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Is there a regulatory trade-off between stability and performance? Evidence from Italian banks.

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Abstract

Disentangling the direct causal effect that sanctions exert on bank performance from the indirect through default risk, we show that a trade-off exists for regulators between banks' performance and stability in Italy. Two key findings provide evidence for the nontriviality of the return-risk nexus: (i) banks' liquidations are concentrated at the lower-end of the profitability distribution, resulting in (attrition) biased estimates; (ii) the drop-out is informative since it depends on the unobserved measurements of profitability. Despite this evidence, while returns are affected by sanctions and regulatory requirements, default risk is not. However, looking at growth of gross loans, enforcement actions reduce default risk though at a cost of a significant fall in lending, creating a regulatory trade-off. In fact, through loans' growth, we account for the key dynamics of intermediaries' soundness, namely higher profits and less non-performing loans.

Key Words: *Enforcement Actions; Bank Supervision; Bank Profitability; Bank Default Risk; Liquidity Creation*

JEL Classification: *G18, G21, G28.*

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1. Introduction

Financial stability concerns have often fueled the regulatory community debate, becoming the predominant topic since the global financial crisis of 2007-2009. Since then, national and supranational authorities have introduced large-scale reforms, tailored at reducing the likelihood and potential losses of systemic financial distresses, while ensuring the lowest costs in terms of economic growth and welfare (e.g. banking union in Europe, Basel III, etc.). The key challenge for financial regulators arises indeed from the trade-off between overall financial stability and bank soundness.

Aiming at safeguarding financial system stability, the supervisory framework has been implemented through multiple lines of defense, among which administrative actions and sanctions. By means of these tools, supervisory authorities aim at punishing and correcting management deficiencies, hence contributing to a safer and more stable banking system. However, the strong regulators' commitment to financial stability objectives, pursued mainly by means of crisis-management tools (for instance, the bail-in policy), has been recently accused of perverse outcomes, like favoring moral hazard and feeding new risks. Moreover, preventive actions are under scrutiny as well because they may endanger banks' performance and reputation, hence being associated with the occurrence of severe bank distress or failure. Compliance to strict regulation and overheated bank default risk, in turn, may have significant adverse effects for the real economy, mostly due to the contraction in lending and liquidity creation. To the extent that the punished behavior constitutes an industry-wide phenomenon, enforcement actions may also pose a threat to financial stability itself (Skinner, 2016).

This analysis contributes to the discussion about the policy trade-off between the stability of the financial system and the soundness of banks. To this end, we investigate the impact of enforcement actions on banks' performance, taking into account the probability that a bank might default. To the best of our knowledge, this is the first attempt to estimate the causal effect of sanctions on banks' performance while simultaneously controlling for the effect that sanctions have on the probability of failure. Previous literature has typically investigated those two phenomena separately.

The analysis builds on a database comprehensive of the monetary penalties imposed by the main Italian supervisory authorities and balance sheet data for Italian banks, from 2008 to 2015. We distinguish between sanctioned and non-sanctioned banks and between active and defaulted banks. On the one hand, we classified as sanctioned those bank incurring in enforcement actions at least once over the decade considered. On the other hand, following (Calabrese & Giudici, 2015), we consider as defaulted those banks that were inactive, dissolved or merged by end of 2015. The inclusion of defaulted intermediaries allows to evaluate the effectiveness of supervision towards the most fragile segment of the banking sector and the most critical cases for the supervisory final outcome. The selected sample consists of 157 banks, among which 133 are active over the full period with an average yearly default probability of less than 3%. The sanctioned banks (even is subsequent years) are roughly

13% of the total, more than 20% of the defaulted banks incurred in sanctions at least once since 2008. The complexity and amplitude of the sample may, however, pose several identification issues, that need to be tackle properly.

