Discussion Paper

Catharsis –
The real effects
of bank insolvency and resolution

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***The Stability of the European Financial System and the Real Economy
in the Shadow of the Crisis***

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and the Journal of Financial Stability in Dresden from 17 to 18 January 2013.

**The views expressed in the paper are those of the author and do not necessarily
reflect those of the Deutsche Bundesbank.**

Thursday, 17 January 2013

8:45 – 9:00	Registration
9:00 – 9:10	**Opening Remarks** by **Alexander Karmann** (TU Dresden) and **Thilo Liebig** (Deutsche Bundesbank)
9:10 – 9:25	**Welcome Address** by **Hans Müller-Steinhagen** (Rector, TU Dresden)

Session 1	**Business Models and Risk-Taking of Banks I**
	Chair: Iftekhar Hasan (Fordham University)

9:25 – 10:15	**Which banks are more risky? The impact of loan growth and business model on bank risk-taking**
	Matthias Köhler (Deutsche Bundesbank)
	Discussant: Michel Dietsch (Université de Strasbourg and Banque de France)
10:15 – 10:25	Coffee Break
10:25 – 11:15	**Modelling and measuring business risk and the resiliency of retail banks**
	Mohamed Chaffai (Université de Sfax) and *Michel Dietsch* (Université de Strasbourg and Banque de France)
	Discussant: Matthias Köhler (Deutsche Bundesbank)
11:15 – 12:00	**Invited Talk**
	Capital Levels and Risk-Taking Propensity in Financial Institutions
	Giovanni Barone-Adesi (University of Lugano and Swiss Finance Institute)
12:00 – 13:30	Lunch Break

Session 2	**Business Models and Risk-Taking of Banks II**
	Chair: Thilo Liebig (Deutsche Bundesbank)
13:30 – 14:20	**The Common Drivers of Default Risk**
	Christoph Memmel (Deutsche Bundesbank), Yalin Gündüz (Deutsche Bundesbank) and Peter Raupach (Deutsche Bundesbank)
	Discussant: Wolfgang Bessler (Justus-Liebig University Giessen)
14:20 – 15:10	**Bank Risk Factors and Changing Risk Exposures of Banks: Capital Market Evidence Before and During the Financial Crisis**
	Wolfgang Bessler (Justus-Liebig University Giessen) and Philipp Kurmann (Justus-Liebig University Giessen)
	Discussant: Christoph Memmel (Deutsche Bundesbank)
15:10 – 15:25	Coffee Break
Key Note Speech 15:25 – 16:10	**Why is the 'euro crisis' so difficult to deal with?** **Martin Hellwig** (Max Planck Institute for Research on Collective Goods)
Session 3	**The Financial Crisis and the Real Economy**
	Chair: Stefan Eichler (TU Dresden)
16:10 – 17:00	**Catharsis - Tracing the Real Effects of Bank Insolvency and Resolution**
	Josef Korte (Goethe University Frankfurt)
	Discussant: Camelia Minoiu (International Monetary Fund)
17:00 – 17:10	Coffee Break
17:10 – 18:00	**Liquidity Shocks, Bank Balance Sheets, and International Lending During the 2007-08 Crisis**
	Camelia Minoiu (International Monetary Fund) and Tümer Kapan (Fannie Mae)
	Discussant: Josef Korte (Goethe University Frankfurt)
19:00 – 22:00	**Reception and Conference Dinner** **Dinner Speech: Andreas Dombret** (Member of the Executive Board, Deutsche Bundesbank)

Friday, 18 January 2013

Session 4	**Regulatory Issues**
	Chair: Olivier De Bandt (L'Autorité de Contrôle Prudentiel France)

9:00 – 9:50

A Model of Mortgage Losses and its Applications for Macroprudential Instruments

Christian Hott (Zurich Insurance Group)

Discussant: Clemens Bonner (De Nederlandsche Bank)

9:50 – 10:00 Coffee Break

10:00 – 10:50

Steering the LCR with the Interbank Money Market

Clemens Bonner (De Nederlandsche Bank) and Sylvester Eijffinger (CentER, Tilburg University)

Discussant: Roman Horvath   (Institute of Economic Studies, Charles University Prague and IOS Regensburg)

10:50 – 11:00 Coffee Break

11:00 – 11:50

Central Bank Transparency and Financial Stability: Measurement, Determinants and Effects

Roman Horvath   (Institute of Economic Studies, Charles University Prague and IOS Regensburg) and Dan Vaško (Institute of Economic Studies, Charles University Prague)

Discussant: Christian Hott (Zurich Insurance Group)

11:50 – 12:35

Invited Talk

Financial Contract: Bank versus Bank

Iftekhar Hasan (Fordham University)

12:35 – 13:40 Lunch Break

Session 5

Chair: Alexander Karmann (TU Dresden)

13:40 – 14:30 **Fiscal Spillovers in the Euro Area**

Guglielmo Maria Caporale (Brunel University London, CESifo and DIW Berlin) and Alessandro Girardi (Istat, Rome)

Discussant: Giovanni Calice (University of Southampton)

14:30 – 15:20 **Liquidity Spillovers in Sovereign Bond and CDS Markets: An Analysis of The Eurozone Sovereign Debt Crisis**

Giovanni Calice (University of Southampton), Jing Chen (Swansea University, School of Business and Economics Swansea) and Julian Williams (University of Aberdeen)

Discussant: Jorge Antonio Chan-Lau (International Monetary Fund)

15:20 – 15:35 Coffee Break

15:35 – 16:25 **Equity Returns in the Banking Sector in the Wake of the Great Recession and the European Sovereign Debt Crisis**

Jorge Antonio Chan-Lau (International Monetary Fund), Estelle X. Liu (International Monetary Fund) and Jochen M. Schmittmann (International Monetary Fund)

Discussant: Guglielmo Maria Caporale (Brunel University London, CESifo and DIW Berlin)

16:25 – 16:40 **Concluding remarks** by **Alexander Karmann** (TU Dresden) and **Thilo Liebig** (Deutsche Bundesbank)

End of Conference

Non-technical summary

How does the treatment of insolvent banks affect the real economy? This paper analyzes the effects of rules-based bank resolution on real economic growth. Economic theory stipulates that banks play a growth-enhancing role for the economy at large by allocating and monitoring credit. However, distorted incentives for banks, depositors, and regulators associated with bank insolvency and resolution may corrupt banks' credit allocation and monitoring decisions. In the absence of efficient and effective bank insolvency rules, banks fall short on performing their growth-enhancing role. This may ultimately lead to suboptimal real economic performance. Based on these theoretical arguments and existing empirical research, we argue that a rules-based prompt resolution policy stipulating purchase and assumption or straightforward closure and liquidation of insolvent banks (re)establishes the incentive system and provides for economically superior credit allocation and monitoring. The direction of the effect of such closure rules is a priori not necessarily obvious as positive effects of reestablished incentives might be outweighed by negative effects of individual bank failures, such as contagion and credit supply shocks.

Hence, we test the hypothesized 'catharsis effect' of regulatory insolvency and positive capital closure rules for its implications on the real economy. In order to measure the 'catharsis effect', we propose a new indicator and exploit its cross-sectional variation in European regulatory closure policies. Essentially, we define a hypothetical positive capital closure rule that stipulates automatic resolution as soon as a bank falls below a pre-specified capital ratio. The catharsis indicator measures how strictly such a rule is implemented by relating bank assets that have been resolved after undercutting a specific capital ratio to all bank assets of banks that have undercut this ratio. Hence, the indicator essentially captures the idea of how rules-based failed banks are resolved. In addition, we construct a panel of more than 2 million firm-year observations containing economic performance data of non-financial firms. As the relation between real economic growth and the financial system might be prone to reverse causality and endogeneity issues, we employ an identification framework consisting of several econometric techniques which helps us establish causality.

Our results confirm the hypothesis of a positive 'catharsis effect' and yield three important findings. First, we find a comparably stronger implementation of a hypothetical positive capital closure rule to have a positive and statistically as well as economically significant effect on individual firm growth. To underline the causality of this relation, we show that the effect is particularly pronounced for firms that are structurally more dependent on bank financing. With regard to economic significance, our results suggest

that the 'catharsis effect' can cause a difference of roughly 0.4 to 0.6 percentage points in firms' growth rates. Second, investigating the transmission channels of the 'catharsis effect', we find that it essentially works through benefiting better quality firms ('quality channel') and reallocating credit towards firms that need it most ('quantity channel'). Third, additional analyses suggest that the 'catharsis effect' works best under specific economic conditions, for example in open banking systems that provide high access to international finance and hence mitigate potential negative consequences of insolvent bank liquidation. All our findings are robust to various specifications.

Taken together, our results strongly underline the significance of bank insolvency and resolution for the real economy.

Nicht-technische Zusammenfassung

Wie beeinflusst die Behandlung insolventer Banken die Realwirtschaft? Die vorliegende Studie analysiert die Auswirkungen von regelbasierter Abwicklung insolventer Banken auf realwirtschaftliches Wachstum. In der ökonomischen Theorie spielen Banken als Finanzintermediäre eine wachstumsfördernde Rolle für eine Volkswirtschaft. Allerdings können verzerrte Anreize von Banken, Einlegern und Aufsichtsbehörden rund um Bankinsolvenzen und -abwicklungen wesentliche Entscheidungen in der Kreditvergabe und Kreditüberwachung korrumpieren. In Ermangelung von effizienten und effektiven Bankinsolvenzvorschriften bleiben Banken dann auf Grund dieser verzerrten Anreize oft hinter ihrer wachstumsfördernden Rolle zurück. Im Ergebnis kann dies zu suboptimaler realwirtschaftlicher Leistungsfähigkeit führen. Basierend auf diesen theoretischen Argumenten und empirischer Forschung argumentieren wir, dass eine regelbasierte Abwicklung insolventer Banken ein geeignetes Anreizsystem (wieder)herstellt und eine volkswirtschaftlich effizientere Funktionalität von Banken ermöglicht. Die Richtung des Effekts einer solchen Abwicklungsregel ist a priori jedoch nicht offensichtlich, da positive Auswirkungen wiederhergestellter Anreize gegebenenfalls durch negative Auswirkungen von Bankinsolvenzen - wie z.B. Ansteckungseffekte oder Rückgang des Finanzierungsangebots - aufgewogen werden können.

Vor diesem Hintergrund testen wir den hypothesierten "Katharsis-Effekt" regulatorischer Insolvenz bzw. regelgebundener Abwicklung insolventer Banken hinsichtlich der Auswirkungen auf die Realwirtschaft. Zur Messung des "Katharsis-Effekts" konzipieren wir einen neuen Indikator und nutzen dessen Variation in der Abwicklungspolitik verschiedener europäischer Staaten. Dabei definieren wir eine hypothetische Insolvenzegel, die eine automatische Abwicklung vorsieht, sobald eine Bank unterhalb einer vorgegebenen Eigenkapitalquote fällt. Der Katharsis-Indikator misst, wie streng eine solche Regel umgesetzt wird, indem er die Summe von Banken, die nach dem Unterschreiten einer bestimmten Eigenkapitalquote abgewickelt wurden, ins Verhältnis setzt zu allen Banken, die diese Quote unterschritten haben. Darüber hinaus konstruieren wir ein Panel von mehr als 2 Millionen Unternehmens-Jahres-Beobachtungen mit Daten zur wirtschaftlichen Leistungsfähigkeit von Unternehmen der Realwirtschaft. Da die Beziehung zwischen realem Wirtschaftswachstum und Finanzsystem zahlreiche wechselseitige Wirkmechanismen aufweist, nutzen wir eine Identifikationsstrategie bestehend aus mehreren ökonometrischen Techniken, um den Nachweis von Kausalität zu führen.

Unsere Ergebnisse bestätigen die Hypothese eines positiven "Katharsis-Effekts" und lassen sich dabei in drei wichtigen Erkenntnissen zusammenfassen. Zunächst zeigen die

Ergebnisse, dass eine vergleichsweise stärkere Umsetzung einer hypothetischen Abwicklungsregel einen positiven und statistisch sowie ökonomisch signifikanten Effekt auf das Wachstum von Unternehmen der Realwirtschaft hat. Um die Kausalität dieser Beziehung zu unterstreichen, zeigen wir darüber hinaus, dass der Effekt besonders ausgeprägt ist für Unternehmen, die strukturell von der Finanzierung durch Banken abhängig sind. Mit Blick auf die ökonomische Signifikanz der Ergebnisse kann der "Katharsis-Effekt" rund 0,4 bis 0,6 Prozentpunkte Unterschied in der Wachstumsrate von Unternehmen ausmachen. In einem zweiten Schritt untersuchen wir mögliche Transmissionsmechanismen für den "Katharsis-Effekt". Dabei wird deutlich, dass insbesondere Unternehmen mit höherer Profitabilität von einer stärkeren Abwicklung insolventer Banken profitieren ("Qualitätskanal") und zudem eine Reallokation von Kreditvolumen an die Unternehmen stattfindet, die externe Finanzierung strukturell am stärksten benötigen ("Quantitätskanal"). Drittens deuten zusätzliche Analysen darauf hin, dass die Funktionalität des "Katharsis-Effekts" von wirtschaftlichen Rahmenbedingungen abhängig ist. Ein Beispiel hierfür sind Banksysteme, die einen offenen Zugang zu internationaler Finanzierung (z.B. durch ausländische Banken im Inland) bieten und damit mögliche negative Folgen der Abwicklung insolventer Banken abmildern können. In einem solchen System ist der "Katharsis-Effekt" besonders stark ausgeprägt. Alle Ergebnisse sind robust in verschiedenen Spezifikationen.

