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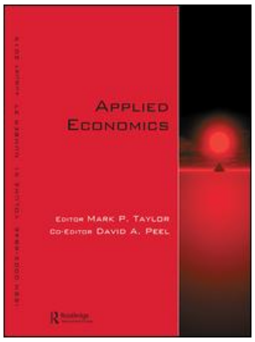

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Charter value, risk-taking and systemic risk in banking before and after the global financial crisis of 2007-2008

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ABSTRACT
We investigate how bank charter value affects risk for a sample of OECD banks by using standalone and systemic risk measures before, during, and after the global financial crisis of 2007–2008. Prior to the crisis, bank charter value is positively associated with risk-taking and systemic risk for very large 'too-big-too-fail' banks and large U.S. and European banks but such a relationship is inverted during and after the crisis. A deeper investigation shows that such a behaviour before the crisis is mostly relevant for very large banks and large banks with high growth strategies. Banks' business models also influence this relationship. We find that for banks following a focus strategy, higher charter value amplifies both standalone and systemic risk for large U.S. and European banks. Our findings have important policy implications and cast doubts on the relevance of the uniform more stringent capital requirements introduced by Basel III.

KEYWORDS
Systemic risk; standalone risk; charter value; global financial crisis; bank regulation

JEL CLASSIFICATIONS
G21; G28; G32

I. Introduction

This paper revisits the charter value hypothesis (CVH) in banking and the effectiveness of its risk-disciplining impact in the light of the major transformations of the banking industry before and after the global financial crisis of 2007–2008 (GFC). Worldwide, in the years preceding the GFC, banks experienced tremendous changes. Specifically, value enhancing mergers and acquisitions (M&A) arrangements led banks to grow in size, become larger and more powerful by increasing their market shares, and yet, riskier (Anginer, Demirguc-Kunt, and Zhu 2014; Martinez-Miera and Repullo 2010; De Jonghe and Vander Vennet 2008). Mechanically, banks gained competitive advantage and an increase in their charter value, backed by size, operational complexity and higher profit expectations driven by more aggressive risk-taking policies (Jones, Miller, and Yeager 2011; Furlong and Kwan 2006; Stiroh 2004).[1] Such operations had altered bank charter value but also the importance of large 'too-big-to-fail' (TBTF) banks and institutions which were later recognized as 'systemically important financial institutions' (SIFIs) or 'too-complex-to-unwind' banks.[2] These banks were at the heart of the GFC. They were deeply involved in complex activities and tended to accumulate less capital and less stable funds before the crisis while regulators, by focusing on microprudential regulation, did little to prevent the resulting build-up of systemic risk (Bostandzic and Weiss 2016; Laeven, Ratnovski, and Tong 2015; Brunnermeier, Dong, and Palia 2012).

It is widely recognized that charter value (or franchise value, proxied by Tobin's q) self-disciplines bank risk-taking, the so-called charter value hypothesis (CVH), and provides banks with a valuable source of monopoly power (Jones, Miller, and Yeager 2011; Ghosh 2009; González 2005; Gan 2004; Demsetz, Saidenberg, and Strahan 1996; Keeley 1990). Higher charter value is indeed expected to lower risk-taking incentives and increase capital because of the higher bankruptcy costs that banks could endure if they fail.

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[1]Jones, Miller, and Yeager (2011) emphasize three factors to explain the increase in charter value during the 1988–2008 period: a rise in banks' noninterest income, a run-up in the stock market, potentially 'irrational exuberance', and a strong economic growth.

[2]M&A operations have significantly reduced the degree of competition and have positively affected prices and margins. They were achieved for strategic reasons, such as improving market share, profitability, or efficiency (Jones, Miller, and Yeager 2011; De Jonghe and Vander Vennet 2008).

A decline in charter value will have the opposite effect as banks could be encouraged to take on more risk to benefit from the deposit insurance put option (e.g. Jones, Miller, and Yeager 2011; Keeley 1990). Nevertheless, banks have systematically looked for higher profitability, more returns and higher margins, by increasing their exposure to new market-based instruments and by extensively relying on short-term debt (Martynova, Lev, and Razvan 2014). This shift towards new financial instruments at a large scale and riskier business model is puzzling for banks with high charter value.

Meanwhile, systemic risk has considerably increased in the banking industry with a higher threat posed by very large banks, including those with high charter values which pursued riskier policies prior the GFC. Market imperfections and system vulnerability to contagion have also enhanced systemic risk (Hartmann 2009). Also, banks had benefited from implicit guarantees and deposit insurance, particularly for SIFIs, which allowed them to gain competitive advantages and to change their growth strategy and business model and therefore to take more risk (Jones, Miller, and Yeager (2011)). Another factor that has received less attention, before the GFC, is the increase in bank charter value. This leads us to adopt a different view on the disciplining role of charter value in such a risk-accumulating period (before the GFC).

The perception of bank risk has also changed, based not only on its individual dimension (idiosyncratic risk and individual default risk), but also more and more on the vulnerability of banks and their contribution to systemic risk. Hence, throughout this paper, we look at both risk dimensions and consider standalone alongside systemic risk measures. We go beyond the literature addressing the nexus between bank charter value and risk by considering systemic risk indicators (Anginer, Demirguc-Kunt, and Zhu 2014; Hovakimian, Kane, and Laeven 2015; Jones, Miller, and Yeager 2011; Soedarmono, Sitorus, and Tarazi 2015) along the traditional standalone proxies (Niu 2012; Jones, Miller, and Yeager 2011; González 2005).

Large banks, TBTF banks and SIFIs, have a natural tendency to grow further, change their business model and hence follow high-risk strategies presumably above the socially optimal levels (Acharya et al., 2012). Their failure propagates contagion across the system and could also trigger the default of other banks and degenerate into global financial distress.[3] Although there is no unique definition of systemic risk, wherein the entire financial system is distressed, it is commonly accepted that a bank's systemic risk exposure refers to the comovement of individual bank risk and sensitivity to an extreme shock (Haq and Heaney 2012; Weiss et al. 2014; Laeven, Ratnovski, and Tong 2015). Various measures have been proposed in the literature to capture bank systemic risk. Adrian and Brunnermeier (2016) have introduced a comovement measure (ΔCoVaR) of financial system value at risk (VaR) conditionally on banks' VaR; Acharya (2009) considers the sensitivity of bank equity losses to market crashes (MES); while, the tail-beta used among others by Campbell, Hilscher, and Szilagyi (2008) and Anginer, Demirguc-Kunt, and Zhu (2014) captures the sensitivity of systematic risk to extreme events (tail risk).

The inherent unstable nature of risk (pre- and post-GFC), suggests that the relationship between charter value and risk may possibly change depending on the opportunities and constraints that banks face in different environments. Typically, the acute GFC period (2007–2009) is a period of high volatility and a sharp decrease in the stock prices of most listed banks. To study to what extent charter value impacts risk-taking behaviour and stability in such circumstances, we build our analysis not only on standalone risk measures but also on systemic risk indicators which capture different risk dimensions and specifically, either the contribution of an individual bank's collapse to systemic risk or the exposure of a given institution to a major shortfall in the financial system as a whole. To deal with endogeneity, we use a two-step approach. In the first step, we estimate banks' charter value and in the second step, we regress banks' risk-taking and risk exposure on charter value.We contribute to the existing literature by

[3]Laeven and Levine (2007) argue that SIFIs engaged in multiple activities (charter-gain-enhancing) suffer from increased agency problems and poor corporate governance that could be reflected in systemic risk. Demirgüç-Kunt and Huizinga (2013) find that banks that rely to a larger extent on non-deposit funding and non-interest income are more profitable but also riskier.

addressing the following questions: Is the impact of charter value on bank risk-taking dependent on economic conditions (before, during and after crisis periods)? Does charter value differently affect standalone risk and systemic risk measures? If yes, are there differences across the pre, over and post crisis periods? Is the relationship between charter value, risk-taking and systemic exposure influenced by bank size or growth and diversification strategies?

Although there is a broad literature looking at the impact of charter value on bank individual risk (Niu 2012; Jones, Miller, and Yeager 2011; González 2005; Konishi and Yasuda 2004; Demsetz, Saidenberg, and Strahan 1996; Keeley 1990) there is no clear-cut consensus on the effect of bank charter value on banks' standalone risk and systemic risk in normal versus abnormal economic conditions (i.e. pre and post the GFC). Hence, this paper examines the stability of the relationship between charter value and risk to track possible changes before the crisis (2000–2006), during the crisis (2007–2009), and after (2010–2013). It also looks into possible differences for U.S. banks, European banks and the more conservative banks in the rest of OECD countries which rely on a more traditional banking model.[4] It also considers possibly different impacts of charter value on standalone and systemic bank risk measures. To the best of our knowledge, this is the first study that investigates the charter value hypothesis by considering both standalone and systemic risk measures of bank risk by further differentiating the exceptional risk-building period prior to the GFC from the acute crisis and post-crisis periods.

We use a sample, spanning from 2000 to 2013, of 853 banks established in OECD countries. The results show that prior to the GFC charter value positively impacts both standalone and systemic bank risk measures but such a relationship is inverted during and after the crisis. A deeper investigation shows that such a behaviour before the crisis is mostly relevant for very large banks and large banks with high growth strategies. Banks' business models also influence this relationship. In the presence of strong diversification strategies, charter value has no impact on both standalone and systemic risks. Conversely, for banks following a focus strategy, higher charter value amplifies the systemic risk for very large banks and both standalone and systemic risk for large U.S. and European banks.

The remainder of the paper is organized as follows. Section 2 presents the data and variables used in this paper. In Section 3, we present the empirical specifications. In Section 4, we present the results of the econometric investigation. Section 5 reports robustness checks and concludes.

II. Data and variables

Sample selection

The sample comprises publicly traded OECD banks for which stock price information and accounting data are available in both the Bloomberg and Thomson-Reuters databases.[5] To ensure that we use the most informative risk indicators, we delete banks with missing historical stock prices or infrequently traded stocks. We disregard stocks if daily returns are zero during at least 30% of the whole trading period. Hence, we only consider bank stocks that are very liquid, i.e. those that are most likely to reflect important extreme events in their movements. Subsequently, we retrieve accounting data and filter out bank-year observations by dropping the top and bottom 1% level to eliminate the adverse effects of outliers and misreported data. Due to the delisting of many banks, mainly due to mergers and acquisitions, we end up with an unbalanced panel dataset of 853 commercial, cooperatives and savings banks, from the 28 major advanced OECD economies, among which 22 are European[6] (Table 1). Our sample period runs from 3 January 2000 to 31 December 2013 (Table 2). The

[4]Banks in these three geographical areas have very different business models and operate in differently organized banking systems. U.S. and European banks are more market-oriented; whereas, Australian, Canadian and Japanese banks are more reliant on traditional intermediation activities. Haq et al. (2019) argue that Australian and Canadian banks appear to pursue safer policies, even before the GFC (1995–2006), hence preserving financial stability.

[5]Stock returns are computed in local currency terms. Annual income statement and balance sheet data are converted into U.S. dollars.

[6]From 988 banks, we end up with 853 banks due to our data cleaning process as well as the data availability that varies depending on the combination of variables used in regressions. Our sample consists of 22 European countries, three Americas countries (U.S., Canada and Mexico) and three Asian-Pacific countries (Japan, South Korea, Australia). Iceland and New Zealand were dropped because of insufficient liquid stocks (see Table 1).

