Terlizzese, 1996; Guiso & Paiella, 2001). Some researchers have put effort into demonstrating how health can be regarded as a form of background risk, and provide empirical results on how financial investment choices change with health conditions. The most frequent finding is that, a sudden health issue or poor health conditions tend to shift resources towards safer types of financial investments, with disaffection from the participation to the equity market and from the holding of risky securities. Papers support with various arguments the way in which health affects portfolio choice. Some sustain that there is a precautionary saving purpose behind the health effect, to the extent that the expected future medical expenditures subtract resources from financial investments (among others, see Atella, Brunetti, & Maestas, 2012; Berkowitz & Qiu, 2006; Goldman & Maestas, 2007; Gollier & Pratt, 1996; Heaton & Lucas, 2000; Pang & Warshawsky, 2010; Pratt & Zeckhauser, 1987). Others consider the interplay between health and other circumstances which affect the life span horizon, such as aging (Coile & Milligan, 2009) or bequest motives (Feinstein & Lin, 2006). Finally, some papers propose models where health enters as a direct argument of the investor utility function, and the marginal utility of consumption is found to vary with health (among others, see Cardak & Wilkins, 2009; Edwards, 2008; Finkelstein, Luttmer, & Notowidigdo, 2008; Love & Smith, 2010; Rosen & Wu, 2004). Evidently, the relationship occurring between health status and portfolio choice is actively discussed in the literature, and the standpoint of researchers in the field is extremely heterogeneous.

With this work we wish to take part in this debate, and our focus is on deeply understanding whether there is a relevant link between health status and portfolio choice. More specifically, we contribute to the previous literature surveying the individual health condition in a more extensive way. Since the health dimension is characterized by various different facets, our analysis aims at establishing the relationship occurring with portfolio decisions from different proxies of health, where each proxy should reflect a specific health dimension (subjective, objective, and mental health). We use data contained in the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), which

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http://dx.doi.org/10.1016/j.irfa.2014.01.008
1057-5219

paints a picture of the lives of Europeans aged 50 and over from 11 countries. We concentrate on the decision of households on their stockholding, and on the relative share of their portfolio which is invested into risky assets. Our empirical models relate these two choices on the household health condition, while controlling for a large number of individual and household characteristics, as the household composition and various socio-economic features. We mainly test the most common channels that the literature so far has suggested as drivers for the impact from health on investments, and that we have mentioned few rows above. In particular, we check whether the implication from health on portfolio choice is imputable to precautionary saving and/or risk aversion changes. Despite we cannot rule out if one channel is more effective than the other, our results suggest that, a significant path from health on portfolio choice is only associable to a measure of subjective health. More specifically, people self-reporting a negative health condition are found to be less likely in owning some stocks and are holding fewer risky assets. If we instead measure the physical health status of the same respondents (counting the number of limitations in daily life activities or the number of chronic diseases), or measure their psychological feelings (through a depression scale), than it does not hold any more that being worse in health has significant affections on investments. Our results show that, the prediction of a negative health risk on financial choices highly depends on the notion of health we refer to, since we showed that different health measures might yield inconsistent results. The rest of the paper is organized as follows: Section 2 reviews the most relevant contributions to the literature which has surveyed the effect of health status on portfolio choice; Sections 3 and 4 present the data and describe in more detail the variables of interest; Section 5 reports the econometric results; Section 6 provides the conclusions and some discussion of the results, comparing them with previous contributions in the literature.

2. The effect of health status on portfolio choice

There is abundant evidence of an association between economic measures, such as income and wealth, and a variety of variables which are linked to the state of health of individuals. Indeed, several studies confirm the existence of a link between the two spheres. However, there is still no consensus on the nature and the direction of this relationship. On the one hand, changes in socio-economic status may lead to worse health status. On the other hand, also changes of the health status may have an impact on the individuals' income and wealth: a poor health status, limiting the ability to work and increasing medical costs, could restrict opportunities for individual income and accumulated wealth. According to Palumbo (1999), the expectation of substantial future medical expenses reduces, as a precautionary measure, the current and future consumption. Moreover, if the marginal utility of consumption decreases with worsening health conditions, individuals will be inclined to consume more when they are healthy compared to periods in which they are sick, and save more when the probability of a worsening of their health status increases. Closely related to this is the question of the impact of a poor health status on life expectancy: in life-cycle models, the mortality risk induces a transfer of future consumption towards the present. Smith (1999) finds that under the risk of future health problems, subjects might be induced to reduce the transfer of wealth to heirs, rather than decrease their-consumption. According to this logic, current status of health and probability to leave an inheritance are strongly correlated.

In the following paragraphs, we focus on the recent literature that studies the relationship between health status and portfolio choices. Previous contributions in the empirical literature suggest different channels through which health might affect financial decisions, i.e. precautionary saving motive, direct effect of marginal utility of consumption, and the perception of the life span and planning horizon.

2.1. First channel: precautionary saving motive

The fear of potential health shocks can lead to higher medical spending which absorbs the financial wealth of the investor. In this view, health expenditures is a type of undiversifiable background risk that induces precautionary saving and prompts safer portfolios (among all: Atella et al., 2012; Berkowitz & Qiu, 2006; Goldman & Maestas, 2007; Gollier & Pratt, 1996; Heaton & Lucas, 2000; Pang & Warshawsky, 2010; Pratt & Zeckhauser, 1987). Our work attempts to complement the works by Atella et al. (2012) and Guiso et al. (1996). The former uses the same data source as our current research (the Survey of Health, Aging and Retirement in Europe, SHARE) to show how health risk affects the portfolio choice only of those investors living in countries with a less protective healthcare system. Their result highlights the role of national healthcare systems in reducing the overall background risk faced by households and, consequently, in dampening the precautionary saving purpose. Guiso et al. (1996) use data from the Survey of Household Income and Wealth, and focuses on the investigation of the relationship between stockholding choices and different household characteristics. The authors argue that, among other factors, future medical expenses are a common source of risk, as they find that households headed by individuals who spent more days sick tend to hold safer financial portfolios, even after controlling for many other individual characteristics.

2.2. Second channel: direct effect on the marginal utility of consumption

Health status could have an impact on financial decisions through its direct effect on the marginal utility of consumption. Edwards (2010) explores the implications for portfolio choice of a special type of state-dependent utility function, which includes consumption and health. The author proves that, if the cross partial derivative of utility with respect to consumption and health is negative, then investors who perceive their health status as poor will hedge by holding safer financial portfolios. Finkelstein et al. (2008) use seven waves of panel data on older individuals from the Health and Retirement Study (HRS) and estimate how individual adverse health events affect a proxy for utility, comparing the effects across people of different income levels. They find robust evidence of the fact that deteriorations in health are associated to a statistically significant decline in the marginal utility of consumption. Cardak and Wilkins (2009) use data from the Household Income and Labour Dynamics in Australia (HILDA) survey to investigate the determinants of the portfolio allocation of Australian households. Their results suggest that the share of risky assets held in financial portfolios is significantly and negatively affected by poor health status. They retain that poor health conditions reduce risky asset holdings via its effects on measured risk and time preferences. In their analysis, households that consider themselves financially risk averse have a much lower risky asset ratio. Using data from the Health and Retirement Study (HRS), Rosen and Wu (2004) find that a fair or poor health status reduces the probability of holding risky assets as well as the portfolio shares held in those assets. Possible explanations for this outcome are explored using variables for health insurance, bequest motive and planning horizon, though, according to their analyses, none of these latter ways seems to be the channel through which health status explicates an effect on portfolio composition.

2.3. Third channel: life span and planning horizon

A third potential channel is through life span and time horizon. All things equal, advancing age leaves less time remaining before death, which may be a reason to invest more safely.