Zusammengenommen unterstreichen unsere Ergebnisse, wie bedeutend die Abwicklung insolventer Finanzinstitute für die Realwirtschaft sein kann.

Catharsis -
The Real Effects of Bank Insolvency and Resolution[*]

Josef Korte

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Abstract

In general, banks play a growth-enhancing role for the real economy. However, distorted incentives for banks, depositors, and regulators in connection with bank insolvency may corrupt banks' credit allocation and monitoring decisions, leading to suboptimal real economic outcomes. A rules-based prompt resolution regime for insolvent banks may reestablish the incentive system and provide for economically superior credit allocation and monitoring. We test the hypothesis that regulatory insolvency has a cathartic effect using a large firm-level dataset and proposing a new indicator to measure the strength of catharsis. Employing an instrumental variable setup and an interaction approach, we try to overcome concerns about causality and potential endogeneity which are usually inherent to research into the real economic implications of bank regulation. We find a comparably stronger implementation of a hypothetical positive capital closure rule to have a positive and statistically as well as economically significant effect on individual firm growth - particularly for firms that are structurally more dependent on bank financing. Our findings are robust to various specifications. Investigating the transmission channels of the 'catharsis effect', we find that it essentially works through benefiting better quality firms and reallocating credit towards firms that need it most. Additional analyses suggest that the 'catharsis effect' works best in open banking systems that provide high access to international finance and, hence, mitigate potentially negative credit supply effects of insolvent bank liquidation. Taken together, our findings advocate stronger attention being given to incentive-compatible bank resolution regimes.

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1 Introduction

Banks provide valuable services, which makes them effective contributors to the performance of the real economy. Economic theory has settled on financial intermediaries to perform important functions in overcoming imperfections in a real world characterized by financial frictions. This link between financial intermediation and the real economy has also been empirically established (Fisman and Love, 2007; Rajan and Zingales, 1998; King and Levine, 1993). It is particularly the conventional function of financial intermediaries, i.e. the collection, transformation, allocation, and monitoring of credit into its most productive uses, which is of paramount importance to the real economy. Performing this task without distortions improves the efficiency of capital allocation and reduces the cost of external financing for economic agents, thus supporting economic performance (Beck et al., 2000; Levine, 2005).

However, not only does the beneficial role of the banking system arise from market imperfections, but there are also several sources of market failure in financial intermediation. Asymmetric information and moral hazard, for example, distort agents' incentives in financial intermediation and lead to economically suboptimal outcomes that materialize in the misallocation of credit or the inherent fragility of the financial system. Such market imperfections in financial intermediation have prompted countless attempts at correction by way of intervention through regulation and legal provisions. A core element of this regulatory architecture is the treatment of distressed banks, and particularly the resolution of insolvent institutions (Dewatripont and Rochet, 2009).

In fact, there is extensive theoretical research and empirical evidence pointing towards a magnitude of distorted incentives surrounding bank insolvency resolution that can easily corrupt banks' and regulators' decisions. The suboptimal outcomes are most visible in distorted credit allocation and monitoring decisions in the absence of a strict insolvency resolution regime. Since their failure has strong negative externalities, banks might take excessive risks anticipating a bailout if their strategy goes wrong (Marin and Vlahu, 2011). They might also try to become 'too big to fail', or herd and overinvest into specific asset classes in an attempt to become 'too many to fail' (Acharya, 2009). Likewise, institutions that are close to or de facto insolvent might channel credit to high-volatility, negative NPV assets in an attempt to 'gamble for resurrection' (Freixas and Rochet, 2008). Distorted incentives also induce government officials and regulators to forbear their regulation - effectively creating and sustaining 'zombie' institutions that are technically insolvent but still allowed to operate (Kane, 1987). The outcomes of such distorted credit allocation and monitoring are felt in the real economy, where it is not the projects and firms that need and deserve credit most on grounds of economic viability and profitability which are favored by incentive-corrupted financial intermediaries, but those that have particular risk-profiles or belong to certain asset categories. However, there are correcting mechanisms available in the toolkit of banking regulation: Insolvency resolution regimes constitute an important vehicle for correcting or preventing such distorted incentives.

Our analysis is dedicated to testing whether the resolution of insolvent banks in a strict and rules-based manner (re)establishes proper incentives in credit allocation and monitoring. If that is so, it should improve the economically beneficial functions of financial intermediaries. Ultimately, this should have positive real effects. Put differently, this is another manifestation of Schumpeter's concept of creative destruction: Insolvency and resolution regimes promote an efficient reallocation of resources and thus have a cleansing effect on financial intermediation, which ultimately improves financial functions and real economic performance. Hence, they produce a form of 'catharsis' in the banking system. We set out to test whether such a 'catharsis effect' is to be found and what the mechanisms and conditions of its operation are.

This paper is intended to contribute to the existing empirical literature on the effects of bank regulation and insolvency at an intersection of three areas of research. First, it augments existing research on the real effects of the structure and conduct of financial intermediation under regulation. Significant contributions to the literature have so far evaluated the economic structure and growth effects of foreign bank entry and financial integration (Giannetti and Ongena, 2009), of bank concentration and competition (Cetorelli and Strahan, 2006; Cetorelli, 2004), of loan subsidies and direction of credit (Bertrand et al., 2007), of banks' efficiency in costs and profits (Hasan et al., 2009), and of bank crises (Dell'Ariccia et al., 2008; Kroszner et al., 2007; Rancière et al., 2008). To the best of our knowledge, the effect of bank insolvency and resolution regimes on real economic performance has not been empirically evaluated so far.

Second, this paper contributes to the literature on alternative treatments of troubled or failed banks. While the effects of various bailout mechanisms and accommodative policies, such as recapitalization, blanket guarantees, and regulatory forbearance have recently attracted a lot of attention (Black and Hazelwood, 2012; Claessens et al., 2005; Dam and Koetter, 2012; Giannetti and Simonov, 2011; Honohan and Klingebiel, 2003; Laeven and Valencia, 2011), there is still a lack of conclusive empirical evidence on the real effects of strict implementation of insolvency and resolution regimes.[1]

In the third area of research, this paper adds to the literature on the effects of bank insolvency. Existing research tests the effects on bank behaviour (Caballero et al., 2008; Peek and Rosengren, 2005; Igan and Tamirisa, 2008), regulatory behaviour (Brown and Dinç, 2011; Imai, 2009), and individual clients (Djankov et al., 2005) of insolvent banks. The closest empirical insight in relation to our paper is probably the combination of Peek and Rosengren (2005) and Caballero et al. (2008). The first pair of authors show that Japan's 'lost decade' was reinforced by troubled banks that were not resolved effectively but instead misallocated credit by expanding lending to weaker, not healthier, firms and hence created artificially surviving, underperforming 'zombie' firms. Caballero et al. (2008), in turn, show that the existence of such 'zombie' firms had a depressing effect on 'non-zombies' and hence decreased overall economic performance. While this

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[1]It should be noted, though, that there are theoretical approaches which model and prescribe policies for the resolution of failed banks (DeYoung et al., 2013).

evidence strongly supports the hypothesis that effective bank insolvency resolution would prevent such outcomes and, consequently, lead to long-run improvements in real economic performance and growth, there is no conclusive evidence for this hypothesis so far.

Hence, to the best of our knowledge, this paper extends the empirical literature by testing for the real effects of strict and rules-based bank insolvency resolution. The remainder of this paper is organized as follows. Section 2 gives an overview of the related theoretical literature and core findings of existing empirical research. Our key hypothesis is derived and elaborated against this background. In section 3, we present our methodology and identification strategy. The dataset, our conception of a bank catharsis indicator, as well as descriptive statistics are presented in section 4. Section 5 contains the results of the analysis and some extensions on the transmission mechanisms and conditions of operation of the 'catharsis effect'. These are complemented with several robustness tests in section 6. Section 7 concludes.

2 Background, related literature and key hypothesis

The purpose of this section is twofold: In a first step, we use theoretical predictions and existing empirical evidence to demonstrate how the treatment of failed banks can affect real economic outcomes. In a nutshell, it does so by influencing incentive structures in financial intermediation and the resulting credit allocation and monitoring decisions. In a second step, we assess several failed bank resolution policies for their effectiveness in establishing efficient incentive structures in financial intermediation that induce positive real effects. This survey of theoretical predictions and empirical indications provides the background for the formulation of our main research question.

2.1 How distorted incentives around bank insolvency can harm the real economy

The existing literature analyzes several dimensions in which the treatment of failed banks can establish or distort incentives and hence influence the individual or collective behaviour of financial intermediaries in an ex ante (i.e. before de facto undercapitalization or insolvency) and ex post sense. We examine each potential incentive distortion in turn. In addition, we give a brief overview of incentive distortions affecting banks' monitors, i.e. depositors and regulators. We show how these are modeled and how they support the corruption of the credit allocation and monitoring function of financial intermediation and hence hamper real economic performance.

Individual bank incentive distortions (ex ante) Highly leveraged firms - such as banks - have incentives to exploit lenders by taking excessive risks (Jensen and Meckling, 1976). For financial intermediaries, the tendency towards excessive risk-taking is even amplified when their failures are associated with strong negative externalities which

give banks bargaining power over their treatment in a failure situation. An individual bank might thus not have to fear bankcruptcy but can anticipate a bailout due to implicit or explicit government guarantees (Marin and Vlahu, 2011). This can lead not only to intentional excessive risk-taking and unsound blow-up of balance sheets, but also to insufficient screening and monitoring of borrowers (Dell'Ariccia and Marquez, 2006). Empirical evidence lends support to such predictions by showing that governance structures in banks that are most accountable to shareholders/bank owners lead to relatively higher risk-taking (Beltratti and Stulz, 2009; Fortin et al., 2010). Moreover, the observation that crises are often associated with prior credit booms (Detragiache and Demirgüç-Kunt, 2005) lends credence to the prediction of unsound balance sheet blow-ups. It is also telling that the most frequent reasons for bank failures seem not to be macroeconomic shocks but unsound investments and insufficient risk management (Caprio and Klingebiel, 1997; IADI, 2005). Caprio and Klingebiel (1997) summarize the ex ante distortion of incentives by concluding that bankers do not seem to plan for failure since they do not have the incentive to do so. Such ex ante incentive distortions lead banks not to perform their original function of credit allocation and monitoring in a way that would be optimal to real economic performance. Rather, they might be inclined to take on excessive risk and value volatility over expected NPV in their credit allocation decisions, hence allocating credit to economically inferior projects.

Not only inefficiently increasing risk or volatility, but also striving for excessive complexity might be an outcome of these incentive distortions. DeYoung et al. (2013) model strong incentives for banks towards complexity when limits in resolution technologies and political pressure prevent the regulator from closing a failed but overly complex bank.

Individual bank incentive distortions (ex post) Once it is severely undercapitalized or close to failure, a financial intermediary can be seen as an option to its owners that is more or less out of the money and only creates value for them in volatility. Hence, incentives grow to further substitute risk for economic soundness in an effort to 'gamble for resurrection'. In addition, banks' assets are opaque, their quality is often observable only in the long-term, and banks that are close to or already undercapitalized have no incentive to disclose when some of their assets are non-performing (Marin and Vlahu, 2011). Hence, they discontinue effective credit monitoring and roll over non-performing loans, hoping they might recover. In fact, available evidence strongly supports unhealthy banks not performing well in their credit allocation and monitoring functions. Amongst others, Igan and Tamirisa (2008) provide evidence that it is particularly weakly capitalized banks that lead credit booms and expand in an effort to grow out of their problems. Peek and Rosengren (2005) show that Japanese banks 'evergreened' their loan portfolios by indiscriminately rolling over their loans to weak companies. Caballero et al. (2008) show how this transmits to the real economy via 'zombie' firms kept half-alive by their evergreening banks, which, in turn, depress economic growth.

In an even more extreme case of incentive distortions, bank owners and managers might

have an incentive for legal or illegal 'looting', i.e. taking on deposits and channeling credit at favourable terms to related firms (Akerlof and Romer, 1993). There is some empirical evidence that supports looting in financial intermediation, for example, by showing that banks in distress heavily engage in related lending in an effort to transfer wealth from the bank to another firm also owned by the bank owners (La Porta et al., 2003).

Collective bank incentive distortions   While individual banks are already prone to moral hazard in their credit allocation, Acharya and Yorulmazer (2007) and Acharya (2009) model how the time-inconsistency of bank closure decisions can lead to incentives for banks to herd into the same asset classes in an effort to be 'too-many-too-fail' - effectively creating systemic risk. Strong empirical evidence supports their model predictions by showing that governments are less likely to close or take over a bank if the whole banking system is in a crisis (Brown and Dinç, 2011; Kasa and Spiegel, 2008) and that banks tend to herd in times of low capitalization (Stever and Wilcox, 2007). Such herding behaviour distorts the credit allocation and monitoring function of financial intermediaries as it leads to a concentration on particular asset classes and a disregard of others, which is not necessarily merited by their risk-return profiles.