Table 1. Sample composition.

Country	Banks	N	Country	Banks	N
Australia	6	83	Luxembourg	1	10
Austria	7	61	Mexico	3	32
Belgium	3	31	Netherlands	3	36
Canada	11	128	Norway	17	205
Czech	1	13	Poland	12	140
Denmark	40	458	Portugal	3	39
Finland	2	25	Slovakia	2	20
France	21	255	South Korea	7	57
Germany	18	201	Spain	15	159
Greece	12	128	Sweden	4	49
Hungary	1	13	Switzerland	24	261
Ireland	2	20	Turkey	16	159
Italy	25	292	United-Kingdom	13	128
Japan	84	1077	United-States	500	5411

Table shows the sample country composition. It presents the distribution of 853 listed banks in 28 OECD countries: Australia, Austria, Belgium, Britain, Canada, Czech, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey and United-States. Sample is dominated by U.S. banks with 506 banks; whereas, the number of European banks stands at 245 banks.

Table 2. Sample distribution by calendar year.

Year	Freq.	Percent
2000	608	6.41
2001	639	6.73
2002	674	7.1
2003	675	7.11
2004	695	7.32
2005	715	7.53
2006	754	7.94
2007	784	8.26
2008	768	8.09
2009	577	6.08
2010	735	7.74
2011	717	7.55
2012	691	7.28
2013	459	4.84

Table shows the sample distribution by calendar year. The sample spans 14 years, from 2000 to 2013. Bank-year observations vary between 459 and 735 observations.

sample is dominated by commercial banks and by U.S. banks. It consists of 500 U.S. banks and 353 non-U.S. banks (of which 245 are European and 84 are Japanese). Taken together, listed banks account for more than 55% of the total assets of the European banking industry and 77% in the U.S. For the other OECD countries, the coverage varies between 9% for Mexico to 31% for Japan.

Data on individual bank daily stock prices, stock market indexes, as well as generic government bond yields, implicit volatility indexes and three-month LIBOR and Overnight Indexed Swap (OIS) spreads were collected from Bloomberg. Annual income statement and balance sheet data are obtained from Thomson Reuters whereas the OECD Metadata statistics provide yearly macroeconomic data: inflation and gross domestic product growth rates.

In line with previous research, we define very large 'too-big-too-fail' banks institutions with total assets above $20 billion, large banks as those with total assets ranging from $1 billion to $20 billion and small banks as those with assets between $500 million and $1 billion (Köhler 2015; Laeven, Ratnovski, and Tong 2015; Barry, Lepetit, and Tarazi 2011; Lepetit et al. 2008). Because of their specific business models centred on traditional banking activities, we exclude banks with less than $500 million of total assets (Distinguin, Roulet, and Tarazi 2013).[7] Thus, our set of financial institutions is fairly homogeneous, with comparable bank types across all OECD countries.

Standalone risk variables

We consider four standalone risk indicators that are equity-based risk measures: total risk, bank-specific risk, systematic risk and a market-based z-score. Total risk is computed as a moving standard deviation of bank stock daily returns. This is calculated each day for each bank using a moving window of 252 daily return observations. Similarly, we estimate the rest of the standalone risk measures with the following single index rolling market model.[8]

$$R_{i,t} = \alpha_i + \beta_{i,M} R_{M,t} + \varepsilon_{i,t}, \tag{1}$$

where $R_{i,t}$ is the daily (t) stock return of bank i, $R_{M,t}$ the daily return on the market index of the country where the bank is located and $\varepsilon_{i,t}$ is the residual term. With this, $\beta_{i,M}$, the equity market betas are used as a proxy of banks' systematic risk. From the residual term, we compute a measure of specific risk which we only use to check the robustness of our overall results. Bank specific risk is estimated as the standard deviation of the residuals generated from the single index rolling regressions of a bank's daily stock returns on the market index.

[7]Community banks are known for their focus on traditional banking activities, i.e. lending and deposit activities within a limited market area. Hence, we exclude community banks, i.e. those with total assets less than $500 million, ratio of total loans to total assets above 33%, and the ratio of total deposits to total assets above 50%.

[8]We use rolling regressions of a bank's daily stock returns on market returns, as a return generating process. We estimate risk measures for each bank using a moving window of 252 daily observations.

Furthermore, we use the market z-score, a metric for insolvency risk and default which is calculated as follows: MZ-Score = $\left(\overline{R_{i,t}}+1\right)/\sigma_{R_{i,t}}$, where $\overline{R_{i,t}}$ is the mean and $\sigma_{R_{i,t}}$ the standard deviation of the monthly returns for a given year. A higher value of MZ-Score indicates a lower probability of failure (Lepetit et al. 2008).

Systemic risk measures

Besides the above standalone risk measures, we also consider three systemic risk measures. First, we follow Acharya et al. (2012) and Brownlees and Engle (2012) and use the Marginal Expected Shortfall (MES) which corresponds to the marginal participation of bank i to the Expected Shortfall (ES) of the financial system.[9] Formally, it corresponds to the expected stock return for bank i, conditional on the market return when the latter performs poorly. Acharya et al. (2012) define the MES as the expectation of the bank's equity return per dollar in year t conditional on a market crash in that given period.

$$MES^{q}_{i,t} \equiv E\left(R_{i,t} | R_{M,t} \leq VaR^{q}_{R_{M,t}}\right) \quad (2)$$

where $R_{i,t}$ is the daily stock return for bank i, $R_{M,t}$ is the daily market return,[10] q-percent is a pre-specified extreme quantile enabling us to look at systemic events. $VaR^{q}_{R_{M,t}}$ stands for Value-at-Risk, which is a critical threshold value that measures the worst expected market loss over a specific time period at a given confidence level. Herewith, we follow the common practice and set q at 5%, the term $R_{M,t} \leq \mathrm{VaR}^{q}_{R_{M,t}}$ reflects the set of days when the market return is at or below the 5-percent tail outcomes in that given year. Thus, under the nonparametric assumption, the MES is the average of bank stock returns during market crash times, that correspond to the 5% worst days of the stock market index. It is expressed as:

$$MES^{q=5\%}_{i,t} = \frac{\sum^{R_{i,t}} \times I\left(R_{M,t} < VaR^{q}_{R_{M,t}}\right)}{\sum^{I}\left(R_{M,t} < VaR^{q}_{R_{M,t}}\right)} = \frac{1}{N}\sum_{R_{M,t} < VaR^{q}_{R_{M,t}}} R_{i,t}. \quad (3)$$

In Equation (3), I (.) is the indicator function defining the set of days where the market experienced 5% worst days (crash period) and N is the number of days where the aggregate equity return of the entire market (proxied by a market index) experienced its 5%worst outcomes (Weiss et al. 2014). The higher a bank's MES is (in absolute value), the higher is its contribution to aggregate systemic risk and so its probability to be undercapitalized in bad economic conditions.

Second, we use CoVaR introduced by Adrian and Brunnermeier (2016) as a similar concept as VaR. It corresponds to the VaR of the entire financial system (i.e. the market index with a return of R_M) conditional on an extreme event leading to the fall of a bank i's stock return R_i beyond its critical threshold level ($\mathrm{VaR}^{q}_{R_i}$). $CoVaR^{q}_{R_{M|i,t}}$ is the q-percent quantile of this conditional probability distribution and can be written as.[11]

$$Prob_{t-1}\left(R_{M,t} \leq CoVaR^{q}_{R_{M|i,t}} | \; R_{i,t} = VaR^{q}_{R_{i,t}}\right) = q \quad (4)$$

Explicitly, Adrian and Brunnermeier (2016) define bank ΔCoVaR as the difference between the VaR of the financial system conditional on the firm being in distress and the VaR of the system conditional on the bank being in its median state. It catches the externality a bank causes to the entire financial system. Therefore, bank ΔCoVaR is the difference between the $\mathrm{CoVaR}^{q=\mathrm{distressstate}}_{R_{M|i,t}}$ of the financial system when bank i is in financial distress, i.e. the bank stock return is at its bottom q-probability level, and the $\mathrm{CoVaR}^{q=\mathrm{median}}_{R_{M|i,t}}$ of the financial system when this bank i is on its median return level, i.e. the inflection point at which bank performance starts becoming at risk. Hence, $\mathrm{CoVaR}^{q}_{R_{M|i,t}}$ measures the systemic risk contribution of bank i when its return is in its q-percent quantile

[9]Economically, the term 'marginal' refers to the bank's capital shortfall stemming from each unit variation in the equity value $\mathrm{MES}^{q}_{i,t}$. The MES measures the increase in systemic risk induced by a marginal increase in the exposure of bank i to the system.
[10]To estimate risk measures, we either employ the financial sector index for the most developed financial market or the broad market index.
[11]As MES, CoVaR is a conditional VaR computed at time t given the information available at time t-1 based on the financial system Expected Shortfall.

(distress state). Here, we set q at 1%. Whereas, $\mathrm{CoVaR}^{q=50\%}_{\mathrm{R_{M|i,t}}}$ measures the systemic risk contribution of bank i when bank i's is in a normal state. The $\Delta\mathrm{CoVaR}^{q}_{\mathrm{R_{M|i,t}}}$ of the individual ban is defined as:

$$\Delta CoVaR^{q}_{R_{M|i,t}} = CoVaR^{q}_{R_{M|i,t}} - CoVaR^{median}_{R_{M|i,t}} \tag{5}$$

Therefore, the systemic risk contribution of an individual bank i at q = 1% can be written as:

$$\Delta CoVaR^{q=1\%}_{R_M|R_i=VaR^{1\%}_{R_{i,t}},t} = \hat{\lambda}^{1\%}_{R_{M|i,t}}\left(VaR^{1\%}_{R_{i,t}} - VaR^{50\%}_{R_{i,t}}\right) \tag{6}$$

$\Delta\mathrm{CoVaR}^{q}_{\mathrm{R_{M|i,t}}}$ is estimated given the bank i's unconditional VaRs, defined in Equation (7), and the conditional VaRs $\{\mathrm{CoVaR}^{q}_{\mathrm{R_{M|i,t}}}=\mathrm{VaR}^{q}_{\mathrm{R_{M,t}}}|\mathrm{VaR}^{q}_{\mathrm{R_{i,t}}}\}$, defined in Equation (8). For bank's unconditional VaRs we run separately 1% and 50% quantile regressions, using daily stock prices over the whole period (Adrian and Brunnermeier 2011). Specifically, we run the following quantile regressions over the sample period to obtain:

$$VaR^{q}_{R_i} = \hat{R}_{i,t} = \hat{\alpha}_i + \widehat{\gamma^{q}_i}R_{M,t-1} + \hat{\varepsilon}_{i,t} \tag{7}$$

$$CoVaR^{q=1\%}_{R_{M|i,t}} = \hat{R}_{M,t} = \hat{\alpha}_{R_{M|i}} + \hat{\lambda}^{1\%}_{R_{M|i,t}}VaR^{1\%}_{R_{i,t}} + \hat{\varepsilon}_{M|i,t} \tag{8}$$

Following regression model in Equation (7), we estimate $VaR^{1\%}_{R_i,t}$ and $VaR^{50\%}_{R_i,t}$. Then, within the q-percent quantile regressions, we predict the systemic risk conditional on bank i in distress ($\mathrm{CoVaR}^{q=1\%}_{\mathrm{R_{M|i,t}}}$ and in the median state ($\mathrm{CoVaR}^{q=50\%}_{\mathrm{R_{M|i,t}}}$, and estimate $\hat{\lambda}^{1\%}_{R_{M|i,t}}$, the slope coefficient of the 1% quantile regression (Equation (8)) (Mayordomo, Rodriguez-Moreno, and Peña 2014; Adrian and Brunnermeier, 2016).