Differently from most of the existing literature on the effect of supervision on banks' performance, we attempt to identify the causal effect of sanction on both performance and default risk by employing a difference-in-difference estimator. We address the major concern of the endogeneity of the enforcement actions (treatment) following the strategy proposed in our previous investigation on the topic, (Guerello, et al., 2017). The identification is based on the selection-on-observables assumption, as discussed in (Banerjee & Mio, 2017), according to which we achieve the conditional independence of the treatment by controlling for the common determinants of sanctions and performance.

Moreover, whereas defaulted banks are always excluded from the analysis in the existing literature due to the endogeneity of default itself, we decided to exploit this feature to disentangle the direct effect of sanctions on performance, from the indirect one that may work through default probability. We overcome the attrition bias (i.e. endogenous banks drop-out from the sample) by employing a two-stage (2SLS) Heckman selection model[5], mainly following the approach discussed in (Semykina & Wooldridge, 2010) for panel data.

The contribution of our analysis is twofold. On the methodological standpoint, we combine new econometric identification strategies to overcome multiple endogeneity issues arising from the complexity of the sample and the nonlinear interlinkages among supervision, financial stability and banks' profitability. From the regulatory point of view, we provide new insights on the effectiveness of banking supervision in terms of safety and soundness of banks.

Concerning the methodological approach, the results support our assumption about the existence of both an attrition and a randomization bias while estimating the causal effect of sanctions on banks performance. The RORWA elasticity to enforcement actions is in fact largely upward biased, and it declines significantly once we correct for the endogeneity of both enforcement actions and default episodes. Hence these issues should not be overlooked, as largely done in literature.

Moreover, the results from the empirical analysis have several policy implications. Once filtering out the indirect effect that the selected indicators exert on profitability through the probability of default, differently from previous evidence on the Italian system, we find that returns (RORWA) strongly depends on supervisory activity: enforcement actions depress profitability while compliance with regulatory requirements is positively associated with higher profits. However, we also observe that sanctioning activity does not have any significant direct impact on default risk, thus pointing towards the rejection of the existence of a trade-off between bank soundness and

[5] (Heckman, 1974) and (Heckman, 1979) for longitudinal data and (Heckman & Macurdy, 1980)

financial stability. Moreover, these findings, jointly with the negative sign of the autoregressive coefficient for RORWA, indicate that most of the observed dependence of profitability on its own history may indeed be attributable to the effects that past values have on the probability of both sanctions and default.

Finally, we compare the results from the profitability analysis with the estimates of the effects on the growth of loans. Lending is, on the one side, the main transmission channel of financial shocks to the real economy and, on the other side, highly affected in its distribution by the banks' default. Indeed, since a decreasing loans' growth rate might be indicative of increasing nonperforming loans ratio (NPL), after the recent financial crisis, several banks experiencing large drops in gross loans incurred in liquidations or acquisitions. We observe that a large trade-off emerges for regulators because enforcement actions increase financial stability (lower default probability) at the cost of lower growth of gross loans, hence depressing the real economy by slowing down liquidity creation.

The remainder of this paper is articulated as follows. Section 2 describes the state of the art on the interlinkages between performance, supervision and risk of failure for banks. Section 3 described the database and the empirical methodology. Section 4 discusses the results in terms of profitability (4.1) and liquidity creation (4.2). Finally, Section 5 concludes.

2. Related Literature

In the aftermath of the recent financial crisis, there has been a flourishing of papers dealing with bank default. Some of them emphasize the role of macro- and micro- prudential regulation in affecting banks' risk-taking and default probability, but this relation is often weakly significant ((Gonzalez, 2005)**,** (Demirguc-Kunt, et al., 2008), (Demirguc-Kunt & Detragiache, 2011)**,** etc.). On the contrary, (Klomp & de Haan, 2012) find that several measures of the tightness of bank regulations (supervisory control, capital regulations, market entry regulations, etc.) significantly impact bank risk to various extent, with riskier banks being highly sensitive. (Hoque, et al., 2015) provide further evidence on the sizable impact of different measures of banking regulation (restrictions on bank activity, deposit insurance, official supervisory power, etc.) on both the banks' distance to default and their individual contribution to systemic risk during and after both the recent financial crisis (2008-2009) and the European sovereign crisis (2011-2012).