In an ex post sense, Rajan (1994) models how bankers collude to delay the recognition of bad loans by rolling them over and disclosing them simultaneously to avoid individual blame. Stever and Wilcox (2007) also support this empirically by documenting a tendency of large US banks to underreport non-performing loan write-offs and provisions in times of overall weak capitalization in the banking industry.

Incentive distortions of banks' monitors (I): Depositors   When banks' lending decisions are prone to moral hazard, one disciplining force could be banks' external financiers, such as depositors. However, economic theory predicts that there is not much of monitoring and disciplining to be expected from depositors that are usually small, dispersed, and properly insured by a deposit insurance system (Marin and Vlahu, 2011; Kaufman, 2006; Calomiris and Kahn, 1991). Less monitoring, in turn, leads to less pressure on the banks to not pursue excessive risk-taking or otherwise distorted credit allocation decisions. Insured depositors might even have an interest in high risk-taking by their banks as long as they get at least a share of the rents, for example, in the form of high deposit interest rates. Hence, they may even collude with the bankers they should monitor. In fact, empirical evidence suggests that banking crises are associated with explicit deposit insurance and are even more severe when the insurance coverage is more extensive or even provided for by the government and not by a banking industry scheme (Detragiache and Demirgüç-Kunt, 2005). Demirgüç-Kunt et al. (2008) go even further by showing that countries with weakly capitalized banking systems tend to introduce or extend deposit insurance coverage, suggesting an interplay of public and private (banking industry) interests for deposit insurance.

Incentive distortions of banks' monitors (II): Regulators   Economic theory provides several explanations of why regulators would not prevent distorted credit allocation decisions. A first line of research suggests that even if regulators wanted to maximize welfare by counteracting distorted incentives, a commitment problem prevents them from doing so. Mailath and Mester (1994), for example, model the time-inconsistency of bank closure decisions for individual banks, suggesting that regulators are unable to commit credibly ex ante on bank closures due to the cost of foregone intermediation and potential future development of bank assets. Acharya and Yorulmazer (2007) extend this approach to collective bank closure decisions and show that it might be ex post optimal for the regulator to bail out banks if they failed collectively. For the individual regulator handling a closure decision, there seems to be a trade-off between preserving short-run financial stability (advocating bailout) and preventing long-run moral hazard and distorted credit allocation (advocating closure), in which the first option is often chosen by a myopic regulator (Hoggarth et al., 2004).[2]DeYoung et al. (2013) model this trade-off between liquidity and discipline and suggest that, when lacking proper resolution technologies, regulators might simply be technologically unable to close overly complex failed banks - and consequently choose the bailout option..

The second line of research does not even have the optimistic assumption of a welfare-maximizing regulator that is merely incapable or myopic but assumes a self-interested regulator that is captured by industry interests or government officials. Regulators may also exhibit corrupted incentives or suffer from principal-agent problems, inducing them to obscure their own inaptitude, or to collude with the banking industry by forbearing strict closure regulation (Boot and Thakor, 1993; Kane, 1987, 1990). Moreover, politicians may intervene in the regulatory treatment of failed banks in order to maximize their own utility functions. This regulatory capture view in failed bank treatment is supported by empirical evidence showing bank closures to be less likely before elections (Brown and Dinç, 2005) and regulators delaying closure of insolvent banks located in the constituencies of senior politicians (Imai, 2009). Caprio et al. (2010) conclude that this distorted failed bank treatment by regulators helps sustain banks' moral hazard and potentially worsens the depth and frequency of banking crises.

2.2   Bailout vs. Catharsis - Which resolution policies are most effective in (re)establishing incentives in financial intermediation

In general, there are two overall categories of how to handle a financial intermediary that is insolvent: An 'accommodative' approach, i.e. bailing out the intermediary trying to preserve it in its current legal form, or a 'cleansing' approach, i.e. sending it through an

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[2]Even if the regulator could credibly commit to a closure policy such as Bagehot's rule to act only as a lender of last resort for illiquid but not insolvent institutions, it is very hard for the regulator to disentangle illiquidity from insolvency (Freixas and Parigi, 2008).

insolvency procedure which entails the closure of the intermediary as an individual legal entity, equity wipeout, and management change. Below, we analyze each approach and the relevant intervention tools in turn. We focus, in particular, on the way these resolution approaches influence the incentive structure and, ultimately, real economic performance.

Accommodating resolution policies - the bailout effect Accommodating policies include extensive government interventions in failed banks that take place before or even when an individual institution enters insolvency, but aim at sustaining the financial intermediary as a legal entity. Typical bailout instruments include blanket guarantees, open liquidity assistance, recapitalization, or forbearance of regulatory prescriptions. While they help to protect the existence of failed banks (and hence preserve liquidity), such instruments are often blamed for their effects on incentives. Bagehot (1873) long ago warned that liquidity assistance should not be extended to insolvent institutions as this support would sustain or even encourage worse credit allocation decisions. This warning is reinforced by Kane and Klingebiel (2004), who predict that financial intermediaries that are treated with accommodating policies will suffer from distorted incentives, and engage in gambling for resurrection, effectively externalizing their risk-taking to the taxpayer and, hence, society at large. The authors provide evidence from several case studies to show how most countries' accommodative policies were mismanaged and aggravated the incentive distortions. In this light, government bailout policies and safety nets have been identified as a potential source of instability rather than a remedy for it (Calomiris et al., 2005).[3] Extensive empirical evidence on the macroeconomic level supports this view by suggesting that accommodative policies - particularly if not well executed - often do not speed financial and economic recovery and do not mitigate real output loss, but rather increase the cost of banking crises and moral hazard in the long run (Honohan and Klingebiel, 2003; Dell'Ariccia et al., 2008; Giannetti and Simonov, 2011). At the bank level, several recent contributions analyze the effects of bailout policies or (implicit) state guarantees and show that these increase moral hazard and banks' risk taking (e.g. Black and Hazelwood (2012); Dam and Koetter (2012); Duchin and Sosyura (2012)).

Cleansing resolution policies - the 'catharsis effect' Cleansing resolution policies are characterized by the end of existence of the financial intermediary as a legal entity in its previous form, including equity wipeout and ousting of management. Such policies focus particularly on purchase and assumption (P&A), i.e. merger or acquisition of a failing bank by another institution, and straightforward closure and liquidation. Several authors have modeled the effects of such policies. Acharya (2009) and Acharya and Yorulmazer (2007) infer from their model that the sale of a failed bank to its competitors - who might even receive liquidity support from the regulator - improves the ex ante incentive

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[3]Admittedly, there are also models which suggest well-designed bailout policies exhibit a positive effect on banks' charter values that more than offsets the moral hazard effect, leading to more prudent risk-taking behaviour (Cordella and Yeyati, 2003). However, these conclusions depend on very specific economic circumstances and specifically designed (and executed) policies.

structure of financial intermediation. From the standpoint of incentives and ultimately efficient credit allocation decisions, they find an assisted P&A policy to be superior to other resolution mechanisms. Panyagometh and Roberts (2009) present a model that yields similar conclusions. It might be argued that such a policy inevitably results in a trade-off between incentives for efficient credit allocation and reduced competition in the banking sector. Perotti and Suarez (2002) formalize this trade-off and show that a P&A policy provides strong ex ante incentives for intermediaries to stay solvent when failed banks are sold to survivors and thus increase the survivors' charter value. They suggest that these incentives, together with adjustments in bank entry regulation might mitigate the trade-off.

Some authors go even further and advocate a strict closure and liquidation policy as soon as (or even slightly before) a bank has become insolvent. Davies and McManus (1991), for example, model how specific closure rules increase or decrease banks' incentives for risk-taking, advocating timely closure policies and constant monitoring of bank risk. Lindgren (2005) argues that straightforward closure is one of the most important ways to keep the financial system competitive, efficient, and sound - which already alludes to bank closures having a cathartic effect. Kane (2002) explicitly formulates this 'catharsis effect' and relates it to Schumpeter's concept of creative destruction. The main argument supporting a strict closure policy is the reestablishment of incentives, i.e. the expectation of closure in the event of insolvency is intended to reduce moral hazard (Caprio et al., 2010). There is also some empirical evidence to support the hypothesis of a 'catharsis effect' of bank resolution. Demirgüç-Kunt et al. (2006), for example, find that banking crises are associated with a V-shaped output decline and rapid recovery. Moreover, while credit growth contracts in banking crises, the level of credit relative to GDP stays constant, indicating that the credit boom ends, but that there is no sudden and irrevocable collapse of lending. Rather, the authors interpret their findings in line with a flight to quality by depositors and banks alike. Rancière et al. (2008) even find that average growth is higher for countries that experience banking crises, while Dell'Ariccia et al. (2008) provide evidence for the negative real effects of banking crises that grow overproportionately with the severity of the crisis. Taken together, this might be interpreted as further support of a hypothesis that bank closures of insolvent institutions in fact benefit the real economy by (re)establishing incentives for efficient credit allocation.

In order to arrive at this intended effect, while, at the same time, limiting forbearance caused by self-interested or captured regulators, some authors argue for an extremely rules-based closure policy that offers very little room for regulatory discretion (Demirgüç-Kunt and Servén, 2010; Dewatripont and Rochet, 2009; Boot and Thakor, 1993). It is against this background that Kaufman (2011, 2006) proposes his regulatory insolvency policy, which is centered on the idea of a non-discretionary positive capital closure rule. Inspired by the US system of prompt corrective action (PCA) triggered by the violation of specific thresholds such as capital ratios, Kaufman suggests a prompt legal closure as

soon as an institution undershoots a (positive) threshold capital ratio. This proposal is intended to get the catharsis mechanism of bank insolvency to work while avoiding regulatory forbearance.

2.3 Key research question

The literature on the potential implications of the treatment of failed banks for real economic performance and on bank resolution policies provides for some predictions that are empirically testable. To start with, distorted incentives of banks, depositors, and regulators in connection with bank insolvency and resolution can corrupt banks' credit allocation and monitoring decisions as well as their supervision. Ultimately, this leads to suboptimal real economic performance. However, a rules-based prompt resolution policy stipulating purchase and assumption or straightforward closure and liquidation of insolvent banks may reestablish the incentive system and provide for economically superior credit allocation and monitoring. This leads us to hypothesize a 'catharsis effect' of regulatory insolvency. Such an effect materializes, for example, in the positive capital closure rule: When insolvent banks that warrant legal closure in accordance with a prompt resolution rule are, in fact, led into strict insolvency resolution, incentives in credit allocation are (re)established. This ultimately reestablishes the full growth-enhancing effect of credit intermediation on the real economy.

However, an argument might be made in favor of competing hypotheses about the direction of the effect. Positive effects of reestablished incentives might be outweighed by negative effects of individual bank failures, i.e. negative externalities, loss of charter value and growth opportunities, contagion, and credit crunch (Freixas, 1999; Djankov et al., 2005; Kroszner et al., 2007). Moreover, committing a type II error, i.e. accidentally closing a healthy bank, has detrimental real economic consequences (Ashcraft, 2005). Hence, the direction of an applied closure rule is a priori not necessarily obvious. Also, the effect is likely to experience variation across different types of firms (e.g. firms in bank-dependent versus less bank-dependent industries or profitable vs unprofitable firms) or under different economic and financial conditions (e.g. in systems more or less open to international finance). We subject these questions to empirical tests in the following sections.

3 Methodology and identification strategy

The challenge to identify an effect of bank regulation on real economic growth is structurally very similar to the problem that confronts the finance and growth literature in general: While we can easily detect a correlation between certain characteristics of the financial system (be it financial development, foreign bank presence, or bank capital regulation) and real outcomes, establishing a causal link is somewhat harder due to numerous possibilities of endogeneity and omitted variables. To start with, there is an endogenous

relationship between financial development/structure/regulation and economic growth which needs to be controlled for: Growth might be caused by financial characteristics, but also vice versa, and there might be other drivers of growth that are closely related to financial characteristics etc. Using a post hoc approach, i.e. the structure and regulation at the beginning of a period, to explain economic growth over that respective period still leaves room for the interpretations that there are common omitted variables influencing both regulation and economic outcomes or that the regulation anticipates future growth and is thus put in place before the growth period - but nonetheless endogenously related to it (Levine, 2005).

In trying to mitigate these problems, we methodologically rely on the construction of a unique panel dataset, the use of instrumental variables, and the application of an identification approach that exploits firm- or industry-level differences in bank dependency. Our identification framework is closely related to existing research on the effects of banking sector structure and regulation on the real economy. Essentially, we follow a three step regression framework suggested by Giannetti and Ongena (2009), who use identification strategies proposed by Rajan and Zingales (1998), La Porta et al. (2003) and others. The following tree steps constitute the key pillars of our identification strategy.