The third measure of systemic risk is Tail-beta (quantile-beta), based on De Jonghe (2010) and Engle and Manganelli (2004). It is obtained using a quantile regression model at the q pre-specified quantile and captures bank's sensitivity to extreme movements. We use the model presented in Equation (8) and run a 1%quantile regression and tail betas of each bank i are estimated by regressing daily bank stock return $R_{i,t}$ on daily market return $R_{M,t}$. We predict tail-betas ($\beta_{i,\mathrm{M}}$) as the market index coefficients in the 1% quantile regression. Thus, the spillover coefficient ($\beta_{i,\mathrm{M}}$) measures the risk sensitivity of bank i at the 1% quantile. The larger is the spillover effect, the more vulnerable is bank i to a financial downturn.

Long-term performance: bank charter value

Bank charter (franchise) value is our main explanatory variable and based on existing literature, we use Tobin's q as the proxy. Charter value is a forward-looking measure equal to the net present value of the expected stream of rents, which characterizes a bank's profit-generating potential beyond its merchantable assets (Marcus 1984; Acharya 1996; Demsetz, Saidenberg, and Strahan 1996). This value reveals more information than bank size and offers loss absorbing capacities. It sums up intangible assets as goodwill, growth possibilities, economic rents, degree of market power, financial strength, etc. (Furlong and Kwan 2006; Jones, Miller, and Yeager 2011). It is often used for comparability among varying size banks and/or banks with different pricing power (in loan, deposit or other marketable securities) (Keeley 1990). Furthermore, it has a cyclical feature and is also dependant on banks' earnings expectations (Saunders and Wilson 2001). Hence, the advocates of the so-called CVH argue that when the charter is built up, banks (i.e. shareholders) seek to preserve it from adverse shocks; otherwise, it cannot be fully liquidated at the event of closure. Bankruptcy is costly when the charter value is high, with regards also to the additional cost of failure (Jones, Miller, and Yeager 2011; Hellmann, Murdock, and Stiglitz 2000; Demsetz, Saidenberg, and Strahan 1996).

For publicly traded banks, the extent of charter value is reflected in Tobin's q, which is calculated as the bank's future economic profits reflected in the market value of assets (i.e. debt and market value of equity) divided by the book value of total assets. We follow Soedarmono, Sitorus, and Tarazi (2015), Haq and Heaney (2012), Gropp and Vesala (2004) and Keeley (1990) and define it as:

$$q_{i,t} = \frac{MVE_{i,t} + BVL_{i,t}}{BVA_{i,t}} \tag{9}$$

where $MVE_{i,t}$, $BVL_{i,t}$ and $BVA_{i,t}$ represent, respectively: market value of equity, the book value of liabilities and book value of assets of bank i at time t. Market value of equity is the annual average of daily bank market capitalization at year t and the two accounting measures denote values at the end of year t. The numerator of Tobin's q is the market value of assets, i.e. $MVA_{i,t} \equiv MVE_{i,t} + BVL_{i,t}$. It refers partly to the higher run-up in stocks price with regards to other investments. Whereas, the denominator reflects the accounting value of assets.

Moreover, the literature highlights various factors that affect bank charter value. Furlong and Kwan (2006) and Demsetz, Saidenberg, and Strahan (1996) emphasize two main determinants: market regulation which leads to higher market power through M&A operations, and bank-related aspects other than market power as the expansion of off-balance sheet activities and non-interest income.[12] In a similar vein, González (2005), Allen and Gale (2004) and Hellmann, Murdock, and Stiglitz (2000) argue that bank charter value stems from financial liberalization, regulatory restrictions, deposit insurance and competition.[13] Again, Haq et al. (2016) argue that market discipline, bank capital, contingent liabilities, and non-interest income are factors that enhance bank charter value.

In fact, bank charter value may have multiple roles. According to the CVH, it gives banks self-disciplining incentives and restrains excessive risk-taking appetite. Nevertheless, Gropp and Vesala (2004) found the CVH to be only effective for small banks, with lower charter values and that such a result could reflect lower moral hazard with the introduction of explicit deposit insurance in Europe. However, for large banks which are presumably 'TBTF', charter value does not explain their risk-taking. Moreover, although many papers report a negative relationship between bank risk taking and bank charter value, consistent with the CVH (Park and Peristiani 2007; Konishi and Yasuda 2004; Anderson and Fraser 2000; Hellmann, Murdock, and Stiglitz 2000; Demsetz, Saidenberg, and Strahan 1996; Keeley 1990), others find a positive or a non-linear relationship, i.e. a 'U' shape relationship (Niu 2012; Haq and Heaney 2012; Jones, Miller, and Yeager 2011; Martinez-Miera and Repullo 2010; Saunders and Wilson 2001; De Nicolo 2001).

Control variables

We consider various control variables in our regressions that may affect banks' individual and systemic risk measures. Specifically, two main types of controls are considered: bank-specific controls and country-level determinants. For bank-specific controls, we follow the literature (e.g. Agusman et al. 2006; Laeven, Ratnovski, and Tong 2015; Anginer, Demirguc-Kunt, and Zhu 2014, Weiss et al. 2014) and account for bank size, the capital ratio, profitability, the bank's involvement in market-based activities, operational efficiency, and the bank's business model. Bank size is measured by the natural logarithm of total bank assets in U.S. dollars, the capital ratio is defined as total assets over equity and the return on assets as the ratio of net income to total assets). Ratio of net loans to total assets proxies asset mix and the cost-to-income ratio, which is measured by the importance of non-interest expense relatively to total operating revenue, proxies bank efficiency. As a proxy of bank complexity and diversification, we use the ratio of non-interest income to total income (Ghosh 2009; De Jonghe and Vander Vennet 2008).

Regarding country-level factors that capture cross-country variations,[14] we control for macroeconomic conditions, i.e. the gross domestic product growth rate and the annual inflation rate. We also introduce the overall capital stringency index to control for the extent to which regulatory requirements are strict and effective (Barth, Caprio, and Levine 2013). In the

[12]According to the CVH, regulation promotes bank franchise value through more entry restrictions and more market concentration enhancing profit opportunities. By contrast, deregulatory efforts that increase financial service competition may erode charter value and thereby increase risk-taking incentives (Anginer, Demirguc-Kunt, and Zhu 2014; Allen and Gale 2004; Hellmann, Murdock, and Stiglitz 2000).

[13]Anginer, Demirguc-Kunt, and Zhu (2014) and Allen and Gale (2004) argue that in highly competitive markets, banks earn lower rents, which also reduces their incentives for monitoring.

[14]Because we analyse a global sample of banks, the data we use might be subject to country specific reporting standards. Consequently, we control for this possible bias by estimating our baseline regressions using country-level controls.

extension of our analysis, we also consider macro-financial controls. We use interbank market rates to control for differences in interest rates and access to overnight cash markets across OECD countries (Haq et al. 2016; Furlong and Kwan 2006). We introduce the LIBOR-OIS spread (difference between London Interbank Offered Rate and Overnight Indexed Swap) as a proxy of the liquidity risk premium. Besides, we control for M&As by introducing a dummy variable that takes the value of 1 if total assets grow by more than 15% in one year and 0 otherwise (De Jonghe and Özde 2015). Finally, we introduce year dummies to capture year-specific effects.

Summary statistics

Descriptive statistics of our variables are presented in Table 3. The average (median) charter value is 1.06 (1.02), indicating that, on average, the market value of bank assets exceeds their book value by 5.60%. Dispersion in Charter value is relatively low with a standard deviation of 0.17. The remaining controls are comparable to what is observed in previous studies (De Jonghe, Diepstraten, and

Table 3. Descriptive statistics and variables definition.

Variable	N	Mean	Standard deviation	P25	Median	P75	Source	Definition
MES (%)	9491	1.550	1.720	0.243	1.202	2.449	Bloomberg	The Marginal Expected Shortfall (Equation (2)).
ΔCoVaR (%)	9491	1.422	1.671	0.343	1.231	2.368	Bloomberg	Delta conditional VaR (Equation (4)).
Tail-beta	9491	0.643	0.834	0.083	0.673	1.197	Bloomberg	Quantile beta (Subsection 2.3).
Specific Risk (%)	9491	2.072	1.086	1.380	1.784	2.424	Bloomberg	Market model (Equation (1)).
Systematic Risk	9491	0.530	0.516	0.075	0.386	0.959	Bloomberg	Market model (Equation (1)).
Total Risk (%)	9491	2.230	1.090	1.505	1.953	2.635	Bloomberg	Market model (Equation (1)).
MZ-score	9491	54.96	22.53	38.78	52.06	67.44	Bloomberg	Market-based Z-score.
Charter	9491	1.057	0.170	0.984	1.019	1.068	Bloomberg, and Thomsen-Reuters Advanced Analytic (TRAA)	Charter value proxied by Tobin's q (Equation (9)).
Size	9491	8.236	2.171	6.510	7.795	9.730	TRAA	Natural logarithm of bank total assets (in $billion).
CAPR	9487	0.096	0.062	0.062	0.086	0.111	Bloomberg, and TRAA	Capital ratio, total equity over total assets.
Diversification	9169	0.209	0.122	0.124	0.188	0.271	TRAA	Income diversification, noninterest income over total income.
Loans	8590	0.693	0.160	0.611	0.700	0.788	TRAA	Loans to total assets, net loans over total assets.
Efficiency	8516	0.464	0.150	0.359	0.446	0.558	TRAA	Cost income ratio, non-interest expense over total income.
ROA	9291	0.007	0.011	0.003	0.007	0.011	TRAA	Return on assets, ratio of net income to total assets.
d.(merger)	9491	0.361	0.480	0	0	1	SNL, and Bloomberg	Mergers and acquisitions dummy, takes value of 1, if bank had an M&A experience, the annul total assets variation exceeds 15%; 0, otherwise.
LiborOis	9491	27.11	26.26	14.22	19.14	29.25	Bloomberg	Liquidity premium, defined as the spread between 3-month London Inter-Bank Offered Rate (LIBOR) and Overnight Indexed Swaps rate (OIS). It reflects soundness of the banking system.
Growth strategy	5293	0.646	0.534	0.449	0.722	0.881	TRAA	Change in total assets between 2000 and 2006 divided by the average total assets over the pre-GFC period.
Activity-mix	5122	0.203	0.423	0.106	0.352	0.498	TRAA	Change in diversification ratio between 2000 and 2006 divided by the average diversification ratio over the pre-GFC period
InterbankRate	9361	2.527	2.121	0.430	2.106	4.060	Bloomberg	Short-term interbank lending interest rates, in each country.
GDP	9491	1.837	2.060	0.950	1.880	2.790	OECD stats Metadata, and IMF WEO	Gross domestic product growth, defined as annual real GDP growth rate.
Inflation	9491	2.279	2.357	1.500	2.300	3.200	OECD stats Metadata, and IMF WEO	Inflation, defined as annual inflation rate.
Cap_Stringency	9491	8.519	1.463	8	9	9	Barth, Caprio, and Levine (2013)	Capital Stringency index.
Market share	9491	0.017	0.054	0.0001	0.0003	0.003	Bankscope, and TRAA	Share of individual bank's total assets in domestic total assets of the country's banking system.
Tangibility	9212	0.011	0.005	0.010	0.010	0.010	TRAA	Tangible assets ratio, book value of tangible assets to total assets.