Focusing on the effectiveness of the supervisory activity, several researches have investigated the correlation between the information provided to the public after on-site inspections and bank risk of failure. For instance**,** (Cole & Gunther, 1998) and (Chiaramonte, et al., 2015) compare CAMELS[6] downgrades' accuracy of predicting bank failure after on-site inspections with the off-site monitoring based on an early warning models (i.e., probit

[6] CAMELS is the FDIC's (Federal Deposits Insurance Corporation) rating system to evaluate the riskiness of US banks. The acronym "CAMELS" summarizes the main areas monitored: adequacy of capital (C); quality of assets (A); capability of management (M); quality and level of earnings (E); adequacy of liquidity (L); and the sensitivity to market risk (S).

models based, respectively, on key financial ratios or on the Altman's z-score). They show that these ratings' capability to discriminate between failing and surviving exceeds the early warning models' one, but also that this ability depends on the regulatory closure (i.e., if the ratings are no more than one-year old) or on the bank's size. Moreover, (Kerstein & Kozberg, 2013) argue that, although CAMELS ratings are not released to the public, accounting-based proxies for the scoring components are associated with the probability of bank distress. Enforcement actions mainly increase the bank default risk and provide a stronger and earlier warning of distress than balance sheet items alone because they may place restrictions or induce changes on management, reducing managers' ability to govern hence decreasing bank's stability[7]. Above all, (Delis & Staikouras, 2011) assess that information on sanctions and on-site examinations provide better information on risk-mitigation than capital[8] and transparency[9] regulatory frameworks. They foresee that those regulations exercise a disciplinary effect upon bank risk only when combined with effective bank supervision because the development of a credible treat is the underlying force of most regulatory interventions. According to (Caiazza, et al., 2017), supervision disciplinary effects spread to all the banks in the system due to spillovers towards intermediaries with similar risk-profiles to the punished ones.

A related strand of literature focuses on the understanding of the factors behind bank failures as a mean to enhance the efficiency of bank supervision (for reference see the review article (Demyanyk & Hasan, 2010)**)**. The literature on predictive models for single bank's failures is relatively recent[10] and great attention has been devoted to the design of scoring models based on micro-data from the bank's balance sheet (e.g. (Gonzalez-Hermosillo, 1999), (Bongini, et al., 2002), (Arena, 2008), (Mannasoo & Mayes, 2009) and (Vazquez & Federico, 2015)). Most of the recent studies for the US confirm the predicting power of proxies for CAMELS indicators, particularly when complemented with qualitative information, as for instance, political connections (Papanikolaou, 2018), banks' internal control (Jin, et al., 2013)**,** audit quality (Jin, et al., 2011), exposure to real estate market (Cole & White, 2012)**,** market-price based indicators ((Curry, et al., 2007) and others). Other studies report for Europe a high success in predicting bank failures by using proxies for CAMELS jointly with macroeconomic and country-level variables **(** (Porath, 2006) and (Betz, et al., 2014)) as well as the level of non-traditional activities ((Lepetit, et al., 2008) and (Momparler, et al., 2016)). Finally, with regard to Italy, (Mare, 2015) and (Calabrese & Giudici, 2015) disentangle the effect on the probability of bankruptcy (or liquidation) from the one on merging and acquisition. They show a great predictive power of bank level data (mainly CAMELS predictors) for the former and

[7] Supporting evidence to this theory is provided by (Brogi, 2011) and (Cotugno, et al., 2017) for Italy. They show a positive correlation between sanctions and board turn-over as well as associations between enforcement actions and other indicators of board quality (e.g. gender gap, member education, etc.)

[8] Further evidence on the (weak) correlation between capital requirements and bank risk and soundness is surveyed in (Van Hoose, 2007)**.**

[9] Further discussions on transparency requirements and bank risk can be found in the survey of (Alexandre, et al., 2017)**.**

[10] Past contributions mainly refer to (Martin , 1977)

macroeconomic data for the latter. Finally, (Fiordelisi & Mare, 2013) focus on managerial skill and efficiency levels.