Using data from the Health and Retirement Survey (HRS), Coile and Milligan (2009) focus on the influence of aging and health shocks on households' portfolio choice, and find that health shocks explain part of the changes in households' portfolios over time. Feinstein and Lin

(2006) propose a model for elderly asset management and present results based on simulations from the model. Among their findings, authors show that elderly agents in poor health and exposed to greater health expenditure risk, place a slightly lower proportion of their assets in stocks than individuals in good health. A related issue is the bequest motive. Hurd (2002) claims that, while for young people this is quite a remote event, for aged people a bequest motive can extend the time horizon, reducing the effects of mortality risk.

3. Data

In this study, we use data contained in the first wave of SHARE, the Survey of Health, Ageing and Retirement in Europe; its main focus is to provide information on the lives of Europeans aged 50 and over, collecting data in 11 countries from Scandinavia to the Mediterranean. The survey covers 19,548 households and 28,517 individuals on a wide range of topics, encompassing health, socioeconomic status, financial transfers, and intensity of social interaction. For our research, particular attention goes to variables expressing wealth and health conditions. From these, we manage to construct indicators for portfolio choice and to relate them to different health proxies. Some of the questions refer to the household while others are posed to the single respondent. In this case, since our analysis mainly focuses on the households, we combine individual information and take the household average.

4. Measuring health status

SHARE devotes a section of the questionnaire to measuring health status. Empirically, health status is an intrinsically unobservable variable. A formal definition of health status unavoidably involves a number of facets suggesting an exploration of different variables available in SHARE to take into account the multiple dimensions among which the notion of health develops. As a first approximation, we can divide the information of health status into objective and subjective. Concerning the first category, SHARE provides the number of limitations in activities of daily living and the number of chronic diseases.[1]

Regarding the second category, SHARE provides information on self-perceived health status (SPHEU), reported on a 5-point scale (1 = Excellent, 2 = Very Good, 3 = Good, 4 = Fair, 5 = Poor). As Rosen and Wu (2004) and Atella et al. (2012) point out, many contributions in the literature document the validity of self-reported health status. The last relevant health variable included in SHARE is mental health. This is measured by a depression scale variable (EURO-D) which runs from 0 to 12, counting whether the individual reported having problems during the last month from a list of negative feelings, including depression, pessimism, guilt, irritability and tearfulness. Fig. 1 provides the sample distributions of the four indicators of health status. Descriptive statistics (see Table 1) show that only 9.5% of the sample have some limitations with activities of daily living (the dummy variable ADL2 denotes whether the respondent suffers at least one limitation) and the average number is 0.183 (st.dev. 0.624). More than 41% of the sample declare two or more chronic diseases (the dummy variable chronic2 denotes whether the respondent suffers at least one chronic disease) and the average number of chronic diseases is 1.513 (st. dev. 1.308). More than 37% of the sample perceive a subjective health status as being fair or poor, and the average point-scale is 2.301 (st. dev. 0.838). Only 6% of the sample has a depression scale higher than 7, and the average scale is 2.339 (st. dev. 2.086). Table 2 also shows a high level of heterogeneity across countries.

[1] The former includes difficulty in dressing, walking, bathing, eating, getting in or out of bed and using the toilet (ADL). The latter includes heart attack, high blood pressure, high blood cholesterol, diabetes, asthma, arthritis, osteoporosis, Parkinson's and cancer (chronic).

5. Stockownership and risky investment

During the investment process, an individual makes the crucial decision whether or not to spend some of his resources in financial securities traded in organized exchange markets. SHARE respondents are asked about the amount of money they hold in the following financial products: bank accounts, bonds, stocks, individual retirement accounts, contractual savings for housing, whole and term life insurance. As in Christelis, Jappelli, and Padula (2010), we distinguish between direct stockownership and total stockownership, which includes stocks held directly plus stocks held through mutual funds and investment accounts.

In our sample we capture these features of the portfolio choice by two dichotomous variables. The variable for direct stockownership assumes value one if the household has invested any positive amount in stocks. The variable for total stockownership assumes value one if the household has invested into stocks, or mutual funds, or individual investment accounts, assuming these two latter financial products have a certain share invested as well into stocks. Table 3 provides some descriptive statistics on direct and total stockholding. Thirteen percent of our sample invests directly in stocks, while more than twice that (26.7%) holds stocks either directly or through mutual funds and individual retirement accounts. This table also shows a high level of heterogeneity in stockholding across European countries.

While structuring the investment portfolio and in accordance with main insight provided by portfolio theory, the individual typically diversifies among different classes of financial assets. For this reason, in our sample we define the "risky" fraction of the investment portfolio of our households as the sum of stocks, mutual funds and individual retirement accounts over the total gross financial wealth.

6. Unconditional relationship between stock market participation and health status

Our purpose is to investigate the relationship linking stockholding and risky investment to health conditions, identified by four variables (disabilities in daily life activities (ADL), chronic conditions, self-perceived health status (SPHEU) and mental health). To get a first glance of the type of connection, in Figs. 2 and 3 we plot stockholding and risky investments (respectively) over the four proxies of health conditions. In general, objective health seems to have a negative relationship with both stockholding and the relative amount of risky investments, though the path is not continuous and some discontinuities are observable for a large number of limitations or chronic diseases (see Fig. 2a and b). The effect of SPHEU is clearer. The dependent variable in Fig. 2c decreases continuously, suggesting that, as long as the individual reports a poorer view of himself, he tends to leave the equity market and drive resource towards other different and "safer" form of investments. Fig. 3c clearly shows that while people reporting excellent health conditions hold 20% of their resources in risky assets, individuals in poor health status reduce this proportion to below 5%. The effect has the same direction when we consider the mental health indicator EUROD, and in Figs. 2d and 3d we see how the more symptoms of depression are declared, than the more are discouraged riskier investment choices.

7. Conditional relationship between stock market participation and health status

An unconditional analysis may hide the role of other explanatory variables affecting stockholding. For this reason, we estimate a regression model for each of our three dependent variables (direct stockholding, total stockholding, share of risky investment), in which we consider stockholding or the share of risky investment on the left hand side and health status plus a set of control variables on the right hand side. In particular we include the following control variables: age