Table reports summary statistics for all variables: bank risks and explanatory variables, used in the regressions. Bank-level data consists of publicly traded OECD banks from 28 countries during the 2000–2013 period. The imbalanced sample explains why the number of observations are different. We report four basic summary statistics: number of observations, mean, standard deviation and median, for variables measured at time t. We document also data sources and definitions of variables. Detailed information on the construction of bank risk proxies are provided in section 3.

Schepens 2015; Laeven, Ratnovski, and Tong 2015; Black et al. 2016; Niu 2012; González 2005). With regard to risk measures, all the measures exhibit substantial variations over the 13 years covered by our study.[15] MES ranges between −1.13% and 9.63% with an average (standard deviation) of 1.55% (1.72). ΔCoVaR varies around a mean (standard deviation) of 1.42% (1.67). Regarding standalone risk measures the average (standard deviation) values are 2.07% (1.09), 0.53(0.52), 2.23% (1.09), and 54.96 (22.53) for a specific risk, systematic risk, total risk and MZ-score, respectively. All indicators of standalone and systemic risk exhibit substantial volatility as their standard deviations are high, indicating high bank risk-taking and high exposure to default risk.

We report the pair-wise correlation coefficients among the explanatory variables in Table 4. We perform (in unreported results) the variance inflation factor (VIF) test which confirms the absence of major multicollinearity problems for all independent variables in our regressions.[16]

III. Empirical specification

We consider a simultaneous equations model with unbalanced panel data. The specification of the second stage is represented by the following reduced form model:

$$Risk_{i,t} = \beta_1 \widehat{Charter}_{i,t} + \beta_2 X_{i,t-1} + \beta_3 C_{i,t} + \lambda_t + \mu_i + \varepsilon_{2i,t} \qquad (9)$$

where, $\mathrm{Risk}_{\mathrm{i,t}}$ is a set of risk measures, subscripts i denotes individual banks and t denotes each fiscal year. $\widehat{Charter}_{\mathrm{i,t}}$ represents the predicted value of bank charter value of the first stage regression.[17] $X_{\mathrm{i,t-1}}$ and $C_{\mathrm{i,t}}$ are, respectively, vectors of time-varying bank-level explanatory variables for each bank i lagged by one year, to mitigate potential endogeneity concerns, and time-varying country-specific variables to control for macroeconomic variations. The coefficient β_1 captures the effect of charter value on bank risk and the rest of the coefficients are those of the control variables. λ_{t} is a set of year dummies $\left(\sum_{t=2001}^{2013} year_t\right)$ included to further account for time trend varying effects through the business cycle and for possible structural changes in the banking industry. μ_{i} captures bank-specific effects, and standard errors are clustered at the individual bank level.

Our empirical setup may suffer from reverse causality. High-chartered banks might be systemically important and/or involved in high-risk activities, or vise versa. Moreover, bank charter value and risk-taking may be simultaneously targeted in theory (Martinez-Miera and Repullo 2010; Ghosh 2009; Boyd and De Nicoló. 2005; Gropp and Vesala 2004; Keeley 1990).[18] Some papers also argue that higher charter value may derive from high risky strategies (Laeven and Levine 2007; Konishi and Yasuda 2004; Saunders and Wilson 2001; Park 1997). We hence adopt an instrumental variable approach.

To tackle possible endogeneity issues regarding the effects of bank charter value on risk, we use the two-stage least squares (IV-TSLS) instrumental variables method with fixed effects. We hence control for simultaneity bias by applying a simultaneous equation modelling. Thus, we introduce bank charter value as an explanatory variable of bank risk in a two-stage analysis. In the first stage, we instrument and estimate charter value $\widehat{Charter}_{\mathrm{i,t}}$. Previous literature has identified different determinants of charter value (Furlong and Kwan 2006; Jones, Miller, and Yeager 2011). Hereafter, we use three continuous and exogenous variables to instrument charter value. First, as commonly used in the literature, we use the one year lagged value of charter value, assumed to be exogenous, to account for the simultaneity of charter value and risk in our risk models (e.g. De Jonghe and Vander Vennet 2008). Second, we follow González (2005) and include assets tangibility measured as the ratio of tangible assets to total

[15]The differences in the number of observations is due to missing accounting and market data for some banks.
[16]We compute the variance inflation factor (VIF) for each model estimates. The VIF statistics are always higher than 10, suggesting the absence of major multicolinearity issues.
[17]In earlier models, charter value is usually assumed to be exogenous (e.g. Keeley 1990; Gropp and Vesala 2004).
[18]Banks with higher default risk could have a higher market-to-book asset ratio if deposit insurance were underpriced and its value were capitalized on the market (but not on the book). Riskier banks could be over valuated, because risk-shifting increases the option value of equity (Keeley 1990).

Table 4. Correlation matrix.

	Charter	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Size (1)	−0.134***	1											
CAPR (2)	0.357***	−0.357***	1										
Diversification (3)	0.030**	0.397***	−0.017	1									
Loans (4)	0.253***	−0.160***	0.079***	−0.204***	1								
Efficiency (5)	0.043***	−0.017	−0.026*	0.401***	−0.081***	1							
ROA (6)	0.258***	−0.076***	0.417***	0.115***	−0.054***	−0.331***	1						
d.(merger) (7)	−0.101***	0.022*	0.022*	0.041***	−0.066***	−0.105***	0.159***	1					
LiborOis (8)	−0.065***	0.040***	0.005	−0.085***	0.045***	−0.052***	−0.163***	−0.0721***	1				
InterbankRate (9)	−0.053***	−0.081***	0.041***	−0.179***	−0.012	−0.516***	0.166***	0.175***	0.0798***	1			
GDP (10)	0.094***	−0.062***	0.036***	−0.018	−0.041***	−0.133***	0.241***	0.228***	−0.474***	0.221***	1		
Inflation (11)	0.100***	−0.110***	0.128***	−0.142***	0.011	−0.302***	0.163***	0.088***	0.089***	0.627***	0.304***	1	
Cap_Stringency (12)	0.071***	−0.201***	0.081***	−0.187***	0.039***	−0.001	0.075***	−0.054***	−0.077***	−0.057***	0.195***	0.127***	1
MES (13)	0.049***	0.448***	−0.0126	0.171***	−0.0956***	0.039***	−0.098***	−0.073***	0.259***	−0.068***	−0.206***	0.145***	−0.0322**
ΔCoVaR (14)	0.097***	0.323***	0.0461***	0.118***	−0.025*	0.066***	−0.030**	−0.083***	0.337***	−0.149***	−0.235***	0.084***	−0.044***
Systematic Risk (15)	0.111***	0.528***	−0.0330**	0.211***	−0.153***	−0.000	0.013	−0.063***	0.054***	−0.0182	0.0150	0.109***	0.007
Total Risk (16)	−0.021*	−0.094***	0.0346***	−0.032**	0.002	0.156***	−0.303***	−0.054***	0.265***	−0.140***	−0.302***	0.053***	−0.026*
MZ-score (17)	−0.0092	0.051***	−0.050***	0.0160	0.029**	−0.162***	0.192***	0.020*	−0.249***	0.137***	0.231***	−0.055***	0.044***
Tail-beta (18)	0.063***	0.300***	−0.0059	0.128***	−0.112***	−0.002	0.0186	−0.029**	−0.007	−0.014	0.0354***	0.060***	−0.004
Specific Risk (19)	−0.051***	−0.260***	0.0163	−0.102***	0.040***	0.144***	−0.313***	−0.026*	0.201***	−0.095***	−0.258***	−0.005	−0.042***
	MES (13)	(14)	(15)	(16)	(17)	(18)	(19)						
ΔCoVaR (14)	0.633***	1											
Systematic Risk (15)	0.795***	0.511***	1										
Total Risk (16)	0.406***	0.237***	0.173***	1									
MZ-score (17)	−0.431***	−0.297***	−0.269***	−0.840***	1								
Tail-beta (18)	0.490***	0.293***	0.600***	0.128***	−0.191***	1							
Specific Risk (19)	0.100***	0.017	−0.123***	0.909***	−0.730***	−0.039***	1						

Table presents the pairwise correlation matrix for bank-level characteristics and macroeconomics variables. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ denote statistical significance at the 10%, 5% and 1%, respectively. Definitions of all variables are listed in Table 3.

assets to account for possible differences due to the extent of tangible assets, differences in efficiency, branching policy, or country size. Third, we follow Laeven and Levine (2009) and Keeley (1990) and use market share defined as total assets of bank i over the aggregate assets of the banking system in a given country (all banks included, listed and non-listed) as a proxy of market power.[19] Subsequently, in the second stage, risk regressions incorporate the predicted values of charter value from the first stage with the rest of the explanatory variables.[20]

The consistency of the TSLS instrumental variables estimation depends on the relevance and the exogeneity of instruments. The relevance of the instrument set is assessed through the Kleibergen–Paap (KP) rank-LM (from the first stage) test for under-identification and the KP Wald rank F-statistic (Partial F-stat from the first stage) to test for weak identification (Kleibergen and Paap 2006; Cragg and Donald 1993).[21] Besides, to ensure the reliability of the subsequent empirical results at the second stage, we statistically test the joint validity and strength of the chosen instruments. Under heteroscedasticity and robust-clustering, we perform the Hansen j overidentifying restriction test (from each second stage estimation) to check the exogeneity of the instruments in the estimated models (Hansen 1982). Statistics from these respective tests are reported in the results' tables. Overall, the Hansen's j test confirms the validity of instruments.

IV. Results

Impact of charter value on bank risk taking and systemic stability

Before closely looking at the relationship between charter value and bank risk prior, during and after the Global Financial Crisis, we provide the results for the full sample period.

Table 5 reports the coefficient estimates for the baseline IV-TSLS regressions[22] for systemic risk (columns 1 and 2), standalone risk (columns 3 and 4) and default risk (column 5) and the set of bank and country-level control variables over the entire period of investigation (2000–2013). We also consider alternative measures of systemic risk (Tail-beta) and standalone risk (specific risk) in columns 6 and 7. Across these regressions, we do not find clear-cut results as the relationship between charter value and bank standalone and systemic risk measures is negative and statistically significant at the 5% level for only two risk variables: individual banks' systemic risk exposure (MES) and systematic risk (beta). These results are in line with the literature (e.g. Ghosh 2009; Konishi and Yasuda 2004; Hellmann, Murdock, and Stiglitz 2000; Demsetz, Saidenberg, and Strahan 1996; Keeley 1990) and indicate that an increase in charter value encourages banks to take on less risk and become less exposed to systemic shocks that affect the whole financial system. The economic relevance of the coefficient estimates indicates that a one standard deviation increase in charter value (i.e. a 0.17 unit increase in the bank's charter value) would decrease the individual bank's systemic risk exposure and systematic risk by 7% and 5%, respectively.[23]

Regarding the control variables, most of them enter significantly and the coefficients carry the signs obtained in previous studies. Bank size has a positive and statistically significant effect on systemic risk and systematic risk and a negative and statistically significant effect on the rest of standalone risk variables. The coefficient of the capital ratio variable is positive and statistically significant for systemic and systematic risk

[19]Although core deposits are regarded as important to explain charter value (Jones, Miller, and Yeager 2011), we do not introduce them in the regressions because of insufficient observations for banks in countries other than the U.S. Similarly, we do not use the entry denied index as an instrument of charter value, such as in (Laeven and Levine 2009), because the index is not available for almost all the countries, including the U.S., during the 2008–2012 period. Instead, we use a proxy of market power.