In a first step, we use a simple regression framework and exploit the nature of our panel dataset that allows to control for time- and firm-invariant unobserved effects. We test the relation using the following baseline specification:

$$\triangle ln(output_{i,t}) = \alpha + \beta * bank\,catharsis\,indicator_{k,t} + X_{i,t} + Z_{k,t} \tag{1}$$
$$+ \sum_i \gamma_i * firm_i + \sum_t \delta_t * year_t + \varepsilon_{i,t}$$

with i = 1,..., I denoting individual firms, k = 1,..., K denoting countries, and t = 1,..., T years. The dependent variable, $\triangle ln(output)$ is a measure of firm output growth (e.g. revenue growth). The $bank\,catharsis\,indicator_{k,t}$, which is a proxy for the degree of rules-based resolution of de facto insolvent banks, serves as the main explanatory variable.[4] $Firm_i$ and $year_t$ are two sets of fixed effects that control for unobserved time- and firm-invariant effects in our data. To control for covariates that vary over both firm and time dimensions, we insert a vector of firm-specific control variables, $X_{i,t}$, and a vector of country-specific control variables, $Z_{k,t}$. $X_{i,t}$ includes observable time-varying firm characteristics, such as size, age, and profitability, while $Z_{k,t}$ includes observable time-varying country characteristics, such as financial development, bank sector capitalization, bank sector concentration, economic development, and institutional quality. All variables are defined and detailed in the following section, with a particular emphasis given to the conceptualization of the catharsis indicator.

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[4]A detailed explanation of the conceptualization and computation of the bank catharsis indicator is provided in the following section.

Although we exploit the panel characteristics of our dataset and try to control for the remaining observable variables, it is easy to argue that there are numerous problems which cast doubt on the validity of our results in this first step. On the one hand, not all potentially omitted variables might be captured by the fixed effects and controls. On the other hand, one might still argue for endogeneity of bank catharsis, which could simply be an answer or prelude to expected growth.[5] Hence, we subject this baseline specification to two more rigorous tests in order to establish a valid causal relationship.

In the second step, we use an instrumental variable setup, assuming that the regulation of bank insolvency and resolution in country k and period t can serve as a valid instrument for actual resolution of insolvent banks as captured by the catharsis indicator. This idea is similar to the identification approaches of earlier research that has taken legal prescriptions for banks and bank regulation as an instrument for the actual characteristics of the banking sector or manifestations of the law in actual policies (Jayaratne and Strahan, 1996; Giannetti and Ongena, 2009). Hence, we take (a) the existence of a separate bank insolvency law and (b) the existence of superseding insolvency declaration power of an official regulatory or judicial body as instruments for the catharsis indicator. A heteroskedasticity-robust GMM estimator is used for the IV estimation (Baum et al., 2007), and we extensively discuss and test for the validity of the instruments (particularly with regard to the relevance and the exogeneity conditions) in the respective section.

In case the validity of the instrumental variable approach is still not fully convincing, we resort to a third step in our identification strategy, which was suggested by Rajan and Zingales (1998) and recently applied in various attempts to establish causal links between banking and the real economy.[6] The identifying assumption of this approach rests on the presumption that firms which are more dependent on bank financing should experience stronger (or weaker) growth in countries and periods where the resolution regime for insolvent banks is stronger when compared with firms that depend less on bank financing. Following Rajan and Zingales (1998) and the subsequent applications of their idea, we assume that a firm's dependence on bank financing is a technological or economic characteristic of the industry or sector to which the firm belongs. Under this assumption, bank dependence is relatively stable across countries and over time (at least over short to medium time horizons), but varies with the characteristic financial features of an industry, such as its cash-flow and investment structures in the aggregate.[7] Hence, we can compute the bank dependence on an industry-level and test our presumption by augmenting our baseline specification with an interaction term that accounts for the bank dependence of a firm:

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[5]It should be noted that endogeneity due to reverse causality is already reduced by employing firm-level data, since it seems implausible that output growth of a single firm affects bank closure policies.

[6]Refer to Bertrand et al. (2007); Cetorelli (2004); Cetorelli and Strahan (2006); Claessens and Laeven (2005); Dell'Ariccia et al. (2008); Fisman and Love (2007); Giannetti and Ongena (2009), amongst others.

[7]For a detailed discussion of the validity of this assumption, refer to Kroszner et al. (2007).

$$\triangle ln(output_{i,t}) = \alpha + \beta_1 * bankdep_i + \beta_2 * bank\,catharsis\,indicator_{k,t} \qquad (2)$$

$$+ \beta_3 * (bankdep_i * bank\,catharsis\,indicator_{k,t})$$

$$+ X_{i,t} + bankdep_i * Z_{k,t} + \sum_i \gamma_i * firm_i + \sum_{k,t} \delta_{k,t} * country\,year_{k,t} + \varepsilon_{i,t}$$

with i = 1,..., I denoting individual firms, k = 1,..., K denoting countries, and t = 1,..., T years. The $bank\,catharsis\,indicator_{k,t}$ is now interacted with $bankdep_i$, an index that measures the (industry-specific) bank dependence of a firm. This augmented specification has two key advantages over our baseline specification and the IV approach. First, it allows us to control not only for firm- and year fixed effects but also for country-trends, i.e. for country-year fixed effects that would have absorbed the bank catharsis indicator in the baseline specification and could thus not be included before. Hence, we are able to control for a full range of additional unobservables - and are thus closer to excluding almost any potentially omitted variable. Consequently, this specification should help us to overcome endogeneity concerns: Even if firms' average growth rates are correlated with the strength of bank resolution due to reverse causation and/or omitted variables that are not captured by the control variables (or that make the instrument invalid), it is difficult to find an argument for such a variable to drive the relation between firm performance and bank resolution in a systematic way that varies with firms' bank dependence. Second, such an approach provides a more convincing test for establishing causality. In the words of Rajan and Zingales (1998): It provides a 'smoking gun' by testing a specific mechanism through which bank resolution can affect economic growth, namely by disproportionately benefiting firms more dependent on bank finance.

It should be noted that - other than the interaction - the simple effects of the $bank\,catharsis\,indicator_{k,t}$ and $bankdep_i$ are absorbed by the fixed effects in the above specification. In order not to have the country-year specific control variables absorbed, we also interact the vector Z with bank dependence.

4   Data

4.1   Overall dataset composition and data sources

In order to test the specifications outlined in section 3, we construct a new dataset based on several sources. The dataset contains more than 2 million firm-year observations and covers 39 countries over the period 2003-2010. Regarding the regional focus, we decide to limit our sample to European countries for two main reasons. As a first restriction, data availability and reliability limit the dataset, excluding most other regions. Nevertheless, we could also gather a state-level dataset from the US. While there is good data availability for US firms and banks as well, we suspect that the variance of the main explanatory

variable - the bank catharsis indicator - is rather low at an interstate level as it is largely governed by a unified federal regulation framework. This is not so in Europe: The rules for bank insolvency and, particularly, the individual decisions on actual bank resolution are mostly determined by national authorities and hence vary not just over time but also between countries. This setup is beneficial to our identification strategy and suggests a dataset focused on European countries rather than US states. Regarding the timeframe, we aspire to construct a dataset for which there is a minimum of datapoints and regional variance available for each period and which covers more than a part of the business cycle, including both years with and without the influence of financial and economic crises.

The main firm-level data is taken from Bureau van Dijk's Amadeus database, which provides the largest coverage of data on European firms. Bureau van Dijk also provides data on European banks in its Bankscope database that is used to compute the bank catharsis indicator as described in the following subsection. Information on bank insolvency legislation and regulation is taken from the Bank Regulation and Supervision dataset published by the World Bank (Barth et al., 2001, 2004; Caprio et al., 2008). Further country-level control variables are constructed from the World Bank Financial Structure dataset (Beck et al., 2009), the World Development Indicators database and the Polity IV database provided by Marshall et al. (2011).

Following several authors who use data from similar sources (Bertrand et al., 2007; Giannetti and Ongena, 2009; Klapper et al., 2006), we include only firms that meet one of the following criteria: (a) total assets of minimum USD 20 million, or (b) total operating revenue of at least USD 10 million, or (c) at least 150 employees. This is done mainly on grounds of data availability and employability of the dataset. For most of the firms below this size, financial and accounting data is very limited or appears to be unreliable. Also, the availability of micro and small firm data varies greatly over countries. In order not to make our dataset too unbalanced or inconsistent in coverage, we employ these limits. This should also largely exclude 'phantom' firms that are established only for tax or other purposes. Moreover, the literature suggests that it is these medium and large firms for which bank finance - one key measure of our identification assumption - does indeed matter.[8] Additionally, we test the robustness of our results by running the analyses on subsamples and less restrictive samples.

4.2 Conceptualizing a measure for bank catharsis

Our approach particularly depends on a valid and powerful operationalization of the main explanatory variable, the bank catharsis indicator. This section introduces the main idea and operationalization of the catharsis indicator. To start with, the indicator essentially needs to capture the idea of how ordered or rules-based failed banks are resolved. Ideally, it should measure:

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[8]Giannetti and Ongena (2009) provide a detailed discussion of the justification for such a cutoff.

$$bank\,catharsis\,indicator_{k,t} = \frac{Failed\,bank\,assets\,that\,have\,been\,resolved_{k,t}}{Bank\,assets\,that\,should\,have\,been\,resolved_{k,t}} \quad (3)$$

However, there are restrictions imposed by data quality or, more generally, by data availability. Concerning the numerator (i.e. failed bank assets that *have been resolved*, there is often no unified framework for when and how to resolve banks (e.g. missing bank insolvency law). Accordingly, there is no or only limited regulatory reporting available, which is also not necessarily consistent across countries. With regard to the denominator (i.e. bank assets that *should have been resolved*), we encounter the question of how to define and identify which banks *should have been resolved*? The challenge is to find an approach that correctly identifies failed and to-be-resolved banks (minimize type I error), while, at the same time, avoids declaring healthy banks as failed and resolving them accordingly (minimize or even avoid type II error). To overcome these challenges, we suggest a relatively simple indicator which combines enough identification power to proxy for the hypothesized 'catharsis effect' and which can be effectively built for a multitude of banks and countries based on available data and despite inconsistent and incomplete regulatory reporting on bank failures. We conceptualize this indicator as follows.

For the nominator, we need data on failed/resolved banks, which is as encompassing as possible. Bureau van Dijk's Bankscope database reports inactive banks, their last account dates and accounting data as well as reasons for their inactivity (bankruptcy, in liquidation, dissolved by merger etc). Despite valid criticism, Bankscope is probably the most representative cross-country database, with a coverage of 80% or more of bank assets for a multitude of countries (Bhattacharya, 2003; Detragiache et al., 2008; Shehzad et al., 2009). We assume that it is similarly representative for bank closures. In any case, there should be no sampling bias or, at least, no inconsistency between numerator and denominator if the population which the bank closures are taken from (all banks reported in Bankscope) in the numerator is set in relation to a denominator composed of the very same population. This is the case with the following matching procedure employed: We define as resolved in insolvency resolution all banks that have (a) fallen below a pre-determined capital ratio threshold in the previous[9] or the current year and (b) ceased existence as a legal entity by ways of purchase and assumption (or M&A) or closure and liquidation. We exclude M&A from this definition as a robustness check.

Concerning the denominator, the preferred option for detecting which banks should be resolved is to test a regulatory insolvency threshold such as the positive capital closure rule, i.e. a simple capital ratio (equity/total assets) as should-be-resolved-trigger for bank insolvency. This basic principle follows from the discussion in the literature on bank insolvency, particularly from the suggestions of Kaufman (2011) and Lindgren (2005). A positive capital closure rule stipulates automatic regulatory intervention and

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[9]This allows for a timelag of regulatory action.

eventually even closure or purchase and assumption of a bank at the undershooting of pre-specificied positive capital ratios. The main rationale supporting the use of such rules is their simplicity in identifying insolvency (for banks, regulators, and - not least in this context - researchers), relatively small room for manipulation, and their natural tendency to be biased upwards, i.e. to avoid type II errors rather than type I errors. In fact, the literature on bank insolvency detection also suggests that simple capital ratios score surprisingly well in failure detection (Arena, 2008; Estrella et al., 2000) and show better results than more complex regulatory capital ratios (such as tier 1) in predicting failure during the financial crisis (Berger and Bouwman, 2012; Blundell-Wignall and Atkinson, 2010). Hence, we define all banks that fall below a pre-determined, simple capital ratio threshold as failed according to this regulatory definition.

In calculating the numerator and denominator, we take total reported asset values of resolved and failed banks (not bank numbers) to account for the effect that small banks might be more easily resolved by a regulator, but an ordered and rules-based positive capital closure rule should lead to a closure of a de facto failed bank irrespective of bank size.[10] The actual measurement and summary statistics of the bank catharsis indicator are presented in the following section.

4.3   Composition of other variables and descriptive statistics

Table 1 reports the sources and summary statistics of the variables used in our analyses. The definition of the individual variables is given below. Our full sample includes almost 2.2 million firm-year observations from 39 European countries, but we replicate the tests for restricted samples as robustness checks (see section 6). It should be noted that we cleaned the dataset from observations that exhibit logically impossible values and obvious data errors. Other than that, all cleanings or restictions on the dataset are reported with the relevant variables or specifications.