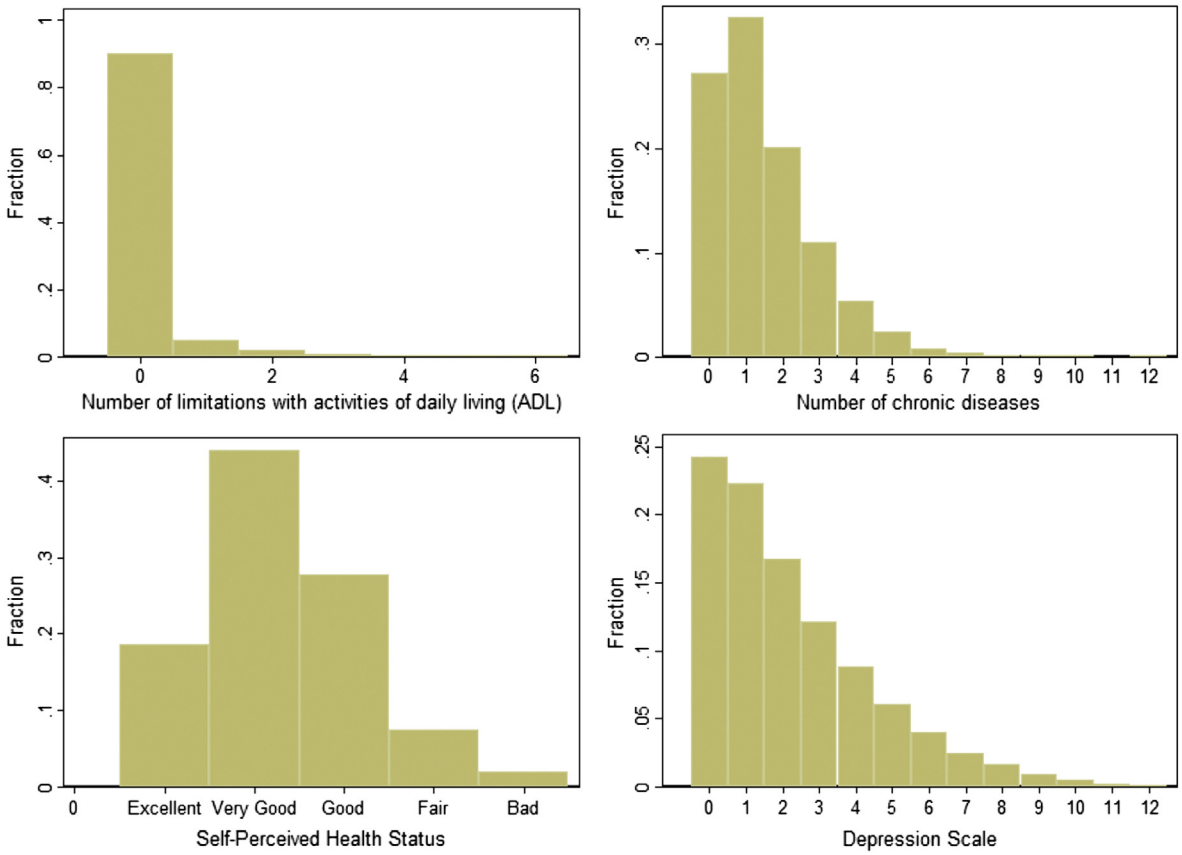

Fig. 1. Sample distributions of the health status indicators.

and its square, education level, number of household's members, employment characteristics, indicators of household resources (gross financial income, real assets and household disposable income), a variable for social activities, a set of indicators for cognitive abilities, and the expectations of leaving an inheritance and country dummies. The four proxies of health status (number of limitation in daily life activities, number of chronic conditions, self-perceived health status and mental health) are considered separately.

To model the stock holding decision more formally, we assume that households compare the utility gain from owning stocks with the entry cost. We express the net utility as:

$$y_h^* = X_h^{'}\delta + \varepsilon_h$$

where h is the household index and X_h are the observable variables affecting the utility gain from owning stocks. Household h owns stocks if $y_h^* \geq 0$, which implies that the probability of observing stock-ownership is $\Phi(X'_h\delta)$. If the unobservable factors are normally distributed, we can use a probit model for direct and total stock market participation estimated with standard maximum likelihood methods. The probit model allows interpreting the estimated marginal effects of the independent variables as their impact on the probability that the household holds some stocks in its portfolio (directly, or, also via "indirect" ownership of stocks). For the share of risky investment we use a censored normal regression model (or Tobit model) to take into account the fact that an optimizing behavior often leads to corner solutions for some nontrivial fraction of the population. Indeed, for some households the optimal share of risky investment coincides with the corner solution of zero investment (see Miniaci & Weber, 2002; Rosen & Wu, 2004 for a review and summary of various econometric issues in estimating portfolio choice models). With the Tobit model we estimate how a one unit change in the independent variables affects uncensored observations. In the set X_h of observable variables we include age and its square, a scaled variable for the education level, the number of household members, a dummy for self-employment, indicators of household resources (gross financial income, real assets and household disposable income), a variable for social activities, a set of indicators for cognitive abilities, and the expectations of leaving an inheritance. To these regressors we add a variable expressive of the health status. Given the complexity of the definition of health status, data enable us to investigate the effect of health on portfolio choice among four different dimensions. In each specification the health proxy is changed and the regression is run anew, according to which health explanatory variable is considered. The first two health proxies (number of limitation in activities of daily life – ADL – and number of chronic diseases) are regarded as a measure of the individual objective health. The third variable is a proxy of a more subjective and personal dimension of health, the health condition as reported by the person interviewed, according to his or her feeling and judgment (SPHEU). The fourth variable is the indicator of the mental health of the individual (EUROD), and takes into account reported negative psychological feelings. The four health proxies are then considered simultaneously and, given the low correlation among them and the large sample size, we do not worry about multicollinearity.

8. Econometric results

This section presents, first of all, the baseline results. We then discuss the results obtained from a deeper analysis conducted to disentangle the channels of health risk transmission.

Table 1
Descriptive statistics of health conditions.

Variable	Mean	Std. dev.	Min	Max	Obs.
Number of limitations in activities of daily life (ADL)	0.183	0.624	0	6	18,402
ADL2	0.095	0.266	0	1	18,402
Number of chronic diseases (*chronic*)	1.513	1.308	0	10	18,402
Chronic2	0.411	0.444	0	1	18,402
Self-reported health (SPHEU)	2.301	0.838	1	5	18,402
SPHEU2	0.374	0.439	0	1	18,402
Depression (EUROD)	2.339	2.086	0	12	18,402
EUROD2	0.061	0.221	0	1	18,402

The variables are taken at their household mean value.

Table 2
Descriptive statistics of health conditions by country.

	Austria	Germany	Sweden	Netherland	Spain	Italy
Number of limitations in activities of daily life (ADL)	0.171	0.171	0.160	0.151	0.262	0.219
Number of chronic diseases (*chronic*)	1.266	1.461	1.507	1.290	1.822	1.702
Self-reported health (SPHEU)	2. 332	2.471	2.169	2.195	2.577	2.565
Depression (EUROD)	2.002	1.939	2.021	2.050	3.155	2.914
Observations	1371	1927	2066	1851	1630	1703

	France	Denmark	Greece	Switzerland	Belgium
Number of limitations in activities of daily life (ADL)	0.187	0.200	0.149	0.098	0.204
Number of chronic diseases (*chronic*)	1.559	1.603	1.411	1.036	1.656
Self-reported health (SPHEU)	2.328	2.173	2.180	1.894	2.205
Depression (EUROD)	2.856	1.872	2.244	1.953	2.373
Observations	1880	1117	1818	649	2390

The variables are taken at their household mean value. Standard errors in parentheses.

9. Baseline results

As mentioned above, we build a regression model for each of our three dependent variables (direct stockholding, total stockholding, fraction of risky investment). Tables 4 and 5 provide the results for the effect of health status on direct stockholding and total stockholding, respectively. Table 6 contains the outcome of the regression estimated for the fraction of risky investment. The whole set of health variables has a negative effect on both stock market participation decision as well as on the percentage of risk carried by the portfolio. Between the two proxies of objective health status (ADL and chronic), statistically significant effects are found only for the indicator of chronic diseases with respect to direct stockholding. The results become highly significant when the health indicator is allowed to coincide with the self-reported health conditions. Tables 4, 5 and 6 show that SPHEU has got a significantly negative effect on all the dependent variables; bad self-perceived health status would lead individuals to reduce both their equity investment and their financial risk-taking. In absolute terms, the marginal effect of SPHEU is always much larger than the marginal effect of the other proxies. We estimate a marginal effect of SPHEU of −0.013 (st. err. 0.004) and −0.033 (st. err. 0.006) for the direct and total stockholding respectively, and a coefficient of −0.064 (st. err. 0.012) for risky investment. The marginal effects of chronic diseases are −0.005 (st. err. 0.002), −0.006 (st. err. 0.004) for direct and total stockholding respectively, and the coefficient is −0.011 (st. err. 0.007) for risky investment, while for EUROD the effect is negative and statistically significant only for the fraction of risky investment (coefficient −0.013, st. err. 0.004). To provide a broader overview of the negative impact of health risk on the portfolio decision, we include the four health proxies simultaneously in the explanatory set of the estimated specifications. As seen in Table 7, SPHEU remains significantly negative across specifications, while the other three proxies of health status are not statistically relevant.

Table 3
Descriptive statistics of stockholding and risky investment by country.