[20]We follow Keeley (1990), Gropp and Vesala (2004) and González (2005) who use the same model specification. Keeley (1990) and Gropp and Vesala (2004) consider the potential endogeneity of Tobin's Q and apply a two-stage procedure to analyse its possible influence on bank risk-taking.

[21]To confirm the validity of the IV, we report the KP rank F-statistics. Under identification test is also assessed by the KP Cragg-Donald Wald F-statistics of the first stage (the null hypothesis of weak instruments is rejected if F-statistic is greater than the Stock-Yogo's critical value (Stock and Yogo 2005; Cragg and Donald 1993)).

[22]Overall, the KP rank LM rejects the null hypothesis at the 1% level, indicating that the models are well identified. The Partial F-statistic, of the KP rank Wald F-test, from the first stage rejects this null hypothesis that the instruments are weak at the 1% level. Hansen's j tests (p-values) for overidentification of instruments show that the instruments are valid. Unreported first stage regression results and tests show that these instruments are both relevant and exogenous.

[23][0.17*(−0.65)]/1.55 = −7% and [0.17*(−0.17)]/0.53 = −5%. This is also associated with 11% and 3% standard deviation reduction in the individual bank's systemic risk exposure (the MES) and volatility risk (systematic risk), respectively.

Table 5. Baseline regression. Standalone and systemic risks: effect of bank charter value on financial stability.

	Systemic risk		Standalone risk		Default risk	Alternative dependent variables	
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	Tail-beta	Specific Risk
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Charter	−0.646**	−0.0815	−0.168**	0.0517	0.662	−0.186	0.0370
	(−2.18)	(−0.25)	(−2.04)	(0.27)	(0.16)	(−1.00)	(0.20)
Size	0.557***	0.178**	0.210***	−0.235***	2.638**	0.262***	−0.438***
	(6.40)	(2.05)	(8.20)	(−4.15)	(2.28)	(6.19)	(−7.59)
CAPR	5.117***	4.733***	1.510***	−0.973*	18.58*	1.743***	−3.489***
	(6.26)	(6.05)	(5.96)	(−1.65)	(1.66)	(3.64)	(−5.50)
Diversification	−0.0363	0.150	0.212**	0.451*	−2.324	−0.0420	0.295
	(−0.10)	(0.41)	(2.18)	(1.71)	(−0.49)	(−0.21)	(1.12)
Loans	0.703***	0.344	−0.0947	0.117	−1.868	0.125	−0.0165
	(2.76)	(1.48)	(−1.34)	(0.69)	(−0.54)	(0.97)	(−0.10)
Efficiency	−0.155	−0.262	−0.133	0.0823	−5.813	−0.0559	0.0832
	(−0.50)	(−0.88)	(−1.64)	(0.35)	(−1.45)	(−0.32)	(0.37)
ROA	−10.55***	3.234	−0.299	−35.62***	295.1***	2.244	−35.68***
	(−3.22)	(1.04)	(−0.45)	(−12.64)	(9.96)	(1.41)	(−12.03)
d.(merger)	−0.0647*	0.156***	−0.0285***	−0.0516**	0.355	−0.0225	−0.0586***
	(−1.74)	(3.93)	(−2.89)	(−2.54)	(0.75)	(−0.96)	(−2.97)
d.(crisis)	0.757***	0.805***	0.0360*	0.898***	−19.46***	−0.00510	0.694***
	(9.87)	(8.24)	(1.87)	(15.82)	(−17.72)	(−0.09)	(12.58)
LiborOis	0.0280***	0.00581	0.00113	0.0459***	−0.979***	−0.00137	0.0335***
	(4.52)	(0.82)	(0.75)	(10.48)	(−10.91)	(−0.34)	(8.16)
InterbankRate	−0.157***	−0.160***	−0.0214***	−0.118***	2.862***	−0.0452***	−0.0967***
	(−8.03)	(−8.19)	(−3.69)	(−9.65)	(9.63)	(−4.04)	(−8.60)
GDP	−0.122***	−0.0586***	−0.00976**	−0.0818***	1.246***	−0.00227	−0.0414***
	(−7.16)	(−3.73)	(−2.56)	(−8.93)	(6.85)	(−0.30)	(−4.56)
Inflation	0.142***	−0.0153	0.0579***	−0.0659***	−0.700	0.0324*	−0.0955***
	(3.61)	(−0.42)	(7.54)	(−2.91)	(−1.53)	(1.85)	(−4.28)
CapStringency	0.0280	0.0104	0.000489	0.00117	0.785**	0.00952	−0.000666
	(1.47)	(0.53)	(0.09)	(0.10)	(2.53)	(0.88)	(−0.06)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	No	No	No	No	No	No	No
Observations	6875	6875	6875	6875	6875	6875	6875
Banks	677	677	677	677	677	677	677
Hansen test (p-value)	0.001	0.398	0.000	0.001	0.001	0.005	0.014
LM χ^2	154.8***	154.8***	154.8***	154.8***	154.8***	154.8***	154.8***
Partial F-Stat	22.51***	22.51***	22.51***	22.51***	22.51***	22.51***	22.51**

Regression results for various bank risk measures on bank charter value over the whole period (2000–2013). In all regressions, columns report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific fixed effects, time dummies and a robust-clustering at the bank-level. Results of model $Risk_{i,t} = \beta_1 \widehat{Charter}_{i,t} + \beta_2 X_{i,t-1} + \beta_3 C_{i,t} + \lambda_t + \mu_{i,t} + \varepsilon_{2i,t}$, where dependent variables are two systemic risk measures: MES and ΔCoVaR (models in the columns: 1 and 2), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3 and 4) and default risk: MZ-score (model in the column 5). We also use other alternative risk measures: Tail-beta and specific risk (models in the columns 6 and 7). Bank charter value (Charter, proxied by Tobin's q) is modelled endogenously in all regressions. We instrument Charter by its one-year lagged value, Tangibility = tangible assets ratio, Market share = bank total assets over domestic total assets of the country banking system and their interactions. Regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Year dummies are not reported. Definitions of control variables are: Size = natural log of total assets, Loans = Loans to total assets, Diversification = non-interest income over total income, Efficiency = cost income over total income, CAPR = capital ratio, equity to total assets, ROA = Return on assets, d(merger) = dummy takes one if the bank experienced a merger-acquisition event (annul total assets variation exceeds 15%), and zero otherwise, and zero otherwise, d.(crisis) = dummy takes one during crisis time [2007–2009], and zero otherwise, GDP = gross domestic product growth, Inflation = annual inflation rate and Cap_Stringency = capital stringency. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *p < 0.1, **p < 0.05, ***p < 0.01 denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

but significantly negative for the other standalone risk proxies. The coefficient of the return on assets is significant for half of our specifications indicating that a higher ROA is associated with lower risk. The coefficient of the M&A dummy is significantly positive only for contagion risk (ΔCoVaR), but significantly negative for the MES, systematic risk, total risk and specific risk. The coefficient of the crisis dummy is positive and significant in all the estimations, meaning that systemic risk, risk-taking and default risk move up during crisis time. With respect to macroeconomic factors, the coefficients of economic growth are negative and significant for all risk measures (except for Tail-beta in column 6). This suggests that although higher economic growth is good for individual bank stability, it could have an adverse effect on the threat that banks might pose to the entire financial system. The inflation rate has a significantly positive impact on systemic risk exposure (MES), systematic risk and tail-beta, but a negative and statistically significant effect on specific and total risk. Thus, in the presence of bad economic conditions such as inflationary pressures or high interbank rates, banks become riskier and more vulnerable to systemic shocks.

Bank charter value and financial stability before, during and after the global financial crisis

In this subsection, we investigate whether the impact of charter value on bank risk taking and bank systemic stability may depend on the considered period: the risk accumulating pre-crisis period (2000–2006), the acute crisis period (2007–2009) and the post-crisis period (2010–2013). In this perspective, we estimate the following cross-sectional regression:

$$Risk_{i,t} = (\beta_1 + \beta_2 D_{2007-2009} + \beta_3 D_{2010-2013}) \times \widehat{Charter}_{i,t} + \beta_6 X_{i,t-1} + \beta_7 C_{i,t} + \lambda_t + \mu_i + \varepsilon_{2i,t} \quad (10)$$

where $Risk_{i,t}$ stands alternatively for measures of standalone and systemic risk of bank i over the year t. $D_{2007-2009}$ and $D_{2010-2013}$ are two dummies[24] which, respectively, take a value of one if the year covers 2007–2009 and 2010–2013, and zero otherwise. We include two interaction terms to test whether there is a difference in the charter value effects on risk during the three considered periods. More precisely, the coefficients β_1, $\beta_1 + \beta_2$ and $\beta_1 + \beta_3$ capture the effect of the bank charter value on bank standalone and systemic risk measures during the pre-global financial crisis years (2000–2006), the acute global financial crisis years (2008–2009) and the post global financial crisis years (2010–2013), respectively. The remaining variables are the same as in the Equation (10).

Table 6 displays TSLS estimations regarding systemic risk (columns 1 and 2), standalone risk (columns 3 and 4) and default risk (column 5) over the pre-crisis period (2000–2006), 2007–2009 and later (2010–2013). We match individual and systemic risk measures to investigate whether the impact of charter value may differ depending on the type of risk and economic conditions (pre-crisis period versus crisis and post-crisis periods). The coefficients estimates for bank charter value are positive and statistically significant in the pre-crisis period (columns 1, 3, 4, 6 and 7), indicating that an increase in charter value is associated with an increase in bank individual risk and systemic risk over the pre-GFC period. Similarly, the negative and significant relationship at the 1% level between charter value and the market-based z-score indicator (column 5) shows that higher charter value increases bank default. Taken together, the results indicate that an increase in bank charter value, i.e. availability of growth opportunities and presence of high earnings potential, is associated with higher risk-taking, which undermines stability and poses greater systemic risk.

When we look into the acute crisis (2007–2009) and the post-crisis (2010–2013) periods (Table 6), we find that the disciplining effect of charter value is only effective after the crisis and that charter value does not play any role during the crisis. Specifically, the Wald tests show that the effects of charter value on both systemic and standalone risk measures are significantly different from zero only during the post-GFC (α_1+ α_3), except for ΔCoVaR (column 2). However, during the acute crisis period, the effect of charter value on risk disappears; though for default risk (column 5), the Wald test (α_1+ α_2) is negative and significant at the 5% level, indicating that the effect of charter value is not reversed (but lessened) during the acute crisis period.