Furthermore, other articles identify several other factors affecting contemporaneously both bank performance (i.e. profitability) and bank default risk, as for instance banks competition (Schaeck & Cihak, 2014), funding costs ((Demirguc-Kunt & Huizinga, 2010) and (Aymanns, et al., 2016)), capital (Berger & Bouwman, 2013), non-interest income ((Demirguc-Kunt & Huizinga, 2010) and (DeYoung & Torna, 2013)) and shareholders' excess control rights (Saghi - Zedek & Tarazi, 2015). With regard to supervisory activity[11], researchers have shown that liquidity creation, profitability, banks' solvency and banking system stability benefit from restricting bank activity and enhancing private monitoring (Barth, et al., 2004), from more stringent risk-weighted and leverage capital ratios ((Estrella , et al., 2000) and (Fiordelisi & Mare, 2013)), from issuing administrative sanctions (Caiazza, et al., 2015). More recently, (Giordana & Schumacher, 2017) show that Basel III regulation induces a decrease in banks probabilities of default because, since banks tend to increase their capital through retained earnings, higher capital soundness (NSF ratio) and capital-to-assets ratio increase both capitalization and profitability. In particular, (Berger, et al., 2016) argue that there is a trade-off between risk mitigation and liquidity creation for regulators because lower bank risk comes at the cost of lower bank lending.

The interlinkages between banks performance and banks probability of default are of interest for the supervisory authorities well beyond the direct effects that they exert on each other or beyond the existence of common factors. Namely, the large literature dealing with the effectiveness of bank supervision has highlighted how the macroeconomic and bank level effects of bank regulation, on-/off-site monitoring and enforcement actions, are dependent on the riskiness of the sanctioned banks and on size of the (induced) change in risk-strategies after the supervisory event.

Regarding general regulatory and supervisory policies, (Choretareas, et al., 2012) show that strengthening official supervisory power or increasing capital requirements have a positive impact on bank efficiency also through the reduction of the probability of distress, while higher regulatory restrictions on bank activities and private monitoring adversely affect bank operational efficiency. A few studies examine the direct effect of enforcement actions and show that the expected shrinkage of bank liquidity creation is dependent on some measures of bank risk, like the leverage ratios in (Peek & Rosengren, 1995) or the occurrence of harder enforcement actions (i.e. cease and desist orders, formal agreements, prompt corrective actions, etc.) in (Danisewicz, et al., 2016). Furthermore, (Curry, et al., 1999) didn't just provide evidence that, to survive, troubled banks start changing operational policies some time before the examination, but they showed that the effects on banks' behavior (and

[11] Other papers assess the impact of enforcement actions on performance but disregard the role of bank default risk. Among them, (Muré & Pesic, 2010) point out a positive (but weak) association with loans growth and (Deli, et al., 2016) show that following an enforcement action, all the pricing terms of loans originated after the imposition are better for borrowers as well as there is an increase in loan sizes and duration.

performance) become more pronounced after the issuance of a formal enforcement action. Above all, (Delis, et al., 2017) argue that the longer risk-based capital ratios deteriorate before occurrence of the sanctions, the more likely the punished bank will face dropping productivity and other serious distress in the following years. Attuned to this theory, (Guerello, et al., 2017) assess that both the fall in liquidity creation and the lowering in returns (on assets) are more pronounced for repeatedly sanctioned banks (i.e. banks not changing their strategies following an enforcement action in order to avoid further occurrence of sanctions), hence turning out to be riskier.

Building on this latter evidence, we contribute to the literature on the effects of regulation and supervision on bank performance and risk by jointly analyzing the effects of sanctions on profitability or liquidity creation and bank probability of default. Hence, the main contribution of the proposed analysis relies on the fact that we allow for contemporaneous and different effects of enforcement actions on performance and bank default probability, while not disregarding the strong interconnections between these two aspects of the banking activity. This allows us to disentangle the direct causal effect of supervision on performance and the indirect effect through the impact on default risk.