	Whole sample	Austria	Germany	Sweden	Netherland	Spain
Direct stockholding	0.175	0.055	0.148	0.422	0.190	0.071
	(0.380)	(0.229)	(0.355)	(0.494)	(0.392)	(0.257)
Total stockholding	0.327	0.104	0.282	0.751	0.265	0.142
	(0.469)	(0.305)	(0.450)	(0.433)	(0.442)	(0.349)
Risky investment	0.158	0.037	0.099	0.438	0.097	0.078
	(0.288)	(0.145)	(0.217)	(0.354)	(0.223)	(0.221)
Observations	18,402	1371	1927	2066	1851	1630

	Italy	France	Denmark	Greece	Switzerland	Belgium
Direct stockholding	0.056	0.163	0.341	0.063	0.270	0.190
	(0.231)	(0.370)	(0.474)	(0.243)	(0.444)	(0.392)
Total stockholding	0.140	0.434	0.568	0.109	0.359	0.395
	(0.347)	(0.496)	(0.496)	(0.312)	(0.480)	(0.489)
Risky investment	0.070	0.222	0.250	0.045	0.158	0.190
	(0.209)	(0.323)	(0.324)	(0.158)	(0.286)	(0.309)
Observations	1703	1880	1117	1818	649	2390

The variables are taken at their household mean value. Standard errors in parentheses.

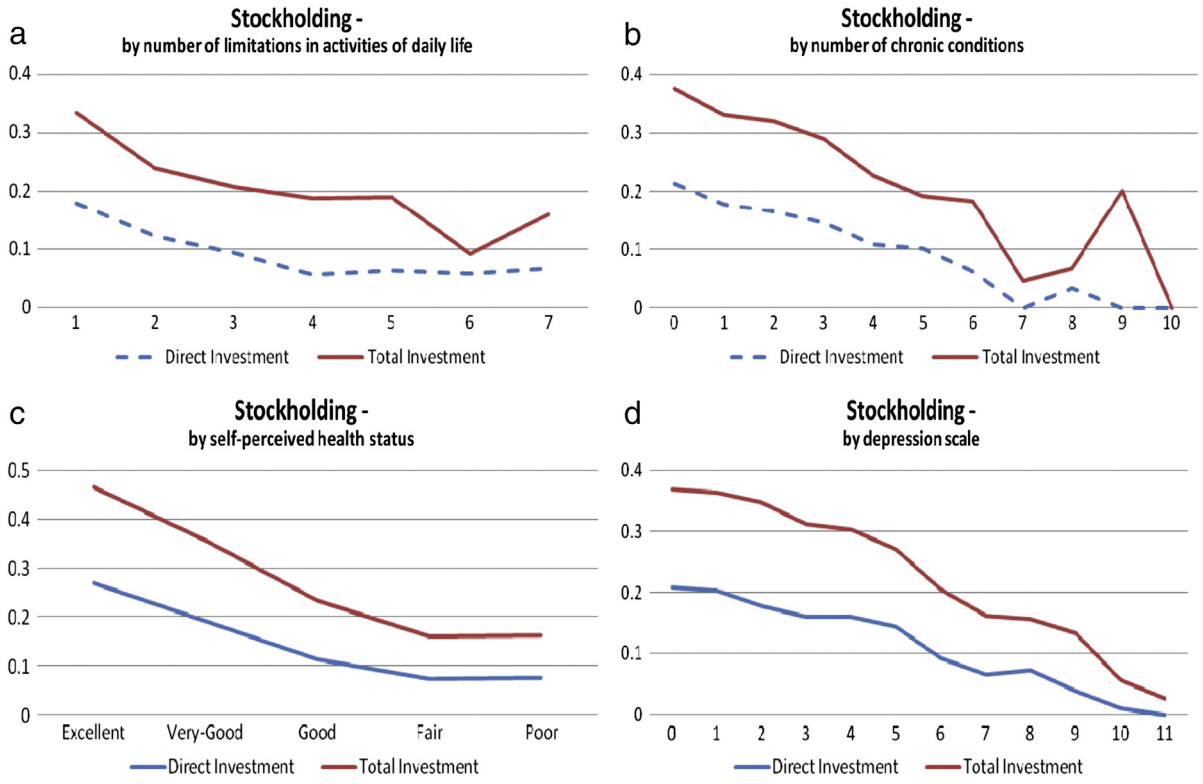

Fig. 2. Direct and total stock market participation by health status.

10. Disentangling health risk transmission

In this section we try to disentangle the different channels through which health risk may have an effect on investment decisions, thus we wish to provide information on the reasons which bring people in bad health to disaffect from the equity market and to decrease the level of financial risk undertaken. A deeper understanding of the channels of health risk transmission is important because it might involve relevant policy implications. Indeed, it would help to introduce incentives specifically designed to increase the stock market participation. As mentioned in

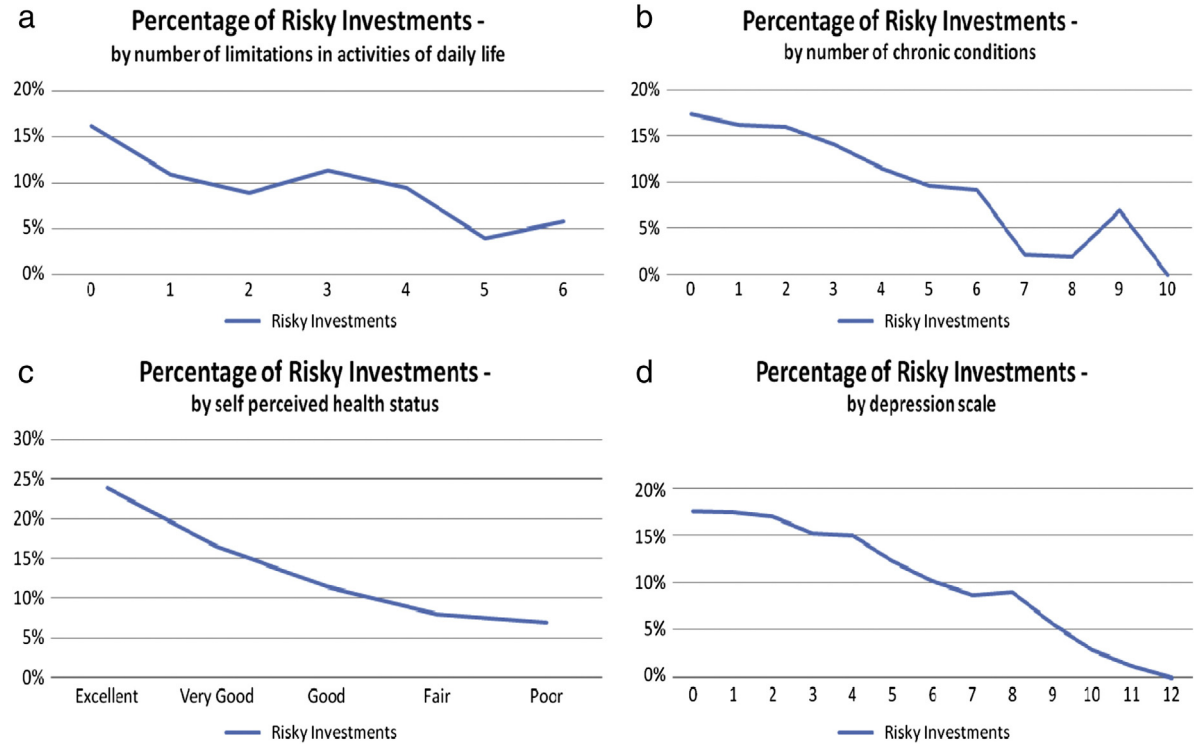

Fig. 3. Percentage of risky investment by health status.

Table 4
Probit regressions for direct stockholding — alternative proxies for health status.