The impact of charter value on risk is also economically meaningful. For instance, before the crisis a one standard deviation increase in the charter value (0.17) leads to an increase in the MES of 16.7% ([1.67*0.10]/1.00) (column 1 of Table 6) and a decrease in the MES in the subsequent period of 3.36% ([−0.25*0.27]/2.00) (column 1 of Table 6, period).[25]

Besides, in Columns (6 and 7) of Table 6, we consider alternative measures of systemic risk (Tail-beta) and standalone risk (specific risk) and obtain quantitatively similar results. We find that the effect of charter value on both tail-beta and specific risk flips from positive and significant during the pre-crisis period (α_1), to negative and significant during the post-crisis period (the Wald tests: α_1+ α_3).

[24]Studies using similar definitions include Saheruddin (2014), Berger and Bouwman (2013) and Temesvary (2014), among others.
[25]Based on the standard deviations of the charter value and the mean values of the MES over the pre- and post-crisis periods, respectively.

Table 6. Broad sample of banks. Charter value and risk: the relationship between bank charter value, standalone and systemic risk in the pre-crisis, acute-crisis and the post-crisis periods.

	Systemic risk		Standalone risk		Default risk	Alternative dependent variables	
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	Tail-beta	Specific Risk
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Charter (α1)	1.671**	0.0188	1.651***	2.108***	−35.71***	1.569***	2.514***
	(2.01)	(0.03)	(7.50)	(3.13)	(−3.37)	(4.05)	(3.93)
Charter*$D_{2007-2009}$ (α2)	−1.920**	0.904	−1.482***	−1.910***	20.44**	−1.804***	−2.285***
	(−2.34)	(1.10)	(−6.95)	(−2.87)	(2.06)	(−4.41)	(−3.42)
Charter*$D_{2010-2013}$ (α3)	−1.925**	0.209	−1.699***	−2.321***	39.29***	−1.711***	−2.738***
	(−2.40)	(0.30)	(−7.86)	(−3.57)	(3.81)	(−4.46)	(−4.43)
$D_{2007-2009}$	2.952***	−1.138	1.498***	3.229***	−45.89***	1.560***	3.493***
	(3.42)	(−1.29)	(6.65)	(4.90)	(−4.52)	(3.63)	(5.24)
$D_{2010-2013}$	2.151**	−0.503	1.749***	2.863***	−53.76***	1.545***	3.182***
	(2.55)	(−0.69)	(7.77)	(4.31)	(−4.96)	(3.87)	(5.07)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6875	6875	6875	6875	6875	6875	6875
Hansen test (p-value)	0.001	0.312	0.000	0.001	0.002	0.001	0.020
LM χ^2	80.55***	80.55***	80.55***	80.55***	80.55***	80.55***	80.55***
Partial F-Stat	45.16***	45.16***	45.16***	45.16***	45.16***	45.16***	45.16***
Wald tests: $\alpha_1+\alpha_2$	−0.249	0.923*	0.169	0.198	−15.27**	−0.235	0.229
$\alpha_1+\alpha_3$	−0.254**	1.113	−0.048*	−0.213***	3.580***	−0.142**	−0.224***

Table shows regression results for various bank risk measures on bank charter value over the whole period [2000–2013]. In all regressions, columns report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific-fixed effects, time dummies and a robust-clustering on the bank-level. In all regression, $D_{2007-2009}$= dummy takes one during crisis time [2007–2009], and zero otherwise; $D_{2010-2013}$= dummy takes one if the year is 2010 to 2013, and zero otherwise. Dependent variables are four systemic risk measures: MES and ΔCoVaR (models in the columns: 1 and 2), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3 and 4) and default risk: MZ-score (model in the column 5). We also use other alternative risk measures: Tail-beta and specific risk (models in the columns 6 and 7). Bank charter value (Charter) is modelled endogenously in all regressions. We instrument Charter by one-year lagged Charter, tangible assets ratio, market share and their interactions. Besides, regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *p < 0.1, **p < 0.05, ***p < 0.01 denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

On the whole, Table 6 shows that bank charter value and risk move together during the profitable, pre-crisis period (2000–2006), i.e. bank earnings potential (Tobin's q) accelerates bank risk-taking and the sensitivity to extreme systemic shocks. Therefore, the self-disciplining role induced by charter value is not effective during the years that preceded the GFC. However, the relationship disappears during the acute crisis period (2007–2009) and after the crisis (2010–2013), the coefficients of charter value take the opposite sign consistent with the CVH whereby bank charter value reduces both individual and systemic risks.[26]

In what follows, we go deeper in the investigation of the positive relationship between charter value and bank risk during the pre-crisis period. Specifically, we test whether differences in risk-taking culture across countries, bank size, and growth and diversification strategies are possible drivers of such an unexpected impact of charter value on risk.

Charter value-bank risk relationship before the crisis: the impact of cross-country heterogeneity, bank size, and growth and diversification strategies

We consider four potential determinants that could explain the positive relationship of charter value on risk uncovered for the pre-GFC period: differences in risk-taking cultures, bank size, growth strategy and business model. We hence slightly modify Equation (11) as follows:

$$Risk_{i,t} = (\beta_1 + \beta_2 Factor) \times \widehat{Charter}_{i,t} + \beta_3 X_{i,t-1} + \beta_5 C_{i,t} + \lambda_t + \mu_i + \varepsilon_{2i,t} \quad (11)$$

where $Risk_{i,t}$represents measures of standalone or systemic risk of bank i over the year t. *Factor* stands alternately for bank location to take into account differences in risk-taking cultures (*d(EU)* and *d (NonUS-EU)*, which, respectively, take a value of one if banks are from Europe, the rest of OECD

[26]Considering sub-samples over the three sub-periods instead of the model in Equation (11) with interaction terms yields similar conclusions (see Table A1 in Appendix).

countries; and zero otherwise); bank size (*d(Large)* and *d(Small)*, which, respectively, take a value of one if \$1 billion $<$ total assets $\leq$ \$20 billion, \$500 million $<$ total assets $\leq$ \$1 billion; and zero otherwise); growth strategy (*d(High growth), d(Low growth)*, which, respectively, take a value of one if a bank is in the top quartile of total asset growth over the pre-GFC, in the bottom quartile of total asset growth over the pre-GFC; and zero otherwise) and business model (*d(Diversified), d(Specialized)*, which, respectively, take a value of one if a bank is in the top quartile of the diversification ratio[27] change over the pre-GFC, in the bottom quartile of the diversification ratio change over the pre-GFC; and zero otherwise.[28] We also include the same set of control variables as in Equation (10).

The relationship between charter value and bank risk may depend on differences in risk-taking cultures. For instance, Japanese banks are well known to be more conservative than their U.S. counterparts (Haq et al. 2016). We, therefore, take advantage of the heterogeneity of our OECD bank sample that comprises different countries and financial systems (market-based vs. bank-based financial systems). We define three geographical sub-groups: U.S., European countries and the rest of the OECD countries (which is dominated by Japan). Panel A of Table 7 displays the results. They show that the positive relationship between charter value and bank risk during the pre-crisis period only holds for banks in the U.S. (coefficient α1, Panel A) and Europe (Wald tests α1+ α2) because, for the rest of OECD countries, the relationship is comparatively weaker or non-existent for more than half of our specifications (Wald tests α1+ α3, Panel A).

In the next step, we only keep U.S. and European banks, i.e. we eliminate from our sample banks from the rest of OECD countries for which the robust positive relationship between charter value and bank risk is not found, and test whether the charter value-bank risk relationship may be influenced by bank size. Panel B of Table 7 reports the results. We find that a high charter value increases both standalone and systemic risks for very large and large banks; whereas for small banks, such a relationship is either non-existent or strongly lessened (Wald tests α1+ α3).

Lastly, we consider the sample of very large and large banks for which the positive relationship between charter value and risk is confirmed (i.e. we eliminate from our sample small banks and banks from the rest of OECD countries), and then explore if differences in growth strategies and business models alter such a relationship. We define banks with high growth strategies as those in the top 75th percentile of bank total assets variation[29] during the pre-GFC period, while banks with low growth strategies are those in the bottom 25th percentile. We use similar cut-offs for the business model (activity-mix) and consider the variation of the non-traditional income ratio as an indicator of bank diversification.[30]

Table 8 (Panels A and B) displays the results.[31] It indicates that the positive impact of charter value on both standalone and systemic risks is confirmed only for large and very large banks following a high growth strategy (Panel A of Table 8). In fact, charter value has no impact on both standalone and systemic risks when banks pursue a low growth strategy, except for total risk when banks are very large (Table 8, column (9)). As regards to bank business models, the positive impact of charter value on bank risk is confirmed only for the sample of large banks with a focus strategy, while it is non-existent for highly diversified banks (Table 8, Panels B).

V. Robustness checks and conclusion

Robustness checks

To check the robustness of the results, we proceed as follows. Firstly, the definition of TBTF banks we consider (banks with total assets above \$20 billion) is presumably more accurate for banks operating in the most developed banking systems but less appropriate for the less developed OECD countries.

[27]The diversification ratio is defined as noninterest income over total income.

[28]Growth strategy (business model) variation is computed as the change over the pre-GFC period (between 2000 and 2006) in total assets (diversification ratio) over the average total assets (diversification ratio) (see descriptive statistics, Table 3).

[29]Table 3. contains the definitions of growth strategy and business model (activity-mix).

[30]We use the ratio of non-interest income to total income as the diversification ratio. Alternately, we consider the ratio of non-interest income to operating income and obtain similar results.

[31]To save space, Table 8 does not report the results obtained for alternative risk measures— *Tail beta* and *Specific risk*.

Table 7. Bank charter value and financial stability in the pre-crisis period [2000–2006]: effect of geographical distribution and size.