3. Econometric specification

3.1. Data description

We test the joint significance of enforcement actions on both performance and default risk on a sample of Italian banks. We focus on the Italian banking system for two main reason. On the one hand, since the Italian corporate sector, differently from US, is highly dependent on the banking sector, the effects of macro-prudential policies towards banks on the real economy are amplified. On the other hand, the banking system is characterized by a plethora of small and unlisted banks, hence posing a challenge for supervisors and constituting potential fuel for the European and worldwide systemic risk.

Using accounting data retrieved from Orbis Bank Focus®, we complement a newly built database comprehensive of the money penalties imposed by Bank of Italy and Consob.[12] We consider the application of our model to 157 Italian banks, observed over the period 2008-2015. Following(Fiordelisi & Mare, 2013) and (Mare, 2015), who focus exclusively on cooperative banks (BCC), we recognized the peculiarity of this segment of the banking system. It is characterized by small dimension, geographic concentration, and mutualistic scope. These features make the supervision of this sector especially challenging and the default rate of those banks much higher than that of commercial peers. Furthermore, this branch has undertaken a deep reform from the regulatory point of

[12] The database in its preliminary form was built by the Center for Applied Research in Finance (CAREFIN), but since 2013, it has been developed by the Arcelli Centre for Monetary and Financial Studies (CASMEF), with the financial support of Oasi, Inc. Since then, it is property of CASMEF and it is not publicly available. CASMEF has also established a permanent observatory on the sectioning activity in Italy aimed at analysing this phenomenon by many different standpoints, at increasing the awareness and stimulating the debate about this topic across Europe. A complete description of the database structure is provided in our previous analysis, (Guerello, et al., 2017). For further information about the data, please contact casmef@luiss.it.

view. The same reasons that induced those previous researches to restrict their attention exclusively on cooperative banks, motivate us to exclude them from the sample and to leave their analysis to dedicated future research.

3.2. Endogeneity of the treatment effect

Exploiting the information potential of the database, which is not just limited to sanctioned banks (differently from (Pesic & Muré, 2010) and (Deli, et al., 2016)), we compare those banks with the never-sanctioned ones, namely the control group, by means of a difference-in difference estimator. The causal effect of the enforcement action is measured as the difference between the breaks in the hypothetic trend (i.e., the trend of the control group) and in the observed one after the sanction (i.e. the treatment). This method rests on the assumption that, in the absence of sanctions, the trends of performance indices would have been the same across the two groups. However, previous literature raises concerns about the endogeneity of treatment (randomization bias) because enforcement actions are not an exogenous source of variation of bank performance. The existence of such an endogeneity issue is evident in **Table 1**, which reports key descriptive statistics for some variables of interest comparing sanctioned and never-sanctioned banks.

Table 1 Statistical distribution of selected outcomes: sanctioned vs. never-sanctioned banks

	Sanctioned Banks			**Never-Sanctioned Banks**		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**
RORWA	0.01%	-5.04%	5.29%	0.81%	-3.92%	13.1%
Growth of Loans	4.82%	-13.2%	30.2%	13.6%	-5.26%	211%
Default Frequency	2.64%	0.00%	7.02%	2.94%	0.00%	9.68%

While previous analyses have lessened the randomization bias by means of instrumental variables, for example, by employing, as an instrument, the female representation in the group of inspectors in (Delis, et al., 2017), we rely on the conditional independence assumption. As a weaker form of the completely random assignment assumption, this assumption requires that participation in the treatment should not depend on outcomes, after controlling for the variation in outcome induced by heterogeneous dynamics of a fixed set of regressors. If there is no omitted variable bias, once those control variables are included in the regression, the treatment participation decision will not affect the conditional distribution of potential outcomes. As proposed in (Banerjee & Mio, 2017) who adopt this strategy to quantify the effect of liquidity regulation, we can correctly identify the causal effect of sanctions by including a set of observable determinants for the sanctioning event (selection-on-observables) which remove biases in the comparison between sanctioned and never-sanctioned banks. In this case, the conditional independence assumption translates into the following hypothesis: in the absence of sanctions, sanctioned banks would have follow the same trend as non-sanctioned banks reporting the same balance sheet items, used as

controls. Therefore, conditional on the dynamics of those controls, we can predict the "correct" hypothetical trend for the sanctioned banks in absence of sanctions.