Direct stockholding	(1) dy/dx	(2) dy/dx	(3) dy/dx	(4) dy/dx
Number of limitations in activities of daily life (ADL)	−0.004			
	(0.005)			
Number of chronic diseases (*chronic*)		−0.005**		
		(0.002)		
Self-reported health (SPHEU)			−0.013***	
			(0.004)	
Depression (EUROD)				−0.002
				(0.001)
Age	0.003	0.003	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)
Age squared	−0.000	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of household components	0.022***	0.022***	0.023***	0.021***
	(0.005)	(0.005)	(0.005)	(0.005)
Education level	0.022***	0.022***	0.021***	0.022***
	(0.002)	(0.002)	(0.002)	(0.002)
Numeracy	0.022***	0.022***	0.021***	0.022***
	(0.003)	(0.003)	(0.003)	(0.003)
Fluency	0.001**	0.001**	0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Recall	0.006***	0.006***	0.005***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)
Employed	0.001	0.000	−0.001	0.000
	(0.008)	(0.008)	(0.008)	(0.008)
Social activities	0.027***	0.027***	0.025***	0.026***
	(0.006)	(0.006)	(0.006)	(0.006)
Probability of leaving an inheritance greater than 50,000 euro	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Household income (in 100,000 euro)	0.004**	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Real assets (in 100,000 euro)	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Household financial assets (in 100,000 euro)	0.028***	0.027***	0.027***	0.027***
	(0.004)	(0.004)	(0.003)	(0.004)
R^2	0.222	0.222	0.223	0.222
Observations	18,402	18,402	18,402	18,402

Estimation is performed at household level and the variables are taken at their household mean value.
Each regression includes a complete set of country dummies.
We report the marginal effects. Standard errors are in parentheses.
Significance: *10%, **5%, ***1% confidence levels.

Section 2, previous contributions identify three main channels: precautionary saving motive, direct effect on the marginal utility of consumption (pure risk aversion), and the perception of life span. Let us start from the latter. Bad health is perceived as a factor that shortens the individual time horizon, with the consequence of setting up safer portfolios. Moreover, investors' age can affect directly portfolio allocations, independently on its effect on health, as Ameriks and Zeldes (2004) point out in their exhaustive survey. They find that the direction of the effect is far from simple, since it depends on the choice of the utility function, the correlation of income and rate of return shocks, transaction costs, the behavior of risk aversion over the lifetime, and taxes.

In our specifications, we always check for age and age squared and the results show that these variables are almost never significant, suggesting that age per se has no explanatory power on portfolio choice. All our models have been augmented by an interaction term between the health proxies and a dummy variable denoting whether the age level is above or equal to 65 (see Table 8). Again, the proxy of self-perceived health status is always statistically significant at the 1% level, and the marginal effect for the stock market participation is even slightly lower in absolute value for people aged 65 +, evidence that would suggest the idea that our results would not be importantly driven by the older fraction of the population. Another way to test this channel of health risk transmission might be taking into account the individual life expectancy. SHARE questionnaire asks respondents about their life expectancy. In particular, they are requested to declare their expected probability of living for the next ten years. Taking the complement to 1, we get a proxy for the expectation of dying within the same time horizon. The interaction of such a variable with health would measure the effect on portfolio choice of bad health conditions accompanied by an increase in the expectation of not living for more than ten years. Table 9 shows that the direction of this effect is not clear and in none of the cases significant. Health still continues to have a negative impact on investments and this effect could not be strongly addressed to the reduction in the planning horizon.

As already noticed, another important factor that may affect the perception of the length of the life span is the expectation to leave a bequest. For this reason, in all specifications we control for the bequest motive measured by the probability of leaving an inheritance larger than 50,000 euro. The results show that when taking into account the bequest motive as well, the negative relationship between stockholding and the proxies of health status still holds. Overall, the results seem to suggest that the shortening of life span is not a channel of health risk transmission.

Another potential channel for health risk transmission is identified as the “precautionary saving motive”. According to this view, the threat of sustaining unexpected medical payments determines estrangement from risky securities, while holding safer portfolios should guarantee available resources for future health expenditures. To stress this idea, we use the information related to the purchase of private health insurance. If health insurance offers a buffer towards future health expenditures, then we would expect that the connection between

Table 5
Probit regressions for total stockholding — alternative proxies for health status.

Total stockholding	(1) dy/dx	(2) dy/dx	(3) dy/dx	(4) dy/dx
Number of limitations in activities of daily life (ADL)	−0.004			
	(0.009)			
Number of chronic diseases (*chronic*)		−0.006*		
		(0.004)		
Self-reported health (SPHEU)			−0.033***	
			(0.006)	
Depression (EUROD)				−0.004
				(0.002)
Age	0.013*	0.013**	0.013**	0.012*
	(0.006)	(0.006)	(0.006)	0.006
Age squared	−0.000**	−0.000***	−0.000**	−0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Number of household components	0.032***	0.031***	0.033***	0.031***
	(0.009)	(0.009)	(0.009)	(0.009)
Education level	0.036***	0.036***	0.035***	0.036***
	(0.004)	(0.004)	(0.004)	(0.004)
Numeracy	0.036***	0.035***	0.033***	0.035***
	(0.006)	(0.006)	(0.006)	(0.006)
Fluency	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Recall	0.007**	0.007**	0.006**	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)
Employed	0.010	0.009	0.003	0.009
	(0.013)	(0.013)	(0.013)	(0.013)
Social activities	0.078***	0.078***	0.073***	0.077***
	(0.012)	(0.012)	(0.012)	(0.012)
Probability of leaving an inheritance greater than 50,000 euro	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Household income (in 100,000 euro)	0.008	0.008	0.008	0.008
	(0.006)	(0.006)	(0.006)	(0.006)
Real assets (in 100,000 euro)	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Household financial assets	0.139***	0.139***	0.137***	0.139***
(ln 100,000 euro)	(0.009)	(0.008)	(0.008)	(0.009)
R^2	0.298	0.298	0.300	0.298
Observations	18,402	18,402	18,402	18,402

Same as in Table 6.

portfolio choice and health is influenced by health insurance coverage. We test this hypothesis in the same way as Rosen and Wu (2004), and include in all our models a dummy variable denoting whether the individual owns any private health insurance or not. Results are reported in Table 10. Our outcome is similar to Rosen and Wu (2004) in two aspects: the results show i) the positive and significant marginal effect of health insurance on portfolio choice, and ii) the negative effect of health is still persisting despite we check for health insurance ownership. In order to test this issue in a more extensive way, we add in Table 11 interaction terms between the health status and private health insurance coverage. Each interaction term should capture the impact of health on the dependent variable as the respondent holds a private health insurance. Adding the interaction terms, the health insurance dummy is no more significant, whereas we observe a positive and statistically relevant coefficient as we interact the health insurance dummy with SPHEU. People who are reporting worsening health conditions are nonetheless incentivized to invest into equities, as long as they are holding a private health insurance. Although, the estimated total effect from self-perceived health remains negative on portfolio choice. Interesting results are not found for the other interactions.

If we previously focused on private health insurance coverage, we retain that, we should also consider that public health insurance could have an impact on our results. The presence of a national health system may weaken the precautionary saving intention of investors, as they could rely on public health coverage in order to face health shocks, and ultimately could employ resources for other purposes, affording to take more financial risk. Atella et al. (2012) sustain that health risk affects portfolio choices only in countries with less protective healthcare systems. We run our specifications splitting the sample in a way similar to that used in Atella et al. (2012), distinguishing between countries with a national health system with full coverage (NHS), namely Denmark, Italy, Spain and Sweden, from those countries with a national health system with partial coverage (non-NHS), namely Austria, Belgium, France, Germany, Greece, The Netherlands and Switzerland. In general, NHS countries grant full coverage for a comprehensive package of medical expenditures to face negative health events, while in non-NHS countries the public health system is not fully protective and several forms of private health insurance cover medical expenditures.

From Table 12 we deduce that SPHEU still continues to be significantly negatively estimated across both NHS countries and non-NHS countries. We also control for the ownership of private health insurance and its interactions with the four proxies of health status. This table shows that, in countries with partial coverage, the effect of SPHEU on stockholding and share of risky investment is negative and significant, and the magnitude of this effect is almost double with respect to countries characterized by a NHS with full coverage. In non-NHS countries the marginal effect from the interaction between SPHEU and the private health insurance dummy is always positive and significant, although the total effect from SPHEU on the total stockholding and the share of risky investment persists to be negative.