	Systemic risk		Standalone risk		Default risk	Alternative dependent variables	
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	Tail-beta	Specific Risk
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Geographical areas (risk-taking culture) effects on the relation between bank charter value and risk, broad sample.							
Charter (α1)	16.79***	13.64***	6.367***	4.215***	−92.51***	3.838**	0.934
	(6.24)	(5.01)	(7.26)	(2.59)	(−3.01)	(2.56)	(0.60)
Charter*d(EU) (α2)	−14.98***	−13.26***	−5.739***	−1.729	35.62	−2.549*	1.411
	(−5.14)	(−3.78)	(−6.61)	(−1.08)	(0.97)	(−1.65)	(0.93)
Charter*d(NonUS-EU) (α3)	−11.88***	−13.51***	−5.643***	−1.701	8.937	−3.063	1.675
	(−3.31)	(−4.39)	(−4.92)	(−0.91)	(0.18)	(−1.52)	(0.99)
Observations	3145	3145	3145	3145	3145	3145	3145
Hansen test (p-value)	0.004	0.324	0.001	0.003	0.001	0.612	0.047
LM χ^2	43.43***	43.43***	43.43***	43.43***	43.43***	43.43***	43.43***
Partial F-Stat	10.76***	10.76***	10.76***	10.76***	10.76***	10.76***	10.76***
Wald tests: $\alpha_1+\alpha_2$	1.810**	0.380	0.628***	2.486***	−56.890***	1.289***	2.345***
$\alpha_1+\alpha_3$	4.910*	0.130	0.724	2.514**	−83.573*	0.775	2.609**
Panel B: Size effects on the relation between bank charter value and risk, U.S. and European countries.							
Charter (α1)	13.15***	7.779***	1.687	4.445***	−155.5***	3.692**	2.956**
	(6.23)	(3.53)	(1.64)	(4.05)	(−4.63)	(1.98)	(2.47)
Charter*d(Large) (α2)	−8.247***	−4.975**	0.403	−2.822**	107.4***	−1.708	−2.297*
	(−3.87)	(−2.25)	(0.39)	(−2.40)	(3.12)	(−0.90)	(−1.82)
Charter*d(Small) (α3)	−10.50***	−8.503***	−1.213	−2.971**	96.52**	−0.432	−1.772
	(−3.94)	(−3.14)	(−1.16)	(−2.15)	(2.36)	(−0.19)	(−1.23)
Observations	2639	2639	2639	2639	2639	2639	2639
Hansen test (p-value)	0.001	0.003	0.000	0.164	0.160	0.070	0.540
LM χ^2	35.82***	35.82***	35.82***	35.82***	35.82***	35.82***	35.82***
Partial F-Stat	42.78***	42.78***	42.78***	42.78***	42.78***	42.78***	42.78***
Wald tests: $\alpha_1+\alpha_2$	4.903***	2.804***	2.090***	1.615***	−48.100***	1.984***	0.659
$\alpha_1+\alpha_3$	2.650	−0.724	0.474*	1.474*	−58.980**	3.26*	1.184

Table shows the two-stage least squares (TSLS) IV estimation results on the relation between charter value and risk and the effect of bank size (Panel A) and geographical localization (Panels B and c) for all banks over the pre-crisis period [2000–2006]. In all regressions report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific fixed effects, time dummies and a robust-clustering on the bank-level. Dependent variables are four systemic risk measures: MES and ΔCoVaR (models in the columns: 1 and 2), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3 and 4) and default risk: MZ-score (model in the column 5). We also use other alternative risk measures: Tail-beta and specific risk (models in the columns 6 and 7). Bank charter value (Charter) is modelled endogenously in all regressions. We instrument Charter by one-year lagged Charter, tangible assets ratio, market share and their interactions. In Panels A and B, d(EU) = dummy takes a value of one if banks are from Europe banks, and zero otherwise; d (NonUS-EU) = dummy takes a value of one if banks are neither from U.S. nor Europe (from the rest of remaining OECD countries: Australia, Canada, Japan, South Korea and Turkey), and zero otherwise; d(Large) = dummy takes one if banks are large, those with total assets ranging between \$1 and \$20 billion), and zero otherwise; d(Small) = dummy takes one if banks are small, those with total assets between \$500 million and \$1 billion, and zero otherwise. Panel A presents the effect of the geographical areas (that differentiates risk-taking culture) on bank risk-taking and systemic risk for the broad sample of banks. Panel B presents the effect of bank size on risks for the U.S. and European sample of banks. Besides, regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

Therefore, we keep the absolute size criterion of total assets above \$20 billion for banks operating in the world's top 10 economies, and for the rest of the OECD countries in our sample, we use bank size relative to GDP. Very large banks with respect to the home country's GDP are defined as those with a ratio above 10% (De Jonghe et al. 2015). We re-estimate the regressions in Table 8 and find similar conclusions. Considering growth and diversification strategies during the pre-crisis period, the results of Table 9 support our earlier findings although for very large banks, the relationship becomes positive and significant when banks have a strong diversification strategy. Secondly, we consider an alternative proxy of charter value. We use the standardized market value added (MVA)[32] and market-to-book ratio, as alternative measures of Tobin's q, and obtain similar conclusions (Table 10). In unreported results but available upon request, we use the median as a new cut-off to define high and low bank growth and diversification strategies during the pre-crisis period, instead of the top 75th and bottom 25th quartiles of total assets and non-traditional income ratio variations. Finally, we run all our regressions using subsamples instead of interaction terms and get similar conclusions. Our results are therefore

[32]We calculate the standardized market value added MVA as (current market capitalization – total equity) divided by total equity.

Table 8. The effects of growth strategies and business models in the relationship between charter value and financial stability over the pre-crisis period [2000–2006] for U.S. and European large and 'TBTF' banks, with total assets above $1 billion.

	Subsample of large banks					Subsample of very large banks				
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Growth strategies and the effect of bank charter value on risk.										
Charter (α1)	5.094***	2.951***	2.819***	2.683***	−35.52**	21.12**	11.97	2.695*	9.069**	−246.5*
	(4.60)	(2.83)	(6.12)	(2.76)	(−1.98)	(2.07)	(1.55)	(1.72)	(2.02)	(−1.95)
Charter*d(High growth) (α2)	−0.0133	−0.117***	−0.0554***	−0.0417	−0.104	−4.058	−3.153	−0.304	−1.788	61.60*
	(−0.41)	(−3.77)	(−3.16)	(−1.45)	(−0.22)	(−1.57)	(−1.63)	(−0.65)	(−1.51)	(1.79)
Charter*d(Low growth) (α3)	−5.496	2.946	0.673	−1.247	148.5	−50.18*	−24.74	−4.930	−25.45**	618.6*
	(−0.39)	(0.30)	(0.11)	(−0.18)	(0.61)	(−1.82)	(−1.17)	(−1.15)	(−2.09)	(1.80)
Observations	1331	1331	1331	1331	1331	473	473	473	473	473
Hansen test (p-value)	0.260	0.457	0.607	0.623	0.440	0.359	0.077	0.362	0.756	0.393
LM χ^2	21.90***	21.90***	21.90***	21.90***	21.90***	10.25*	10.25*	10.25*	10.25*	10.25*
Partial F-Stat	33.35***	33.35***	33.35***	33.35***	33.35***	4.57**	4.57***	4.57***	4.57***	4.57***
Wald tests: $\alpha_1+\alpha_2$	5.081***	2.834***	2.764***	2.641***	−35.42**	17.162**	8.817*	2.391**	7.281**	−176.9**
$\alpha_1+\alpha_3$	−0.402	0.005	3.492	1.436	112.48	−28.96	−12.77	−2.235	−16.381**	399.5*
Panel B: Business models and the effect of bank charter value on risk.										
Charter (α1)	7.774***	6.350***	4.354***	5.789***	−80.81**	9.420**	3.078	2.060**	3.229*	−24.31
	(4.34)	(4.00)	(4.84)	(3.96)	(−2.24)	(2.06)	(0.85)	(2.44)	(1.93)	(−0.53)
Charter*d(Diversified) (α2)	−4.543	−8.782**	−2.962*	−6.171***	94.80*	−2.756	4.938	−2.580	2.186	−150.6
	(−1.60)	(−2.51)	(−1.90)	(−2.85)	(1.75)	(−0.28)	(0.39)	(−1.24)	(0.50)	(−1.19)
Charter*d(Specialized) (α3)	4.655*	5.298***	2.962**	5.662***	−83.15**	11.74	3.708	0.244	0.369	259.4
	(1.83)	(2.66)	(2.55)	(2.67)	(−2.02)	(0.66)	(0.27)	(0.06)	(0.05)	(1.21)
Observations	1331	1331	1331	1331	1331	473	473	473	473	473
Hansen test (p-value)	0.248	0.376	0.498	0.813	0.394	0.021	0.038	0.308	0.192	0.090
LM χ^2	11.15*	11.15*	11.15*	11.15*	11.15*	12.38*	12.38*	12.38*	12.38*	12.38*
Partial F-Stat	23.37***	23.37***	23.37***	23.37***	23.37***	5.70**	5.70***	5.70***	5.70***	5.70***
Wald tests: α1+ α2	3.231	−2.432	1.392	−0.382	3.99	6.664	8.016	−0.52	5.415*	−174.91*
α1+ α3	12.429***	11.648***	7.316***	11.451***	163.96**	21.16	6.786	2.304	3.598	235.09

Table shows the two-stage least squares (TSLS) IV estimation results on the relation between charter value and risk and the effect of bank growth strategies (Panel A) and business models (Panel B) for U.S. and European banks over the pre-crisis period [2000–2006]. In all regressions report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific-fixed effects, time dummies and a robust-clustering on the bank-level. Dependent variables are four systemic risk measures: MES and ΔCoVaR (models in the columns: 1,2,6 and 7), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3,4,8 and 9) and default risk: MZ-score (models in the columns 5 and 10). Bank charter value (Charter) is modelled endogenously in all regressions. We instrument Charter by one-year lagged Charter, tangible assets ratio, market share and their interactions. Panel A reports estimation results for banks group with high growth strategies (d(High growth) = dummy takes one if banks are in top quartile, Q75, of bank total assets variation during the pre-crisis period, and zero otherwise) and those with low growth strategies (d(Low growth) = dummy takes one if banks are in bottom quartile, Q25, of bank total assets variation during the pre-crisis period, and zero otherwise). Panel B reports estimation results for banks group with strong diversification strategies (d(Diversified) = dummy takes one if banks are in top quartile, Q75, of diversification ratio variation during the pre-crisis period, and zero otherwise) and those with focus strategies (d(Specialized) = dummy takes one if banks are in bottom quartile, Q25, of diversification ratio variation during the pre-crisis period, and zero otherwise). In both analyses, we differentiate between large banks (with total assets ranging between $1 and $20 billion) and very large banks (with total assets above $20 billion). Besides, regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

robust to alternative definitions of TBTF banks, charter value and the choice of cut-offs.

Conclusion

Previous studies on the relationship between charter value and bank risk-taking have mainly focused on standalone risk measures and report mixed results. Although higher charter value is generally considered as beneficial in terms of bank stability, by reducing a bank's risk-taking incentives, some studies find this relationship not to be linear. This paper considers both standalone and systemic risk measures and shows that the relationship between charter value and risk is different during normal times and distress periods dependent on the state of the economy and the business cycle. Specifically, based on our investigation of 853 publicly traded banks in 28 OECD countries over the 2000–2013 period, we find that before the global financial crisis charter value positively impacted both individual and systemic risks. Such a behaviour is mostly effective for large and 'too-big-to-fail' banks with fast growth policies or other large banks with focus strategies. Our findings highlight that instead of mitigating risk, charter

Table 9. Alternative definitions of TBTF. The effects of growth strategies and business models in the relationship between charter value and financial stability over the pre-crisis period [2000–2006] for U.S. and European large and 'TBTF' banks, with total assets above $1 billion.