Dependent variables

We measure our main dependent variable - firm performance - by the growth of a firm's operating revenue. The operating revenue arguably provides a simple measure of firm performance that is less prone to disturbances such as extraordinary revenues or accounting and tax rules that can influence more sophisticated measures like EBIT. The growth rate of the operating revenue is computed as $ln(operating\,revenue_{i,t}/\,operating\,revenue_{i,t-1})$ and denoted $\Delta \ln(\text{OpRev})$ in the following tables. In order to limit the influence of outliers, we trim the sample at the 1st and the 99th percentile of the growth rates. A robustness check is also carried out on an uncensored sample.

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[10]Following the core idea of the catharsis indicator, a country which resolves two small banks that failed according to the rule but supports continued operations of a failed large bank should have a smaller indicator than a country which resolved one small and one large failed bank and forbears on the second small bank that failed. This can be attained by comparing asset values.

In addition to operating revenue growth as main dependent variable, we also analyze how changes in financing structure are influenced by the bank catharsis indicator in order to assess the channels through which resolution of insolvent banks might influence real economic performance. Essentially, this additional dependent variable allows us to test whether and explain why particular firms experience stronger growth following more rules-based bank insolvency resolution. One potential channel could be the reallocation of bank credit. Hence, we examine changes in financing structure towards debt financing as an additional dependent variable. This is proxied by the change in the financial debt ratio of a firm, denoted Δ debt/assets and computed as $[(shortterm\,loans_{i,t} + longterm\,debt_{i,t}) - (shortterm\,loans_{i,t-1} + longterm\,debt_{i,t-1})]/non\,equity\,liabilities_{i,t}$.[11] We also censor the sample at the 1st and 99th percentile as we did for the firm growth variable to limit the influence of outliers.

Explanatory variables

The bank catharsis indicator as a main explanatory variable is defined and operationalized above. It is computed based on individual bank-year level observations and aggregated to the country-year level. It should be noted that we limit our sample to country-year combinations for which at least ten bank observations are available in order to ensure that our indicator is not driven by extreme outliers.[12] Since we employ the matching procedure described above, all our results are between 0 and 100% by definition.

Calculating the bank catharsis indicator based on an hypothetical positive capital closure rule, we need to decide on a cutoff serving as a hypothetical trigger for insolvency resolution according to this rule. We choose to construct the bank catharsis indicator for an 8% capital ratio closure rule. The first reason for doing so is intuitive: 8% is arguably in line with traditional regulatory requirements - although these are now far more complex in computation than a simple capital ratio - and thus also make sense as a potential cutoff for insolvency regulation. The second reason is more quantitative: Among several cutoffs that have been computed, the 8% cutoff for the matched catharsis indicator exhibits the best 'detection rate', i.e. it peaks in the average identification of banks that really failed while falling below the threshold scaled by the banks that would have been regarded as failed since they fall below the threshold. Nevertheless, we compute several alternative bank catharsis indicators that are used for robustness tests in order to check that our results are not driven by the choice of the cutoff or the indicator definition. On the one hand, we compute the indicator for 7% and 9% simple capital ratio thresholds (i.e. 1% around the peak and reference case of 8%). With regard to alternative catharsis indicator definitions, we compute an indicator using average values of capital and assets for the capital ratio and another indicator using tier 1 ratios instead. While both of these

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[11]Note that we use an increase in the debt-to-non-equity-liabilities ratio to make sure that the increase of the ratio is not driven by a loss in equity (as it might be when using a loans-to-total-liabilities ratio).

[12]Note that we also censor the sample at the 1st and 99th percentiles of the catharsis indicator as a further robustness check in section 6.

alternatives make sense from an economic point of view, we have much less data available for these computations. Still, we compute both indicators to use them for additional robustness checks.

Table 1 shows that the sample mean of the bank catharsis indicators is between 2.2% and 4.5% respectively. These numbers might appear surprisingly low in the first instance. But this finding can be explained by two factors. First, it indicates that - generally - regulators refrain from resolving banks, even if their capital ratios drop below 8%. This could be due to limited willingness on the part of the regulators. Second, there are also many banks that would be regarded as being in healthy financial condition despite their capital ratio dropping below 8%. Whether they are is a different question. Both rationales - the limited willingness to close banks and the existence of otherwise healthy banks with low capital ratios - drive down the indicator in the aggregate. However, we would argue that this does not blur the identification power of our indicator, as we basically test whether countries that seem to follow a closer implementation of this positive capital closure rule (i.e. a more rules-based insolvency resolution policy) experience higher growth rates in their real economy, which is possible as long as there is some variation in the explanatory variable.[13] In fact, the indicator exhibits considerable variation over time and between countries. We use this variation as one source of our identification henceforth. In addition, to make sure this variation is not driven by outliers, nor by small countries that only have few bank-year observations available, we first limit the sample to countries and years with at least ten bank observations as described above. In addition, we carry our robustness tests (a) using a censored catharsis indicator and (b) excluding the countries with the lowest number of observations. Finally, by separately controlling for the overall capitalization of the banking system, we make sure that it is not the over- or undercapitalization of banks in general that is driving our results.

The index of bank dependence is defined as the ratio of financial debt to total liabilities of a firm, i.e. $(shortterm\ loans_{i,t} + longterm\ debt_{i,t})/total\ liabilities_{i,t}$. It is computed using firm-level data that is aggregated to the industry level in order to provide a measure of the technological or economic demand that firms of a specific industry exhibit due to the typical cash-flow and financing structure in that industry (Rajan and Zingales, 1998). Only industries for which more than 30 firms with all necessary data are available in our dataset are included in the calculation to avoid disturbances by outliers and erroneously computed bank dependence indices. The initial index of bank dependence is calculated as a sector average at the NACE-4 industry classification level since this classification is

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[13]The only problem of limited identification power could occur if the banks that are closed down are not identifiable by a positive capital closure rule, for example, if they regularly have more than 8% capital ratio when they fail. To exclude this possibility, we computed unmatched bank catharsis indicators (i.e. we sum all failed banks in the numerator, regardless of their capital ratio) for the 8% cutoff and found that they are not more than 1% larger on average. For lower cutoffs this difference grows, while it falls for higher cutoffs. While this provides another indication of the preference for the 8% cutoff, it also shows that the matched catharsis indicator should cover most of the banks that have, in fact, failed (and that it is not driven down to a large extent by excluding failed banks due to the matching requirement). It thus exhibits good insolvency detection properties.

available for the largest number of firms in Amadeus and provides bank dependence measures on a granular level for around 700 sectors. In addition, we compute an alternative bank depedence index based on sector averages of US SIC classification industries, which provides a rougher cut on bank dependence by distinguishing around 200 sectors. This alternative index is used for robustness checks.

Other firm-level variables

In order to account for firm characteristics that are not captured by firm fixed effect, i.e. that vary over time for a given firm, and that might influence firm growth (or financing structure), we introduce firm level covariates. Firm size is typically seen as a determinant of firm growth as smaller firms are expected to growth faster on average. To control for this growth convergence effect (Kroszner et al., 2007), we include the relative size of a firm measured as its lagged share in total assets (on a country-year level to account for diverging economic structures in different countries). Likewise, as young companies are typically expected to grow faster than old ones (Giannetti and Ongena, 2009), we account for this by including firm age as a control variable. As the age effect on firm growth is expected to decline with age, we include the natural logarithm of this variable in our regressions. Finally, we expect that firm profitability also influences firm growth as highly profitable firms can be expected to grow faster than firms that do not perform as well. Hence, we construct a simple profitability measure from the available data that provides a proxy for the return on assets (RoA) and is computed as $profit\,or\,loss_{i,t}/total\,assets_{i,t}$.

Additionally, we run tests for which a firm's activity status is used. Firm status is a dummy variable that takes on the value of 1 if a firm is active (i.e. operating/in business) in a given year, while 0 indicates that a firm has been dissolved or liquidated.

Other country-level variables

While the time-invariant covariates can be controlled for in our regression framework by exploiting the panel character of our dataset, there might nevertheless be other variables that vary by country and year and that are potential determinants of firm growth. It could, for example, be argued that our bank catharsis indicator just proxies for other factors that cause comparative differences in firm growth. Hence, we identify five such potential covariates that should be controlled for. First, the strength of bank insolvency resolution could be a mere proxy for the state of the banking system in general, particularly for its capitalization. Therefore, we insert another control variable, undercapitalization of the banking sector, that is computed on a country-year level as the ratio of bank assets of undercapitalized banks (i.e. below a simple capital ratio of 8%) to total bank assets. In addition, competition (or the lack thereof) in the banking sector could play a role for firm growth as well as the resolution of insolvent banks. For example, the regulator may be less open to a purchase and assumption policy in a country where the

Table 1: **Summary statistics**

Variable group and name	Source	Mean	SD	Min	Max	N
Dependent variables						
Growth oper. revenue ($\Delta \ln(\mathrm{OpRev})$)	AM	12.66	(46.50)	-174.11	321.2	1794189
Growth debt/asset (Δ debt/assets)	AM	1.18	(17.88)	-95.75	71.59	1311729
Explanatory variables						
Catharsis indicator (7% CR)	BS	2.52	(6.49)	0	54.25	2188814
Catharsis indicator (8% CR)	BS	2.34	(5.25)	0	44.07	2192690
Catharsis indicator (9% CR)	BS	2.23	(4.76)	0	33.24	2196761
Catharsis indicator (8% CR, avg)	BS	2.90	(8.38)	0	63.81	1508650
Catharsis indicator (8% tier 1)	BS	4.48	(15.37)	0	100.00	1972574
Bank dependence (NACE-based)	AM	19.62	(7.03)	0.8	57.68	2195945
Bank dependence (SIC-based)	AM	19.56	(6.01)	0.8	51.52	2195941
Industry- and firm-level variables						
Lagged share of firm in country-year total assets	AM	0.01	(0.29)	0	100	1905364
Firm age (log)	AM	2.54	(0.98)	0	6.8	2163383
RoA (profits/assets)	AM	5.64	(11.7)	-43.75	59.07	1919068
Firm status	AM	0.94	(0.23)	0	1	2196075
Country-level variables						
Financial development	WB FS	109.05	(52.03)	13.24	269.76	1796423
Bank system undercapitalization	BS	72.63	(30.54)	0	98.74	2196075
Bank concentration CR3	WB FS	62.78	(24.23)	11.9	100	1882352
GNI per capita	WDI	19481	(10661)	419.34	54772	2190554
Political openness index	P4	9.12	(1.87)	-7	10	2179883
Bank insolvency law	WB BRS	0.44	(0.50)	0	1	878093
Bank insolvency power	WB BRS	0.99	(0.09)	0	1	1101317
International debt issues/GDP	WB FS	60.46	(40.39)	0.13	344.39	1880281
Loans from non-resident banks/GDP	WB FS	62.22	(84.88)	2.16	1509.92	1882619

Notes: Table reports variable names, sources, means, standard deviations, minimum and maximum values, and the number of firm-year observations for which data is available in our sample. The sources are: Amadeus company database by Bureau van Dijk (AM), Bankscope bank database by Bureau van Dijk (BS), Marshall and Jaggers Polity IV database (P4), World Bank Bank Regulation and Supervision dataset (WB BRS), World Bank Financial Structure dataset (WB FS), World Development Indicators database (WDI).

banking sector is already highly concentrated. We control for this by employing a simple CR3 concentration index computed as the ratio of the three largest banks' assets to total banking sector assets. In addition, financial development has been shown to positively impact firm growth in numerous studies[14] and could also potentially be related to the treatment of insolvent banks. Hence, we control for financial development making use of the usual proxy $bank\,credit_{k,t}/GDP_{k,t}$ that is taken from the latest version of the World Bank Financial Structure dataset (an update to Beck et al. (2009)). Finally, we control for a country's overall economic development and institutional quality/political openness. We do so by taking gross national income (GNI) per capita on a country-year level from the World Development Indicators database as a proxy for economic development. Political openness is proxied by the polity IV index computed and published by Marshall et al. (2011).

The legal provisions for bank insolvency regulation (bank insolvency law) and insolvency declaration power of the regulator (bank insolvency power) are taken from the World Bank Bank Regulation and Supervision dataset that has been collected over several rounds since 2000 (Barth et al., 2001, 2004; Caprio et al., 2008). Both variables are dummies indicating the existence of a specific bank insolvency law and the power of a regulator or other official agency to order insolvency resolution against a bank (even superseding the bank's management or shareholders), respectively. For additional tests, we also employ data on the access to international finance, namely international debt issues and loans from non-resident banks as ratios to GDP. This data is also provided by the World Bank Financial Structure dataset on a country-year level.

5 Results

This section presents and discusses our main results, structured along the three step analytical framework outlined above. We discuss the results of each step in turn and extend them into additional analyses on the channels of transmission of the 'catharsis effect' and the conditions under which it works most effectively.