We note that, grouping the countries by national health system like in Atella et al. (2012) might not be properly recommendable. However, we wanted to provide results which more seriously consider country

Table 6
Tobit regressions for risky investment — alternative proxies for health status.

Risky Investment	(1)	(2)	(3)	(4)
Number of limitations in activities of daily life (ADL)	−0.013			
	(0.017)			
Number of chronic diseases (*chronic*)		−0.011		
		(0.007)		
Self-reported health (SPHEU)			−0.064***	
			(0.012)	
Depression (EUROD)				−0.013***
				(0.004)
Age	0.013	0.015	0.014	0.013
	(0.011)	(0.011)	(0.011)	(0.011)
Age squared	−0.000*	0.000*	−0.000*	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of household components	0.054***	0.053***	0.057***	0.050***
	(0.016)	(0.016)	(0.016)	(0.016)
Education level	0.076***	0.076***	0.073***	0.075***
	(0.007)	(0.007)	(0.007)	(0.007)
Numeracy	0.068***	0.067***	0.063***	0.065***
	(0.010)	(0.010)	(0.010)	(0.010)
Fluency	0.006***	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Recall	0.012**	0.012**	0.011**	0.012**
	(0.005)	(0.005)	(0.005)	(0.005)
Employed	0.018	0.016	0.006	0.015
	(0.024)	(0.024)	(0.024)	(0.024)
Social activities	0.127***	0.127***	0.119***	0.124***
	(0.019)	(0.019)	(0.019)	(0.019)
Probability of leaving an inheritance greater than 50,000 euro	0.003***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Household income (in 100,000 euro)	0.009**	0.008**	0.008**	0.008**
	(0.006)	(0.004)	(0.004)	(0.005)
Real assets (in 100,000 euro)	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Household financial assets (in 100,000 euro)	0.063***	0.063***	0.062***	0.063***
	(0.013)	(0.013)	(0.013)	(0.013)
Pseudo R^2	0.211	0.211	0.213	0.211
Observations	18,402	18,402	18,402	18,413

Same as in Table 6.

specific features. The fields we are studying in our paper might be indeed highly affected by country characteristics, not only in terms of healthcare organization, but also concerning the financial system and the development of personal finance opportunities.

Finally, in order to further explore the "precautionary saving motive" as a potential channel of health risk transmission, we consider the payment at the household level of out-of-pocket (OOP) medical expenditures, as done in Rosen and Wu (2004). OOP include non-refunded expenses for inpatient care, outpatient care, prescribed drugs and nursing homes sustained in the previous 12 months, with monetary values expressed in euros and adjusted by the purchasing power parity. Augmenting the basic models with OOP medical expenditures does not alter the main result, since the health effect is in most of the cases negative, and self-reported health has larger negative explanatory power, while the variable for OOP expenses is never significant, revealing that OOP medical expenditures do not strongly influence portfolio choice (see Table 13).

11. Risk aversion and health conditions

On the basis of the analysis presented so far, while we can exclude the hypothesis of the shortening of the life time horizon, it is quite difficult to disentangle the other two potential channels of health risk transmission, namely the precautionary saving motive and the direct effect on the marginal utility of consumption (pure risk aversion). Both channels of risk transmission are likely to affect jointly portfolio choices. As a final test of our analysis, we explore whether the health condition of our respondents affects their risk perception. We refer to one question contained in SHARE which should convey information on the attitude of respondents towards financial risk.[2]

We construct a dichotomous variable assuming value one if the respondent has a high risk aversion, while zero if the respondent has a low risk aversion. In Table 14 the dependent variable is the risk aversion dummy, while the explanatory set is the same as in the baseline regressions.

The marginal effect from the health proxies is positive (except for ADL), but very low, and only EUROD is statistically significant. Bad health conditions might modify risk preferences towards a lower willingness to take financial risk, although our data would not significantly support this statement. The current health status is not a primary driver in determining the level of risk undertaken during investments. From the set of controls, we see how better education, more social activities and good numeracy ability might render investors more inclined to assume financial risk. Finally, we also check whether the attitude towards risk is affecting the asset allocation. In Table 15 we see the impact from the proxy for risk aversion on the portfolio choice. As expected, risk averse individuals are less willing to invest in equity or other "riskier" investments, and among the health proxies, is again SPHEU the only variable with statistical relevance.

[2] We consider one question, included in SHARE wave 2. It asks respondents "Which of the following statements comes closest to the amount of financial risk that you are willing to take when you save or make investments? 1. Take substantial financial risks expecting to earn substantial returns; 2. Take above average financial risks expecting to earn above average returns; 3. Take average financial risks expecting to earn average returns; 4. Not willing to take any financial risks". We have generated a dummy variable for risk aversion equal to one if the respondent is not willing to take any financial risks.

Table 7
Regressions for stockholding (direct and total) and risky investment.

	Direct stockholding	Total stockholding	Risky investment
Variables	All health variables	All health variables	All health variables
Number of limitations in activities of daily life (ADL)	0.002	0.007	0.012
	(0.005)	(0.009)	(0.017)
Number of chronic diseases (*chronic*)	−0.002	0.002	0.008
	(0.003)	(0.004)	(0.008)
Self-reported health (SPHEU)	−0.011**	−0.036***	−0.066***
	(0.004)	(0.008)	(0.014)
Depression (EUROD)	−0.001	0.000	−0.006
	(0.002)	(0.003)	(0.005)
Age	0.003	0.013**	0.014
	(0.004)	(0.006)	(0.011)
Age squared	−0.000	−0.000***	0.000*
	(0.000)	(0.000)	(0.000)
Number of household components	0.022***	0.033***	0.055***
	(0.005)	(0.009)	(0.016)
Education level	0.021***	0.035***	0.073***
	(0.002)	(0.004)	(0.007)
Numeracy	0.021***	0.033***	0.063***
	(0.003)	(0.006)	(0.010)
Fluency	0.001**	0.003***	0.006***
	(0.000)	(0.001)	(0.001)
Recall	0.005***	0.006**	0.011**
	(0.002)	(0.003)	(0.005)
Employed	−0.002	0.004	0.006
	(0.008)	(0.013)	(0.024)
Social activities	0.025***	0.074***	0.118***
	(0.006)	(0.012)	(0.019)
Probability of leaving an inheritance greater than 50,000 euro	0.001***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)
Household income	0.004**	0.008	0.008**
(in 100,000 euro)	(0.002)	(0.006)	(0.004)
Real assets	0.001***	0.002***	0.003***
(in 100,000 euro)	(0.000)	(0.000)	(0.001)
Household financial assets (in 100,000 euro)	0.027***	0.137***	0.062***
	(0.003)	(0.008)	(0.013)
R^2	0.223	0.300	0.213
Observations	18,402	18,402	18,402

Same as in Table 6.

12. Conclusion and discussion

Using data from the Survey of Health, Aging and Retirement in Europe, we investigated the relationship between health conditions and portfolio choice for a large sample of people aged 50 and more. We inspected various profiles of human health using several proxies for the health condition: self-perceived health, objective health measured with the number of chronic conditions, and mental health proxied by the number of symptoms of depression. We find only a negative statistically relationship between self-perceived health and portfolio choices, suggesting that, the effect of poor health consists on making safer investment decisions. The results for other three measures of health are not statistically significant suggesting that they are not important for explaining investment decisions.

In general, our results are consistent with the theoretical underpinnings of background risk according to which a poor self-perceived health status, rather than the objective health condition, entails a higher risk of out-of-pocket medical expenditures, a higher risk of mortality, and yields households to reduce their exposure to financial risk. As Idler and Benyamini (1997) pointed out, self-perceived health is an independent predictor of mortality in nearly all of the studies examined, despite the inclusion of numerous specific health status indicators and other relevant covariates known to predict mortality.