	Subsample of non-TBTF					Subsample of TBTF				
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Growth strategies and the effect of bank charter value on risk.										
Charter (α1)	5.315***	3.481***	2.717***	2.633***	−36.18**	19.49**	11.70*	2.720*	8.498**	−221.0**
	(4.80)	(3.33)	(6.09)	(2.69)	(−2.03)	(2.42)	(1.87)	(1.95)	(2.31)	(−2.16)
Charter*d(High growth) (α2)	−0.0221	−0.135***	−0.0550***	−0.0418	−0.0537	−3.188	−2.471	−0.227	−1.499	50.24*
	(−0.64)	(−4.23)	(−3.11)	(−1.44)	(−0.11)	(−1.51)	(−1.55)	(−0.52)	(−1.53)	(1.78)
Charter*d(Low growth) (α3)	−5.857	2.332	0.506	−1.141	148.8	−43.37**	−23.08	−4.258	−23.58**	543.6**
	(−0.40)	(0.23)	(0.08)	(−0.16)	(0.61)	(−2.13)	(−1.44)	(−1.12)	(−2.52)	(2.10)
Observations	1315	1315	1315	1315	1315	489	489	489	489	489
Hansen test (p-value)	0.446	0.333	0.283	0.273	0.568	0.397	0.142	0.147	0.663	0.619
LM χ^2	16.81**	16.81**	16.81**	16.81**	16.81**	17.25**	17.25**	17.25**	17.25**	17.25**
Partial F-Stat	33.78***	33.78***	33.78***	33.78***	33.78***	5.29***	5.29***	5.29***	5.29***	5.29***
Wald tests: $\alpha_1+\alpha_2$	5.293***	3.345***	2.662***	2.591***	−36.126**	16.302***	9.229*	2.493**	6.999**	−170.76**
$\alpha_1+\alpha_3$	−0.242	1.148	3.223	1.492	112.62	−23.88*	−11.38	−1.538	−15.082**	322.6*
Panel B: Business models and the effect of bank charter value on risk.										
Charter (α1)	7.987***	7.995***	4.181***	5.600***	−79.95**	11.78***	5.405	2.474***	4.195**	−65.40
	(4.38)	(4.56)	(4.77)	(3.73)	(−2.23)	(2.59)	(1.54)	(3.15)	(2.39)	(−1.42)
Charter*d(Diversified) (α2)	−5.299	−15.05***	−3.545**	−6.726***	105.9*	−0.343	13.45***	−1.115	1.411	−87.60
	(−1.52)	(−3.30)	(−2.02)	(−2.61)	(1.65)	(−0.06)	(2.84)	(−0.96)	(0.53)	(−1.17)
Charter*d(Specialized) (α3)	4.847*	6.849***	2.785**	5.448**	−81.21*	17.64	8.705	0.673	3.724	131.8
	(1.90)	(3.11)	(2.45)	(2.46)	(−1.91)	(0.91)	(0.59)	(0.16)	(0.43)	(0.55)
Observations	1315	1315	1315	1315	1315	489	489	489	489	489
Hansen test (p-value)	0.452	0.330	0.338	0.428	0.513	0.265	0.288	0.163	0.398	0.134
LM χ^2	10.26***	10.26***	10.26***	10.26***	10.26***	15.76**	15.76**	15.76**	15.76**	15.76**
Partial F-Stat	18.68***	18.68***	18.68***	18.68***	18.68***	8.39***	8.39***	8.39***	8.39***	8.39***
Wald tests: α1+ α2	2.688	−7.055*	0.636	−1.126	25.95	11.437***	18.855***	1.324	5.606***	−153**
α1+ α3	12.834***	14.844***	6.966****	11.048***	−161.16**	29.42	14.11	3.147	7.919	66.4

We define TBTF as very large banks operating in the world's top 10 economies, and with a relative size, with respect to the home country's GDP, above 10% (non-TBTF, otherwise). Table shows the two-stage least squares (TSLS) IV estimation results on the relation between charter value and risk and the effect of bank growth strategies (Panel A) and business models (Panel B) for U.S. and European banks over the pre-crisis period [2000–2006]. In all regressions report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific fixed effects, time dummies and a robust-clustering on the bank-level. Dependent variables are four systemic risk measures: MES and ΔCoVaR (models in the columns: 1,2,6 and 7), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3,4,8 and 9) and default risk: MZ-score (models in the columns 5 and 10). Here, bank charter value (Charter) is Tobin's q, modelled endogenously in all regressions. Panel A reports estimation results for banks group with high growth strategies (d(High growth) = dummy takes one if banks are in top quartile, Q75, of bank total assets variation during the pre-crisis period, and zero otherwise) and those with low growth strategies (d(Low growth) = dummy takes one if banks are in bottom quartile, Q25, of bank total assets variation during the pre-crisis period, and zero otherwise). Panel B reports estimation results for banks group with strong diversification strategies (d(Diversified) = dummy takes one if banks are in top quartile, Q75, of diversification ratio variation during the pre-crisis period, and zero otherwise) and those with focus strategies (d(Specialized) = dummy takes one if banks are in bottom quartile, Q25, of diversification ratio variation during the pre-crisis period, and zero otherwise). Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

value may have provided incentives to accumulate risk which in turn might have contributed to higher systemic risk. By contrast, the results show that during, and more specifically after, the global financial crisis, banks tend to protect their charter value and lessen their risk exposure thereby reducing their contribution to systemic risk.

Our findings have important policy implications. The one size fits all capital conservation buffers introduced by Basel III may not be enough to guarantee bank stability and should not only be based on the business cycle but also on the state of the financial system. Although banks are required to accumulate buffers during economic upturns, banks with a stronger position with the higher charter value might be building up more aggressive expansion strategies during bullish financial markets. Regulators and supervisors should hence closely look into the behaviour of very large 'too-big-to fail banks' and large banks with high growth or strong focus strategies. For such banks, the impact of charter value on bank stability can be a double-edged sword.

Table 10. Alternative measures of bank charter value: standardized market value-added and market-to-book ratio.

	Pre-crisis period [2000–2006]			
	MES	ΔCoVaR	Systematic Risk	Total Risk
Dependent variables	(1)	(2)	(3)	(4)
Panel A: results for the standardized market value added (SMVA)				
SMVA	1.093***	0.809***	0.367***	0.224***
	(6.93)	(5.60)	(6.02)	(3.05)
Observations	2086	2086	2086	2086
Hansen test (p-value)	0.055	0.420	0.142	0.040
LM χ^2	52.59***	52.59***	52.59***	52.59***
Partial F-Stat	85.60***	85.60***	85.60***	85.60***
Panel B: results for the market to book ratio				
Market-to-Book	11.82***	6.962***	4.318***	3.430***
	(6.16)	(4.48)	(6.86)	(4.74)
Observations	2096	2096	2096	2096
Hansen test (p-value)	0.139	0.782	0.367	0.0708
LM χ^2	38.09***	38.09***	38.09***	38.09***
Partial F-Stat	58.32***	58.32***	58.32***	58.32***

Table displays the results on the baseline model for standardized market value added (Panel A) and market-to-book ratio (Panel B) as alternative definitions of bank charter value (Tobin's q). We consider only very large banks (as banks with total assets greater than USD20 billion) and large banks (total assets ranged between USD1 and USD20 billion) operating in U.S. and Europe. SMVA is computed as the difference between the market value and capital contribution over book value of equity normalized by total equity. Columns report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific fixed effects, time dummies and a robust-clustering on the bank-level. Table shows regression results for various bank risk measures on SMVA value or/Market-to-Book ratio the whole span of investigations [2000–2013], the pre-GFC [2000–2006] and the post-GFC [2010–2013] periods. Dependent variables are four systemic risk measures: MES and ΔCoVaR, matched with two standalone risk measures: systematic risk and total risk. Standardized market value added (SMVA) and market-to-book ratio (Market-to-Book) are modelled endogenously in all regressions. We instrument SMVA by one-year lagged SMVA, tangible assets ratio and market share. Market-to-Book is instrumented by one-year lagged Market-to-Book, tangible assets ratio and market share. Besides, regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$ denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).

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Appendix

Table A1. Relationship between bank charter value and financial stability in the pre-crisis, acute-crisis and the post-crisis periods.

	Systemic risk		Standalone risk		Default risk	Alternative dependent variables	
	MES	ΔCoVaR	Systematic Risk	Total Risk	MZ-score	Tail-beta	Specific Risk
Dependent variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: The effects of bank charter value on risk in the pre-crisis period [2000–2006]							
Charter	7.673***	5.422***	2.819***	3.255***	−75.18***	2.283***	1.918**
	(6.05)	(4.89)	(6.31)	(4.88)	(−5.58)	(3.24)	(2.44)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3145	3145	3145	3145	3145	3145	3145
Hansen test (p-value)	0.001	0.051	0.000	0.032	0.000	0.562	0.173
LM χ^2	44.70***	44.70***	44.70***	44.70***	44.70***	44.70***	44.70***
Partial F-Stat	25.65***	25.65***	25.65***	25.65***	25.65***	25.65***	25.65***
Panel B: The effects of bank charter value on risk in acute-crisis period [2007–2009]							
Charter	−7.064	7.585	−1.193	−3.621*	30.50	−4.043	−3.085
	(−1.26)	(1.35)	(−0.90)	(−1.65)	(0.73)	(−1.56)	(−1.63)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1583	1583	1583	1583	1583	1583	1583
Hansen test (p-value)	0.019	0.926	0.000	0.213	0.108	0.447	0.558
LM χ^2	9.01*	9.01*	9.01*	9.01*	9.01*	9.01*	9.01*
Partial F-Stat	2.085*	2.085*	2.085*	2.085*	2.085*	2.085*	2.085*
Panel C: The effects of bank charter value on risk in post-Crisis period [2010–2013]							
Charter	−0.488**	−0.545*	−0.0825**	−0.552***	6.515***	−0.0558	−0.387***
	(−2.17)	(−1.82)	(−2.04)	(−3.71)	(3.45)	(−0.34)	(−2.59)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2017	2017	2017	2017	2017	2017	2017
Hansen test (p-value)	0.018	0.675	0.045	0.127	0.005	0.394	0.780
LM χ^2	96.98***	96.98***	96.98***	96.98***	96.98***	96.98***	96.98***
Partial F-Stat	30.94***	30.94***	30.94***	30.94***	30.94***	30.94***	30.94***

Regression results for various bank risk measures on bank charter value over the pre-crisis period [2000–2006], the acute-crisis period [2007–2009] and the post-crisis period [2010–2013]. In all regressions, columns report second stage coefficients from a two-stage least squares (TSLS) IV estimator with bank-specific fixed effects, time dummies and a robust-clustering at the bank-level. Results of model $Risk_{i,t} = \beta_1 \widehat{Charter}_{i,t} + \beta_2 X_{i,t-1} + \beta_3 C_{i,t} + \lambda_t + \mu_{i,t} + \varepsilon_{2i,t}$, where dependent variables are two systemic risk measures: MES and ΔCoVaR (models in the columns: 1 and 2), matched with two standalone risk measures: systematic risk and total risk (models in the columns: 3 and 4) and default risk: MZ-score (model in the column 5). We also use other alternative risk measures: Tail-beta and specific risk (models in the columns 6 and 7). Bank charter value (Charter, proxied by Tobin's q) is modelled endogenously in all regressions. We instrument Charter by its one-year lagged value, Tangibility = tangible assets ratio and Market share = bank total assets over domestic total assets of the country banking system. Regressions control for one-year lagged bank-level characteristics to mitigate endogeneity concerns and possible omitted variables. We control also for macro-financial variables and country-level variables. Control variables and year dummies are not reported. Heteroscedasticity consistent and robust standard errors t statistics are in brackets below their coefficients estimates. *p < 0.1, **p < 0.05, ***p < 0.01 denote statistically significant at 10%, 5% and 1% levels, respectively. Hansen j test (from the second stage) reports p-value of overidentification test. Kleibergen-Paap rank LM statistic (LM χ^2 from the first stage) tests the null hypothesis that the excluded instruments are not correlated with the endogenous regressor. Kleibergen-Paap rk Wald F-statistic (Partial F-Stat from the first stage) testing for weak identification. We do not face muticollinearity problems (VIF test is less than 10 basis points, not reported).