5.1 Simple OLS

In a first step, we estimate the impact of the catharsis indicator on firm growth in a simple OLS model. We also exploit the nature of our panel dataset by controlling for time- and firm-invariant unobserved effects. Moreover, all specifications reported below employ heteroskedasticity and autocorrelation-robust standard errors clustered at the firm-level.[15] However, due to the potential problems of endogeneity discussed in section 3, care should be exercised when interpreting these results. While one might not be able

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[14]Refer to section 1.

[15]This approach is recommended, for example, by Wooldridge (2010), and employed similarly by Giannetti and Ongena (2009).

to attribute causality to these estimates, they nevertheless provide an initial indication of the direction and economic significance of the effect.

Table 2 reports the results. Overall, we posit that these first results support our initial hypothesis that the catharsis indicator has a positive and statistically as well as economically significant effect on firm growth. Model (1) tests specifically for a baseline effect without any controls or fixed effects and finds a positive and highly significant coefficient. However, this effect could potentially be a proxy for other variables that explain the positive relation. We test for this by including two sets of control variables, one for firm level controls and one capturing country level controls. If any of the objections hold, i.e. if the positive effect of the catharsis indicator really proxies for one of these factors, the coefficient on the catharsis indicator would be expected to drop in magnitude and/or to become insignicant. Neither is the case: Not in model (2), which introduces the firm level controls, nor in model (3), which controls for the country level covariates. Even when controlling for both sets of control variables at the same time in model (4), the coefficient on the catharsis indicator stays as statistically significant as in the baseline specification. Finally, we exploit the full possibilities of our panel dataset by testing a two-way fixed effects model that controls not just for explicitly included variables but also for two sets of firm and year fixed effects. The column for model (5) reports the results. While the coefficient drops in magnitude, it still remains highly significant in statistical terms.

In order to give an impression of the economic significance, we evaluate the statistically significant coefficient on the catharsis indicator by computing a growth rate differential. This measure captures the difference in the growth rate between a firm located in a country half a standard deviation above the mean of the catharsis indicator as compared to a firm in a country whose catharsis indicator is half a standard deviation below the mean. Applying this growth rate differential to the results reported in table 2 yields an impact of at least 0.3% of operating revenue growth (model (5)). Taken together, the effect seems to be robust to the inclusion of controls and fixed effects, and not only statistically, but also economically significant.

5.2 IV model

This second step is intended to bring our results from showing a positive and significant relation to demonstrating that these are causal and not driven by endogeneity. Hence, we use an instrumental variable setup, employing the regulation of bank insolvency and resolution in country k and period t as an instrument for the catharsis indicator. More specifically, we use two variables from bank insolvency law, one being the existence of a separate bank insolvency law and another being the bank insolvency declaration power of an official regulatory or judicial body. Having two instruments has one particular advantage: We can use overidentification tests as diagnostic tools for the validity of our instrumental variables. All our tests use a heteroskedasticity-robust GMM estimator. The

Table 2: **Firm growth and bank 'catharsis effect' (OLS models)**

Model	(1) OLS Δ ln(OpRev)	(2) OLS Δ ln(OpRev)	(3) OLS Δ ln(OpRev)	(4) OLS Δ ln(OpRev)	(5) OLS Δ ln(OpRev)
Dependent variable					
Catharsis indicator (8% CR)	0.344***	0.441***	0.310***	0.398***	0.0620***
	(0.00564)	(0.00511)	(0.00664)	(0.00624)	(0.00721)
Firm-level controls					
Bank dependence		0.0730***		0.129***	
		(0.00614)		(0.00693)	
Firm age (log)		-0.0733***		-0.0695***	-0.294***
		(0.000468)		(0.000520)	(0.00456)
Lagged share of total assets		0.310**		0.127	-0.187
		(0.126)		(0.124)	(0.405)
Profitability		0.459***		0.445***	0.802***
		(0.00338)		(0.00376)	(0.00677)
Country-level controls					
Financial development			-0.0759***	-0.0725***	-0.0556***
			(0.00112)	(0.00106)	(0.00428)
Bank undercapitalization			0.00630***	0.0509***	0.0166***
			(0.00237)	(0.00234)	(0.00379)
Bank concentration CR3			-0.0137***	-0.0157***	0.00615
			(0.00222)	(0.00204)	(0.00520)
GNI per capita			-0.00175***	-0.00159***	-0.0126***
			(0.000065)	(0.000066)	(0.00090)
Political openness			0.00233***	0.0111***	0.0302***
			(0.000397)	(0.000364)	(0.00110)
Constant	0.118***	0.246***	0.214***	0.204***	0.882***
	(0.000393)	(0.00183)	(0.00304)	(0.00338)	(0.0231)
Firm FE	NO	NO	NO	NO	YES
Year FE	NO	NO	NO	NO	YES
Observations	1,792,558	1,555,980	1,440,787	1,252,126	1,252,126
R-squared	0.002	0.040	0.012	0.045	0.164

Robust clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

results are reported in table 3.

In model (1), we test for the baseline effect of the catharsis indicator, instrumented by both instruments. This yields a positive and highly significant coefficient on the catharsis indicator, which is even larger than the effect in our OLS models. However, the validity of our instruments rests on two conditions. First, a minimum relevance of bank insolvency law and insolvency declaration power to the catharsis indicator is required. Intuitively, this seems to be the case: Legal prerequisites of bank insolvency are a logical determinant of actual bank resolution.[16] Furthermore, employing a weak instrument diagnostic test confirms the validity of this condition. The Kleibergen-Paap Wald F statistic is generally used to test whether the instrumental variables are sufficiently correlated with the potentially endogenous variables in a heteroskedasticity-robust setup (Baum et al., 2007). The reported values are far above the indicative critical values tabulated by Stock and Yogo (not reported), and also far above any other rule of thumb.[17] Hence, we have no indication to assume that our initial proposition of regulatory and legal prerequisites of bank insolvency as a determinant of actual bank resolution should be doubted.

The second condition, the exogeneity restriction, is less obvious. It demands the exclusion of any causal effect of bank insolvency law on firm performance other than through actual insolvency and resolution of banks - otherwise the instrument might not be regarded as exogenous. Arguing purely on grounds of economic theory, it is highly unlikely that there is any direct effect of bank insolvency law on economic growth not working through actual bank insolvencies. However, considering the interplay between growth, banks, and regulation (e.g. lobbying in favor of some regulatory changes in certain expected economic situations), this could be doubted. Hence, we also use Hansen's J statistic, which provides a test of overidentifying restrictions, to assess the validity of instruments in a robust GMM estimation (Baum et al., 2007). This essentially tests the exogeneity of the instruments with the null hypothesis that the instruments are uncorrelated with the error. Table 3 reports p-values for this null hypothesis. As the p-value for our first model is around 0.57, we cannot reject the exogeneity of the instruments.[18] This confirms our initial argument that the law and regulation of bank insolvency resolution is unlikely to have any effect on economic growth other than through the actual resolution of insolvent banks.

Finally, we employ an endogeneity test that investigates whether the assumed endogenous regressor, our catharsis indicator, is in fact endogenous, recommending the use of IV over simple OLS. We use a heteroskedasticity robust test statistic equivalent to the Durbin-Wu-Hausman test, which tests the null hypothesis that the estimates are not al-

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[16]We also find a positive and significant correlation between the catharsis indicator and the suggested instruments.

[17]Baum et al. (2007, 2010), for example, suggest referring to the general rule of thumb of a test statistic greater than ten indicating less concern with weak instruments, as the critical values tabulated by Stock and Yogo are for i.i.d. errors only.

[18]It should be noted, however, that the test is constructed around the failure to reject the null hypothesis, and its power might consequently be rather weak.

tered by using IV as compared to OLS, supporting the assumption that the catharsis indicator is exogenous in our initial models. With a p-value of 0.00 in model (1), the null is rejected, confirming our initial concerns around the endogeneity of the catharsis indicator.

When turning to model (2), we experience a drawback of using legal rules as an instrument, which lies in the stickiness of law. Since law does not undergo major changes over time in a given country (at least not in our dataset as we look at a timeframe of only a few years, with very few variations at the country level), we are not able to include firm (or country) fixed effects. Hence, we have to test this second model with all control variables and year fixed effects only. The results are largely comparable to model (1): While the coefficient on the catharsis indicator drops slightly, it is still as large as, or even larger than, all coefficients estimated in the OLS models and stays highly significant. Also, the diagnostic tests suggest that there is no concern about weak instruments. However, the p-value of the Hansen test drops to 0.22, which still does not reject the exogeneity of the instruments, but is closer to the critical values.

As a note of caution: While our specifications pass the diagnostic tests for the validity of the instrumental variables, this cannot conclusively rule out the possibility of failing on the conditions underlying IV estimation, particularly on the exogeneity condition. While it seems unlikely, concerns might remain regarding potential endogeneity of the instruments, which would render them invalid. Hence, we supplement our results with a further identification idea in the following step of the analysis.

Table 3: **Firm growth and bank 'catharsis effect' (IV models)**

Model	(1) IV GMM	(2) IV GMM
Dependent variable	$\Delta \ln(\text{OpRev})$	$\Delta \ln(\text{OpRev})$
Catharsis indicator (8% CR)	1.146***	0.828***
	(0.0281)	(0.0497)
Firm-level controls		
Bank dependence		0.0684***
		(0.00982)
Firm age (log)		-0.0647***
		(0.000706)
Lagged share of total assets		-0.679**
		(0.299)
Profitability		0.341***
		(0.00512)
Country-level controls		
Financial development		0.0204***
		(0.00191)
Bank undercapitalization		-0.0158***
		(0.00405)
Bank concentration CR3		0.175***
		(0.00867)
GNI per capita		0.00371***
		(0.000118)
Political openness		-0.0183***
		(0.00102)
Constant	0.162***	0.482***
	(0.000862)	(0.00519)
Year FE	NO	YES
Observations	717,211	606,588
R-squared	0.01	0.108
Weak instrument test (F)[1]	7700	4500
Hansen test (p-value)[2]	0.567	0.218
Endogeneity test (p-value)[3]	0.000	0.000

Notes: **[1]** Uses the Kleibergen-Paap Wald F statistic. **[2]** Tests the null hypothesis that the instruments are uncorrelated with the error. **[3]** Tests the null hypothesis that the estimation results are not altered by using instrumental variables.
Robust clustered standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

5.3 Interaction approach

This third step of our identification strategy relies on the identifying assumption that firms which are more dependent on bank financing should experience stronger (or weaker) growth in countries and periods where the resolution regime for insolvent banks - as measured by the catharsis indicator - is stronger as compared to firms in countries and periods where it is weak. Hence, we exploit industry differences in bank dependence to yield a more convincing test in establishing causality. We use the augmented specification presented in section 3 and continue to employ heteroskedasticity and autocorrelation robust clustered standard errors. The results are reported in table 4, which only displays the main coefficients of interest and indicates the inclusion of sets of control variables and their interactions in the respective rows for brevity.

The first specification serves as a starting point that can be compared to the results of model (5) in table 2. Here, we simply add the interaction of the catharsis indicator and bank dependence. While the coefficient on the simple effect of the catharsis indicator becomes insignificant, it is interesting to note that the coefficient on the interaction term is positive and significant. This alludes to a particularly strong effect of bank insolvency resolution for firms that depend structurally more on bank financing. In model (2) we test the interaction term between bank dependence and the catharsis indicator, the simple effects, and the set of control variables. Additionally, where these controls vary only at the country-year level, we interact them with the bank dependence indicator as well. We do this to make sure that our interaction term of interest does not proxy for some other, unobserved, variables whose influence on firm growth also varies systematically with bank dependence. Both the coefficient on the catharsis indicator and - more interestingly - the coefficient on the interaction are positive and significant, further corroborating the hypothesized 'catharsis effect', particularly for bank dependent firms.

In model (3) and (4), we exploit the full advantages of the augmented model, which allows us to control for country trends, i.e. for country-year fixed effects that would have absorbed the bank catharsis indicator in the baseline specification. When we include these country-year fixed effects alongside a set of firm fixed effects, we capture unobserved variance in all of these dimensions. The dummies also absorb all control variables that do not vary over both of these dimensions, i.e. all country-year specific variables including the simple effect of the catharsis indicator, as well as the non-time-varying firm characteristics (i.e. bank dependence). We first test this fixed effects model without control variables in model (3). To make sure that the interaction term is not driven by one of the control variables that also systematically influences firm growth in a similar way varying with bank dependence, we also include the interacted country-level control variables as well as firm-level controls in model (4). The coefficient on the interaction term stays positive and significant in both specifications.