There are several potential reasons why the three other measures of health status are not equally and significantly correlated with portfolio choices. Firstly, each of the three alternative measures reflect only one dimension of overall health status while the self-perceived health status collects all these information and provides an overall evaluation of health. Self-perceived health captures the full array of illness a person has, and possibly even symptoms of disease. Secondly, self-perceived health represents complex human judgments about the severity of current illness. With the exception of Atella et al. (2012), most of the studies considering measures of objective health did not weight the illness in any way. However, it is clear that the severity of illness varies over time and between individuals. This differential weighting might be better captured by perceived health rather than dichotomous diagnostic categories. Thirdly, measures of objective health do not capture the effect of comorbidity. Indeed, there may be complex interactions between conditions that are not captured by an additive measure of chronic diseases and that could be better captured by a comprehensive measure of health, i.e. the self-perceived health. Finally, as Idler and Kasl (1991) suggest, self-assessment of health reflects a personal estimate of longevity that may be based not only on knowledge of the respondent's own current health but also on the knowledge of familiar risk factors: "A family's vulnerability to specific diseases and pattern of longevity represents a social source of knowledge that grows as people age and experience the death of first grandparents and then parents" (Idler & Kasl, 1991, page 28).

Our results are also consistent with most of the findings from previous contributions of the literature. Feinstein and Lin (2006), Edwards (2008), Love and Smith (2010), Cardak and Wilkins (2009) and Yogo (2012) use only self-reported health as a measure of health status and they find that a poor perceived health is negatively associated with stock market participation and with the share of risky investments in the portfolio. Atella et al. (2012) consider several measures of health: perceived health status, a measure of objective health, weighted according to the disease's degree of severity, and a generated measure to proxy future health risk (defined as a function of risky behavior, asymptomatic

Table 8
The effect of subjective health on stockholding (direct and total) and risky investment, including an interaction between health and age.

Variables	Direct stockholding	Total stockholding	Risky investment
Number of limitations in activities of daily life (ADL)	0.0047	0.009	0.017
	(0.008)	(0.016)	(0.032)
Number of chronic diseases (*chronic*)	−0.002	0.005	0.008
	(0.004)	(0.007)	(0.012)
Self-reported health (SPHEU)	−0.011**	−0.033***	−0.051***
	(0.006)	(0.010)	(0.018)
Depression (EUROD)	0.000	0.001	−0.003
	(0.002)	(0.003)	(0.006)
Aged 65 +	−.0109	0.003	0.060
	(0.019)	(0.034)	(0.060)
ADL * Aged 65 +	−0.005	−0.004	−0.006
	(0.011)	(0.019)	(0.039)
Chronic * Aged 65 +	0.000	−0.003	0.002
	(0.005)	(0.009)	(0.016)
SPHEU * Aged 65 +	0.002	−0.007	−0.035
	(0.008)	(0.014)	(0.026)
EUROD * Aged 65 +	−0.002	−0.002	−0.007
	(0.003)	(0.005)	(0.009)
R^2	0.223	0.300	0.214
Observations	18,402	18,402	18,402

The regressions include the same set of control variables of Table 6, a dummy variable for being aged equal or more than 65 and the interaction terms between the health variables and the dummy variable for age 65 +.

Table 9
Regressions for stockholding and risky investment — interaction term between health and expected probability of dying in the next ten years.

Variables	Direct stockholding	Total stockholding	Risky investment
Number of limitations in activities of daily life (ADL)	−0.002	0.006	−0.013
	(0.011)	(0.017)	(0.032)
Number of chronic diseases (*chronic*)	−0.006	−0.004	−0.005
	(0.005)	(0.008)	(0.014)
Self-reported health (SPHEU)	−0.009	−0.027**	−0.036
	(0.008)	(0.014)	(0.025)
Depression (EUROD)	0.002	0.005	0.004
	(0.003)	(0.005)	(0.008)
Pr. of dying within 10 years	0.000	0.001	0.002**
	(0.000)	(0.001)	(0.001)
ADL * pr. of dying within 10 years	0.000	0.000	0.000
	(0.000)	(0.000)	(0.001)
Chronic * pr. of dying within 10 years	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
SPHE * pr. of dying within 10 years	−0.000	−0.000	−0.001**
	(0.000)	(0.000)	(0.000)
EUROD * pr. of dying within 10 years	−0.000	−0.000	−0.000
	(0.000)	(0.000)	(0.000)
R^2	0.221	0.299	0.216
Observations	17,593	17,593	17,593

Same as Table 10

Table 10
Regressions for stockholding and risky investment — ownership of private health insurance.

Variables	Direct stockholding	Total stockholding	Risky investment
Number of limitations in activities of daily life (ADL)	−0.002	−0.006	−0.017*
	(0.003)	(0.005)	(0.010)
Number of chronic diseases (*chronic*)	−0.006*	−0.010**	−0.017**
	(0.003)	(0.005)	(0.009)
Self-reported health (SPHEU)	−0.006**	−0.025***	−0.053***
	(0.003)	(0.005)	(0.009)
Depression (EUROD)	−0.002	−0.002	−0.015*
	(0.003)	(0.005)	(0.009)
Health insured	0.038***	0.077***	0.156***
	(0.008)	(0.013)	(0.022)
R^2	0.225	0.306	0.220
Observations	19,436	19,436	19,436

Same as Table 10

Table 11
Regressions for stockholding and risky investment — interaction terms between health status and health insurance.

Variables	Direct stockholding	Total stockholding	Risky investment
Number of limitations in activities of daily life (ADL)	−0.001	0.003	−0.001
	(0.006)	(0.010)	(0.020)
Number of chronic diseases (*chronic*)	0.002	0.006	0.015
	(0.003)	(0.005)	(0.009)
Self-reported health (SPHEU)	−0.015***	−0.045***	−0.088***
	(0.005)	(0.008)	(0.015)
Depression (EUROD)	0.001	−0.001	−0.006
	(0.002)	(0.003)	(0.006)
Health insured	0.016	0.022	0.053
	(0.016)	(0.027)	(0.046)
ADL * health insured	0.009	0.010	0.023
	(0.010)	(0.016)	(0.029)
chronic * health insured	−0.008*	−0.011	−0.014
	(0.004)	(0.007)	(0.013)
SPHEU * health insured	0.017**	0.029**	0.056**
	(0.007)	(0.012)	(0.023)
EUROD * health insured	−0.004	0.001	−0.002
	(0.003)	(0.005)	(0.008)
R^2	0.225	0.306	0.221
Observations	19,436	19,436	19,436

The regressions include the same set of control variables of Table 6, a dummy variable denoting health insurance coverage and the interaction terms between the health variables and the dummy variable for health insurance coverage.
For direct stockholding and total stockholding we report the marginal effects estimated by a Probit model. For risky investment we report the coefficients estimated by a Tobit model.
Significance: *10%, **5%, ***1% confidence levels.

objective health and grip strength). They discover that the household's decision to hold risky assets is driven primarily by the perceived health status rather than by the objective health condition. Poterba, Venti, and Wise (2011) consider a simple measure of health status based on the first principal component of Health and Retirement Survey responses on self-reported health status, diagnoses, activities of daily living, instrumental activities of daily living, and other indicators of underlying health. They find that persons in the top third of the health distribution accumulate at least 50% more assets than persons in the bottom third of the health distribution. However, their health measure is rather comprehensive and we cannot make a direct comparison of these results with ours.

To the best of our knowledge, only Rosen and Wu (2004) and Coile and Milligan (2009) provide results slightly in contrast with our findings. The first paper associates the health condition to specific medical diagnoses and to an index of the individual's ability to conduct activities of daily living, besides the self-perceived health. They show that all these measures of health are associated with a smaller share of financial wealth held in risky assets in favor of a larger share held in safe assets. The second paper does not use self-perceived health as a

Table 12
Regressions for stockholding and risky investment — by public health system.