This step should finally help us to overcome our endogeneity concerns. As we control for country-time and firm fixed unobservables and a range of potential covariates that

Table 4: **Firm growth and bank 'catharsis effect' (Interaction models)**

Model	(1)	(2)	(3)	(4)
Dependent variable	$\Delta \ln(OpRev)$	$\Delta \ln(OpRev)$	$\Delta \ln(OpRev)$	$\Delta \ln(OpRev)$
Catharsis indicator (8% CR)	-0.0251	0.298***		
	(0.0257)	(0.0250)		
Bank dependence		0.149***		
		(0.0534)		
Catharsis indicator x bank dependence	0.448***	0.496***	0.691***	0.530***
	(0.135)	(0.132)	(0.149)	(0.163)
Firm-level controls	YES	YES	NO	YES
Country-level controls	YES	YES	NO	NO[1]
Country-level controls x bank dependence	NO	YES	NO	YES
Constant	YES	YES	YES	YES
Firm FE	YES	NO	YES	YES
Year FE	YES	NO	NO	NO
Country-Year FE	NO	NO	YES	YES
Observations	1,252,126	1,252,126	1,792,441	1,252,126
R-squared	0.164	0.046	0.398	0.432

Notes: [1] Absorbed by country-year fixed effects.
Robust clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

might influence firm growth systematically with bank dependence, there is hardly any other channel of endogeneity conceivable. Even if reverse causation or omitted variables drive a correlation between average growth rates of firms and the strength of bank resolution, it is difficult to find an argument for such a variable to do so in a systematic way relating to firms' bank dependence. Consequently, we treat this as strong evidence for the causality of the 'catharsis effect' on firm growth.

Interpreting the economic significance of the estimates is slightly more complex for models including an interaction term. In these cases, we evaluate the economic significance at one standard deviation around the mean of both variables, i.e. bank dependence and the bank catharsis indicator. According to this evaluation approach, the results shown in model (4) suggest a difference of roughly 0.6% in the growth rate between a firm located half a standard deviation above the mean of bank dependence as compared to a firm with a bank dependence measure half a standard deviation below the mean, if located in a country half a standard deviation above the mean of the bank catharsis indicator (i.e. with a relatively strict resolution of failed banks) rather than in a country half a standard deviation below the mean. All of the values used for evaluation of economic significance

have been tested individually for their statistical significance by marginal evaluation. They are found to be individually significant at least at the 95% level, in most cases even at the 99% level or above. We consistently apply these additional significance tests to all values used for evaluation in all following tables. [19]

Taken together, our results so far suggest that there is indeed an economically and statistically significant effect of rules-based bank insolvency resolution on economic growth. Particularly the third step of our identification approach provides an indication of the specific mechanism by which the 'catharsis effect' influences economic growth, i.e. it disproportionately benefits those firms that particularly depend on bank finance. But what exactly is the channel of transmission of this effect from the resolution of insolvent banks to firm growth?

5.4   Extension of analyses I - In search of a 'smoking gun'

So far, we have shown that there is a predominantely positive 'catharsis effect'. However, we are also interested in finding some evidence on the transmission channel from bank insolvency resolution to firm growth through which this effect works. Hence, we are essentially searching for a 'smoking gun' that indicates under what conditions or for which firms we find a particularly strong 'catharsis effect'. In this section, we define and test two potential transmission channels through which the growth-stimulating 'catharsis effect' can be assumed to work.

Starting with a first channel, which could be dubbed the 'quality effect', we stipulate that the growth effect we find is essentially driven by higher quality firms. Going back to our initial argumentation that let us hypothesize the existence of a 'catharsis effect' at the beginning, we essentially argued that the prompt and rules-based resolution of insolvent banks reestablishes incentives in financial intermediation and thereby increases the quality of credit allocation decisions. In such an environment, banks will prefer high-quality customers, rather than gambling for high volatility. Consequently, firms that offer more attractive (e.g. profitable) investments, not more volatile ones, benefit from this shift to quality. If this holds true, we should find a different magnitude or even direction of the 'catharsis effect' for firms of high and low quality, with the first ones growing overproportionally and the second group experiencing underproportional growth or even a slowdown. In a nutshell, we expect the quality effect to surface in higher growth of higher quality firms as these should be the beneficiaries of uncorrupted credit allocation decisions.

To test this prediction of a potential channel of transmission, we set up two alternative definitions of firm quality. On the one hand, we distinguish those firms that went bankrupt over the time horizon of our dataset as low quality, while those firms that continued

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[19]It should be noted that we correct for scale endpoints (i.e. we do not go beyond realistic endpoints when computing the values for economic evaluation by limiting values to being ≥ 0 for bank dependence as well as for the catharsis indicator). Differences between this method and not correcting for scale endpoints are very marginal, though, and do not exert a large influence on the computed growth differentials.

operations uninterruptedly are defined as high-quality firms. This definition provides a rather unbalanced sample cut with about 2 million firm-year observations of active firms and only 120,000 observations of firms that are classified as bankrupt, dissolved, in receivership or liquidation. Hence, we apply an alternative definition of firm quality along the criterion of firm profitability: Firms in the top tercile of firm profitability (as defined by the RoA measure outlined above) are taken as high-quality firms, while those in the bottom tercile are defined as 'low quality'. The remaining tercile is eliminated from the dataset. To test whether there is a differential 'catharsis effect' between high and low-quality firms, we cut our main dataset along these definitions of firm quality into subsets and run our main specification.[20]

The results are reported in table 5 along with the results of our augmented specification as a reference case. For both definitions of firm quality, we see a considerably differing 'catharsis effect'. While the coefficient on our main interaction increases only slightly for active firms, it becomes negative - but insignificant - in the sample of firms that went out of business (models (2) and (3)). That there is only a small increase in the coefficient for the active firm sample is not surprising insofar as this sample comprises far more than 90% of the observations, and hence a large move in the coefficient should not be expected. Comparing the results of the samples cut along the top and bottom tercile of profitability, which are reported in models (4) and (5) of table 5, we find even more compelling results. The coefficient on the main interaction is significant and almost 50% larger than in our reference model when the test is run on a sample of high-quality (i.e. high profitability) firms only. When we run the model for low-quality firms only, the coefficient becomes negative, but also insignificant. These results cast some light on our first transmission channel: The 'catharsis effect' seems to mainly impact economic growth through a positive effect on higher-quality firms, while firms with worse performance are not (or potentially even negatively) affected.

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[20]One could also run models with triple interactions (which yield similar results), but we decided to report the results of sample cuts for simplicity of interpretation.

Table 5: **Transmission channel: Firm growth and bank 'catharsis effect' by firm quality**

Model	(1)	(2)	(3)	(4)	(5)
Dependent variable	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)
	Panel A Full sample (reference model)	**Panel B: Split sample** Active firms	Insolvent firms	**Panel C: Split sample** High pro-fitability firms[1]	Low pro-fitability firms[1]
Catharsis indicator x bank dependence	0.530*** (0.163)	0.587*** (0.167)	-0.305 (0.753)	0.762** (0.366)	-0.513 (0.488)
Firm-level controls	YES	YES	YES	YES	YES
Country-level controls[2]	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES	YES
Observations	1,252,126	1,179,171	72,955	368,498	314,340
R-squared	0.432	0.428	0.480	0.653	0.616
Growth rate differential (% of firm growth)[3]	0.6	0.7	N/A	0.9	N/A

Notes: [1] Profitability is defined as ROA lagged by one year, sample is cut at the 33rd and 67th percentiles. [2] Time-variant country-level controls are interacted with bank dependence. [3] The growth rate differential presents a measure (in % growth) of the difference in the growth rate between a firm located half a standard deviation above the mean of bank dependence as compared to a firm with a bank dependence measure half a standard deviation below the mean, if located in a country half a standard deviation above the mean of the bank catharsis indicator rather than in a country half a standard deviation below the mean.
Robust clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Turning to a second potential transmission channel, which could be described as the 'quantity effect', we suggest that the 'catharsis effect' stimulates a reallocation of credit supply benefiting traditional bank customers. This reallocation takes place at the expense of overall credit supply that might have also gone to more untraditional bank investments. While the overall amount of credit supplied to the economy might stagnate or even decrease under a policy of strict bank insolvency resolution, businesses traditionally dependent on credit might see an increase in their credit provision. Theoretically, it could be argued that this is due to a reestablishment of proper incentives in the credit allocation channel: Instead of allocating credit where it finds the highest volatility, and be it outside traditional lending business (as a gambling bank would do), banks reallocate credit back to their traditional customers. And they allocate it particularly to firms which need bank credit most and are thus willing to pay interest rates that are not excessively high and volatile, but high enough to allow banks to obtain optimal risk-adjusted positive NPVs from their lending. Hence, this is not really a quantity effect in the sense of increasing

overall quantity of credit supply, but in the sense of increasing credit supply to firms that need credit. Consequently, our expectation is to see an increase in loan financing, not necessarily for companies in general, but particularly for those firms that depend more on bank finance.[21]

We use an alternative dependent variable, change of the debt ratio, to test this prediction.[22] In order to visualize the effect of the catharsis indicator on this variable, we run three specifications, whose results are displayed in table 6. In the first specification, we regress the change in debt ratio on the catharsis indicator (still without interaction), the full set of controls as well as firm and year fixed effects. The coefficient on the catharsis indicator is very small and far from being significant. This result does not come as a surprise, since the 'catharsis effect' is generally not expected to increase the debt usage in the real economy. On the contrary: While it may be credited with other beneficial effects, the absolute increase of credit supply is unlikely to be an outcome of a more rules-based resolution of insolvent banks. Rather, it may even decrease credit supply when some banks are liquidated. However, our presumption is not focused on a general increase in debt usage, but on an increase particularly for firms that need it, i.e. firms with structurally high bank dependence. We test this in model (2) by including interactions of the country-specific variables, particularly of the catharsis indicator, with bank dependence. While the general impact of the catharsis indicator now even turns negative, we have a strongly positive and highly significant effect on firms that are more bank dependent. This result is also confirmed in model (3), which applies even more stringent country-year and firm fixed effects - a model very similar to our reference case above. Note that the fixed effects absorb the simple effect of the catharsis indicator. Taken together, these results are a strong indication that there is not just a quality effect that explains the impact of our catharsis indicator on firm growth, but also a quantity effect that leads to an improved channeling of credit to firms that need it.

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[21]To take this further, we suggest that one could also look at bank level data for evidence of this effect, for example via a reshuffling between asset classes on bank balance sheets. We leave this for future research.

[22]Note that we use the change in the debt-to-non-equity-liabilities ratio as a depedent variable to make sure that the results are not driven by a loss in equity rather than an increase in debt finance.

Table 6: **Transmission channel: Firm finance and bank 'catharsis effect'**

Model	(1)	(2)	(3)
Dependent variable	Δdebt/assets	Δdebt/assets	Δdebt/assets
Catharsis indicator	0.00454	-0.122***	
	(0.00433)	(0.0138)	
Catharsis indicator x bank dependence		0.651***	0.710***
		(0.0709)	(0.0840)
Firm-level controls	YES	YES	YES
Country-level controls[1]	YES	YES	YES
Constant	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	NO
Country-Year FE	NO	NO	YES
Observations	957,432	957,367	957,367
R-squared	0.041	0.042	0.312

Notes: [1] Time-variant country-level controls are interacted with bank dependence when country-year fixed effects are included in the model.
Robust clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.5 Extension of analyses II - Where the 'catharsis effect' does not work

Apart from the transmission channels, there is another puzzle left for exploration: We argued at the beginning that the direction of the 'catharsis effect' is - at least a priori - far from obvious. While we might conclude to find the positive 'catharsis effect' due to reestablished incentives confirmed by our tests so far, it would be premature to not take the counterargument into consideration. This counterargument stipulates that the positive effect might indeed be outweighed by negative effects of individual bank failures. These range from negative externalities, loss of charter value and growth opportunities, to possible contagion and an economy-wide credit crunch (Freixas, 1999; Djankov et al., 2005; Kroszner et al., 2007). Not investigating what seems to be a valid argument might lead to myopic policy recommendations: While, in general, we find the positive effect to outweigh potential negative effects, there might be particular economic conditions where this is not the case. In this situation, recommending a more rules-based insolvency resolution policy might have no or even detrimental effects. We investigate one such potentially influential condition, namely the openness of the banking system and consequent availability of foreign competitors and foreign credit supply.

The rationale for this characteristic of the banking market to moderate the 'catharsis

effect' is simple. In an open banking system, banks that are resolved in insolvency can be more easily replaced by competitors, potentially from abroad, on the supply side. Likewise, seen from the demand side, domestic firms might be able to satisfy their credit demand by taking out debt from non-domestic banks, provided that they really exhibit profitable investment opportunities. Where this is not the case, i.e. in a banking system relatively closed to international entry and competition, the resolved banks (or their share of the market) might not be assumed or replaced, and firms with profitable investment opportunities might not have access to alternative bankers. Hence, we posit that an open banking system plays a catalytic role for the 'catharsis effect': It provides the environment for resolution to work more seamlessly as it mitigates its potential negative impact with regard to shortages in credit supply.

We test this hypothesis by defining access to international finance as a proxy for openness of the banking system. Access to international finance is measured by the ratio of international debt issues and loans from non-resident banks to GDP. Like before, we split our sample at the terciles of this variable and run our main specification on the subsamples. The results as well as the reference case are displayed in table 7. Taking only the subsample with high access to international finance (model (2)), the coefficient on the main interaction more than doubles and is highly significant, indicating a very strong 'catharsis effect' for firms in a relatively open financial environment. However, in a closed banking system, i.e. bottom tercile of access to international finance, the coefficient drops to close to zero and becomes insignificant. These results indicate that the 'catharsis effect' is not found in the 'adverse' environment of relatively closed banking systems - constituting an important corollary to be considered in any policy recommendation that favors strict and rules-based insolvency resolution.