	Direct stockholding		Total stockholding		Risky investment	
Variables	NHS countries	Non-NHS countries	NHS countries	Non-NHS countries	NHS countries	Non-NHS countries
Number of limitations in activities of daily life (ADL)	0.002	−0.002	0.007	0.003	0.014	−0.002
	(0.006)	(0.009)	(0.010)	(0.017)	(0.025)	(0.031)
Number of chronic diseases (*chronic*)	0.003	0.001	0.005	0.012	0.025*	0.012
	(0.003)	(0.005)	(0.005)	(0.008)	(0.014)	(0.012)
Self-reported health (SPHEU)	−0.012**	−0.020**	−0.030***	−0.061***	−0.089***	−0.092***
	(0.005)	(0.009)	(0.008)	(0.015)	(0.022)	(0.022)
Depression (EUROD)	−0.002	0.004	−0.004	0.004	−0.015*	−0.000
	(0.002)	(0.003)	(0.003)	(0.006)	(0.008)	(0.008)
Health insured	−0.010	0.009	0.133**	−0.014	0.121	0.027
	(0.021)	(.023)	(0.066)	(0.038)	(0.096)	(0.057)
ADL * health insured	−0.013	0.013	−0.032	0.010	−0.064	0.023
	(0.018)	(0.013)	(0.032)	(0.022)	(0.078)	(0.038)
Chronic * health insured	0.002	−0.009	−0.006	−0.018*	−0.012	−0.016
	(0.007)	(0.006)	(0.016)	(0.010)	(0.039)	(0.016)
SPHEU * health insured	0.013	0.025**	−0.004	0.047**	0.044	0.057**
	(0.012)	(0.011)	(0.023)	(0.018)	(0.048)	(0.028)
EUROD * health insured	0.002	−0.008*	−0.001	−0.002	0.003	−0.005
	(0.005)	(0.004)	(0.009)	(0.007)	(0.023)	(0.010)
R^2	0.235	0.236	0.340	0.279	0.247	0.210
Observations	6955	12,481	6955	12,481	6955	12,481

The regressions include the same set of control variables of Table 6, a dummy variable denoting health insurance coverage and the interaction terms between the health variables and the dummy variable for health insurance coverage.
For direct stockholding and total stockholding we report the marginal effects estimated by a Probit model. For risky investment we report the coefficients estimated by a Tobit model.
Significance: *10%, **5%, ***1% confidence levels.
NHS countries and Non-NHS countries are classified as in Atella et al. (2012).

Table 13
The effect of health on stockholding and on risky investment, including out-of-pocket medical expenses.

Variables	Direct stockholding		Total stockholding		Risky investment	
	(a)	(b)	(a)	(b)	(a)	(b)
Number of limitations in activities of daily life (ADL)	0.001	0.002	0.006	0.005	0.010	0.008
	(0.005)	(0.006)	(0.009)	(0.010)	(0.017)	(0.019)
Number of chronic diseases (*chronic*)	−0.003	−0.001	0.002	0.006	0.008	0.014
	(0.003)	(0.003)	(0.004)	(0.005)	(0.008)	(0.008)
Self-reported health (SPHEU)	−0.011**	−0.011**	−0.036***	−0.037***	−0.067***	−0.067***
	(0.004)	(0.005)	(0.008)	(0.008)	(0.014)	(0.014)
Depression (EUROD)	−0.001	−0.001	0.000	0.000	−0.007	−0.007
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.005)
OOP medical expenses	0.000*	0.001	0.001	0.002	0.001	0.004
(in 100 euro)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)	(0.003)
ADL * OOP medical expenses		0.000		0.000		0.000
		(0.000)		(0.000)		(0.001)
Chronic * OOP medical expenses		−0.000		−0.001***		−0.002**
		(0.000)		(0.000)		(0.001)
SPHEU * OOP medical expenses		−0.000		0.000		−0.000
		(0.000)		(0.000)		(0.001)
EUROD * OOP medical expenses		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
R^2	0.223	0.224	0.300	0.301	0.213	0.214
Observations	18,402	18,402	18,402	18,402	18,402	18,402

The regressions include the same set of control variables of Table 6.
In addition, column (a) reports the estimated output including out-of-pocket medical expenditures (in 100 euro). Column (b) also includes the interaction terms between the health variables and out-of-pocket medical expenditures.

Table 14
Regression for risk aversion.

	Risk aversion (dummy variable)
Variables	dy/dx
Number of limitations in activities of daily life (ADL)	−0.004
	(0.009)
Number of chronic diseases (*chronic*)	0.006
	(0.004)
Self-reported health (SPHEU)	0.011
	(0.007)
Depression (EUROD)	0.006**
	(0.003)
Age	−0.011
	(0.007)
Age squared	−0.000*
	(0.000)
Number of household components	−0.030***
	(0.009)
Education level	−0.030***
	(0.004)
Numeracy	−0.021***
	(0.006)
Fluency	−0.002*
	(0.001)
Recall	−0.002
	(0.003)
Employed	−0.021
	(0.014)
Social activities	−0.049***
	(0.010)
Probability of leaving an inheritance greater than 50,000 euro	−0.001***
	(0.000)
Household income (in 100,000 euro)	0.000
	(0.000)
Real assets (in 100,000 euro)	−0.000**
	(0.000)
Household financial assets (in 100,000 euro)	−0.002***
	(0.000)
R^2	0.149
Observations	12,345

Estimation is performed on individuals classified as “financial respondents”.
Significance: *10%, **5%, ***1% confidence levels.

Table 15
Regressions for stockholding and risky investment, controlling for risk aversion.

Variables	Direct stockholding	Total stockholding	Risky investment
Number of limitations in activities of daily life (ADL)	0.000	0.006	0.020
	(0.006)	(0.012)	(0.025)
Number of chronic diseases (*chronic*)	0.000	0.001	0.006
	(0.003)	(0.005)	(0.009)
Self-reported health (SPHEU)	−0.010**	−0.027***	−0.050***
	(0.005)	(0.009)	(0.016)
Depression (EUROD)	−0.001	−0.001	−0.005
	(0.002)	(0.003)	(0.006)
Risk aversion (dummy variable)	−0.090***	−0.176***	−0.265***
	(0.011)	(0.018)	(0.025)
Age	−0.002	0.004	0.016
	(0.005)	(0.009)	(0.015)
Age squared	0.000	−0.000	0.000
	(0.000)	(0.000)	(0.000)
Number of household components	0.013**	0.014	−0.075***
	(0.007)	(0.012)	(0.021)
Education level	0.013***	0.027***	0.052***
	(0.003)	(0.005)	(0.008)
Numeracy	0.013***	0.022***	0.065***
	(0.004)	(0.007)	(0.012)
Fluency	0.001*	0.004***	0.006***
	(0.001)	(0.001)	(0.002)
Recall	0.007***	0.010***	0.009
	(0.002)	(0.004)	(0.006)
Employed	−0.003	0.025	0.061**
	(0.010)	(0.018)	(0.030)
Social activities	0.011	0.042***	0.072***
	(0.006)	(0.013)	(0.020)
Probability of leaving an inheritance greater than 50,000 euro	0.001***	0.001***	0.003***
	(0.000)	(0.000)	(0.000)
Household income (in 100,000 euro)	0.000**	0.001	0.001
	(0.000)	(0.000)	(0.000)
Real assets (in 100,000 euro)	0.000***	0.000*	0.000
	(0.000)	(0.000)	(0.000)
Household financial assets (in 100,000 euro)	0.003***	0.018***	0.005***
	(0.000)	(0.003)	(0.001)
R^2	0.244	0.328	0.255
Observations	12,345	12,345	12,345

Estimation is performed on individuals classified as "financial respondents".
Significance: *10%, **5%, ***1% confidence levels.

measure of health status and focuses only on the influence of health shocks on the household's ownership of various assets, as well as on the dollar value and the share of total assets held in each asset class. The results suggest that the effect of acute events such as heart attack or stroke, or the effect of a newly diagnosed chronic illness reduces the probability of stocks and bonds holdings, while raises the share of assets held in bank accounts.

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