Table 7: **Extensions: Firm growth and bank sector 'catharsis effect' by access to international finance**

Model	(1)	(2)	(3)
Dependent variable	$\Delta \ln(\text{OpRev})$	$\Delta \ln(\text{OpRev})$	$\Delta \ln(\text{OpRev})$
	Panel A Full sample (reference model)	**Panel B: Split sample** High access to international finance[1]	Low access to international finance[1]
Catharsis indicator x bank dependence	0.530*** (0.163)	1.253*** (0.388)	0.0305 (0.246)
Firm-level controls	YES	YES	YES
Country-level controls[2]	YES	YES	YES
Constant	YES	YES	YES
Firm FE	YES	YES	YES
Country-Year FE	YES	YES	YES
Observations	1,252,126	337,343	503,041
R-squared	0.432	0.530	0.530
Growth rate differential (% of firm growth)[3]	0.6	1.4	N/A

Notes: [1] Access to alternative funding/international finance is defined as (loans from non-resident banks + international debt issues)/GDP, sample is cut at the 33rd and 67th percentiles. **[2]** Time-variant country-level controls are interacted with bank dependence. **[3]** The growth rate differential presents a measure (in % growth) of the difference in the growth rate between a firm located half a standard deviation above the mean of bank dependence as compared to a firm with a bank dependence measure half a standard deviation below the mean, if located in a country half a standard deviation above the mean of the bank catharsis indicator rather than in a country half a standard deviation below the mean.

Robust clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6   Robustness

The robustness of the results shown above is tested with various specifications of the variables and with several restrictions of the dataset. This section summarizes the robustness test specifications and reports the main results. For brevity, tables 8 and 9 display only the results of the robustness test for the full specification of the most augmented model, which is the interaction approach, including all fixed effects and control variables. Thus, the results of the robustness tests have to be contrasted with the results of model (4) in table 4, which are also reported as a reference case in both table 8 and table 9. If we find any deviations, we find them here, other results are at least as robust as these.

The following robustness tests have been carried out.

- We address concerns related to our sample by applying or lifting censoring restric-

tion to the dataset. First, there might be concerns that the results are driven by observations from particular countries. We employ two - admittedly arbitrary - sample cuts to test these concerns. On the one end, we run our tests on samples that exclude the largest economies (Germany, United Kingdom, France), together and individually (not reported). Also, we employ a panel that excludes all countries for which fewer than 10,000 firms are available (dropping 16 countries altogether, most of them from Eastern Europe). Third, we perform the tests using a sample that is not censored from outliers in the dependent variables at the 1st and 99th percentiles. Finally, we censor the main explanatory variable, the bank catharsis indicator, at the 1st and 99th percentiles. Although there cannot be any obviously unrealistic result (below 0 or above 100%) by definition as we are using a matched indicator, we use this censored sample as a further robustness check to ensure results are not driven by extreme values within this range. All of the above samples yield highly significant and economically similar results for the coefficients of interest. These are reported in columns (2) to (5) of table 8.

- To check that our results are not driven by the cutoff chosen for computing the catharsis indicator, we use alternative cutoffs for robustness tests. We compute the catharsis indicator based on a 7% and 9% simple capital ratio (instead of 8% in the reference case). The results are reported in columns (2) and (3) of table 9 and are very close to those of our reference case in their economic[23] and statistical significance.

- Our results might also be driven by the way the indicator is defined. To rule this out, we use three alternative definitions, varying both the numerator and the denominator of the catharsis indicator. Concerning the numerator, we exclude M&A of banks falling below the predefined capital threshold from the definition of resolved banks. Alternating the computation of the denominator, we use average values of capital and assets in computing the capital ratio. While this intuitively makes sense from an economic point of view, we have much less data available for this computation, relying on about one-third of the number of banks in calculating the indicator. Hence, we just use it as a robustness test. Additionally, we also compute the catharsis indicator based on an entirely different capital ratio definition, using reported tier 1 ratios instead of simple capital ratios.[24] However, as with average capital and asset values, our dataset contains data on tier 1 ratios for only about one-third of the number of banks in each country-year as compared to the simple capital ratio. Hence, we regard the catharsis indicator computed using the tier 1

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[23]Note the growth rate differentials reported in table 9: Other than the pure magnitude of the coefficients suggests, the economic evaluation in the form of the growth rate differential in fact delivers very similar results due to slightly different means and standard deviations of the alternative variables.

[24]Note that we use 8% as a standard cutoff in this case as well. However, varying the cutoff yields similar results with regard to statistical and economic significance (not reported).

Table 8: **Firm growth and bank sector 'catharsis effect' (Robustness tests I: Restricted samples)**

Model	(1)	(2)	(3)	(4)	(5)
Robustness test	Reference model	Excluding top 3 countries	Excluding countries with few observations	No cleaning in dep. variable	Cleaning (1/99) in expl. variable
Dependent variable	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)
Catharsis indicator x bank dependence	0.530***	0.527***	0.554***	0.761**	0.590***
	(0.163)	(0.175)	(0.163)	(0.356)	(0.219)
Firm-level controls	YES	YES	YES	YES	YES
Country-level controls[1]	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES	YES
Observations	1,252,126	890,227	1,221,023	1,272,329	854,737
R-squared	0.432	0.433	0.429	0.348	0.477
Growth rate differential (% of firm growth)[2]	0.6	0.6	0.6	0.9	0.7

Notes: [1] Time-variant country-level controls are interacted with bank dependence. **[2]** The growth rate differential presents a measure (in % growth) of the difference in the growth rate between a firm located half a standard deviation above the mean of bank dependence as compared to a firm with a bank dependence measure half a standard deviation below the mean, if located in a country half a standard deviation above the mean of the bank catharsis indicator rather than in a country half a standard deviation below the mean.

Robust clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

ratio as less representative of the actual resolution regime and thus only use it as a robustness check. The results are reported in columns (4) to (6) of table 9 and all display coefficients that are positive and highly significant as well as economically similar to the reference case.

- We also test an alternative bank dependence index computed as the sector average of industries classified according to US SIC. This provides a less detailed classification (distinguishing only 200 sectors) than NACE-4, which is our reference classification framework. Applying these alternative measures of bank dependence yields a result with comparable economic and statistical significance, which is reported in column (7) of table 9.

- Instead of using fixed effects models, we test all specifications with random effects models. The results are largely the same, if not even more significant (not reported).

- Finally, various specifications are tested, including and excluding the control variables and fixed effects, for example, with and without the control for return on assets or with the lagged share of assets replaced by a natural logarithm of assets. The coefficient on the bank catharsis indicator stays quantitatively similar and highly significant for all specifications (not reported).

Taken together, the robustness tests suggest that our results are not driven by sample selection or variable definition. Rather, they prove robust to a range of restricted samples, alternative variables, and alternative specifications.

Table 9: **Firm growth and bank sector 'catharsis effect' (Robustness tests II: Variations in variables)**

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
							SIC-level
Robustness test	Reference model	Alternative cutoff (7%)	Alternative cutoff (9%)	Resolution w/o M&A	Average capital ratio (8%)	Tier 1 ratio (8%)	bank dependence
Dependent variable	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)	Δ ln(OpRev)
Catharsis indicator x bank dependence	0.530***	0.344***	0.621***	0.595***	0.272**	0.332***	0.373**
	(0.163)	(0.128)	(0.173)	(0.171)	(0.130)	(0.0668)	(0.171)
Firm-level controls	YES	YES	YES	YES	YES	YES	YES
Country-level controls[1]	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES
Country-Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	1,252,126	1,252,126	1,252,126	1,252,126	812,358	1,183,467	1,272,625
R-squared	0.432	0.432	0.432	0.432	0.476	0.436	0.412
Growth rate differential (% of firm growth)[2]	0.6	0.5	0.7	0.7	0.4	0.9	0.4

Notes: **[1]** Time-variant country-level controls are interacted with bank dependence. **[2]** The growth rate differential presents a measure (in % growth) of the difference in the growth rate between a firm located half a standard deviation above the mean of bank dependence as compared to a firm with a bank dependence measure half a standard deviation below the mean, if located in a country half a standard deviation above the mean of the bank catharsis indicator rather than in a country half a standard deviation below the mean.

Robust clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7   Concluding remarks

In this paper, we analyze the impact of rules-based bank insolvency resolution policy on real economic growth. In particular, we look at a specific insolvency resolution trigger - the positive capital closure rule - and test the effect of its implementation on individual firm growth.

Economic theory and empirical research demonstrate that financial intermediaries can have a positive effect on the real economy. However, distorted incentives for banks, depositors, and regulators in connection with bank insolvency and resolution may corrupt banks' credit allocation and monitoring decisions, leading to suboptimal real economic performance. On the other hand, theory also postulates that a rules-based prompt resolution policy stipulating purchase and assumption or straightforward closure and liquidation of insolvent banks reestablishes the incentive system and provides for economically superior outcomes. However, this does not come without a cost either as a credit supply squeeze could be a consequence. Hence, we test the postulated 'catharsis effect' of regulatory insolvency and positive capital closure rules with regard to its impact on the real economy.

We construct a panel dataset of more than 2 million firm-year observations and propose a catharsis indicator that measures how strongly a hypothetical positive capital closure rule is implemented by essentially forming a ratio between insolvent banks that have been resolved and banks that should have been resolved according to the closure rule. We use a three-step identification strategy to overcome potential endogeneity concerns and to demonstrate causality. Starting from a regression framework that exploits the panel characteristics of our dataset, we also utilize an instrumental variable approach and, finally, an interaction specification. In this last model, we assume that regulatory insolvency of banks should have a particularly strong effect on firms that are structurally more dependent on bank finance. Hence, any 'catharsis effect' should surface particularly strongly in an interaction with bank dependence. In all our specifications, we find an economically and statistically significant, positive impact of the 'catharsis effect' on firm growth - particularly for firms that are more dependent on bank financing.

We are convinced that these results show a causal effect of rules-based insolvency resolution on firm growth and are not spurious for several reasons. First, our identification strategy helps us to overcome potential endogeneity concerns. The instrumental variable approach is robust to standard IV diagnostic tools. Moreover, if we use the interaction specification, we can control for almost any channel of endogeneity. Even if reverse causation or omitted variables drive a correlation between average growth rates of firms and the strength of bank insolvency resolution, it seems inconceivable that they do so systematically with firms' bank dependence. Second, the robustness of the results is confirmed testing various alternative specifications, variable definitions, and restrictions of the dataset. Finally, not only do we find a significant 'catharsis effect', we also trace evidence for two potential transmission channels from bank insolvency resolution to firm growth. The quality channel causes the 'catharsis effect' to mainly impact eco-

nomic growth through a disproportionately positive effect on higher quality (e.g. more profitable) firms as those are the beneficiaries of uncorrupted credit allocation decisions. The quantity channel, on the other hand, stipulates a (re)allocation of credit resulting in an increase in bank debt finance - not for companies in general, but particularly for those firms that structurally depend more on bank finance. Hence, these two channels effectively provide for a 'smoking gun' that surfaces the mechanisms along which the 'catharsis effect' influences real growth.

We also demonstrate that the effectiveness (and potentially even the direction) of the 'catharsis effect' is determined by the regulatory and economic conditions it is implemented in. One such determinant is the openness of the banking system, which can work as a catalyst to the 'catharsis effect'. The potentially negative consequences of failed bank closures - ranging from contagion to credit crunch - should be less severe in the mitigating environment of an open banking system where foreign banks can take over the position of insolvent competitors or supply credit to viable firms. Our results lend support to this rationale, showing that there is a much stronger 'catharsis effect' in open banking systems and none where access to international finance is low. This should guard against premature policy recommendations as there might be circumstances in which the negative effects of bank closure outweigh the generally positive 'catharsis effect'.

This last result already underlines one of the weaknesses of our findings as policy recommendations. First, there are circumstances where we found that the generally positive 'catharsis effect' does not work. Second, our data shows that the hypothetical positive capital closure rule is - at least so far - rather hypothetical in fact as we find only a low level of implementation for most countries and years. While this allows an inference about the effect of the catharsis indicator in the range in which we find it here (roughly between 0 to 50%, skewed towards the lower end), care should be exercised in drawing conclusions about a fully implemented positive capital closure rule. While it might well exhibit the same effects, it could also be that the documented implementation of the rule is already sufficient to discipline banks and realign incentives and that a full implementation would increasingly suffer from the negative effects of bank closure. More research is warranted to cast light on the 'catharsis effect' under a full implementation of a positive capital closure rule.

In general, there are several directions left for future research, concerning (a) the policies and rules of bank insolvency (e.g. testing different resolution policies), (b) its mechanisms and transmission channels, and (c) the conditions of effectiveness of such rules. Notwithstanding this, our results strongly advocate placing bank insolvency and resolution regimes center stage in discussions aimed at reforming bank regulation. Setting up incentive-compatible bank insolvency regimes that facilitate the 'catharsis effect' should be a focal point of researchers' endeavors and policymakers' travails.

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