Following the identification proposed in (Guerello, et al., 2017), we select a robust set of controls by looking at the business characteristics of the intermediaries and at the pillars of the current and prospective banking regulation (i.e. Basel II and Basel III). With regards to the former criterion, we pick the growth of gross loans and the intermediation margin ratio, while, concerning the regulation pillars, we select the Net Stable Funding Ratio (NSFR) along with the return on risk-weighted assets (RORWA), excluding instead both Tier1 ratio and leverage ratio.

We focus our analysis on the effects of sanction on profitability, considered in the literature as one of the main transmission channels of financial shocks to the real economy. Since we are interested in quantifying the effect in the periods immediately after the sanctions, following (Banerjee & Mio, 2017), we look at the (Jordà , 2005) local projections for RORWA to estimate the 1-step ahead cumulative average effects of sanction on the outcome variable, computing regression-adjusted diff-in-diff estimates as detailed above.

In particular, we consider the following specification:

$$Y_{i,t+1} - Y_{t-1} = \beta X_{i,t-1} + \delta\, I_{i,t} + \alpha_i + \varepsilon_{it+1} \qquad \textbf{(1)}$$

Where Y_{t+j} is the banking performances index after j years, X_{t-1} is a set of controls lagged with respect to sanctioning event including the outcome index Y_{t-1}; α_i are idiosyncratic fixed effects, $I_{i,t}$ is a dummy that takes value 0 before the first sanction and 1 after. Since few intermediaries have been sanctioned more than once over the period under consideration, we should read the causal coefficient as indicating the effect of being sanctioned, rather than the effect of the single sanction. As argued in (Guerello, et al., 2017), repeatedly incurring in sanctions is associated with poor future performance due to unadjusted strategies after the enforcement actions, and hence might be endogenous to future sanctions. However, low-quality management is mainly reflected in higher probability of default, hence distinguishing between repeatedly sanctioned banks and the intermediaries punished only once is not relevant whenever the effect of drop-out due to liquidations (or strategic acquisition) is taken into account.

Under the conditional independence assumption, the average treatment effect of being sanctioned is computed as:

$$\delta = E\left[\left(Y_{i,t+1}(I=1) - Y_{i,t-1}\right) - \left(Y_{i,t+j}(I=0) - Y_{i,t-1}\right)\right] = E\left[Y_{i,t+1} - Y_{i,t-1} | I=1; X_{i,t-1}\right] - E\left[Y_{i,t+1} - Y_{i,t-1} | I=0; X_{i,t-1}\right] \qquad \textbf{(2)}$$

3.3. Endogeneity of the sample attrition

As anticipated, we depart from the previous literature by including in the database also the intermediaries which defaulted (M&A included as suggested by literature) at some point within the period under examination and whose

accounting items are, for this reason, not observables since then. A large swath of literature has proved that bank failures can be predicted looking at micro-economic data obtained from the balance sheet of the banks (for instance, (Calabrese & Giudici, 2015)). We do also notice in Table 2 that most of the active banks show higher average values for the outcome variables and lower default probability, hence pointing out a strong association between default risk and those variables.

Due to the endogeneity of default, distressed banks are typically excluded from the analysis, despite being the most informative about supervision's effectiveness. Differently from previous literature, we decide to include the distressed banks in the panel, which ends-up being unbalanced, and we address the endogenous drop-out in order to investigate jointly the effect of enforcement actions on both default probability and bank performance. Specifically, we employ a two-stage (2SLS) Heckman selection model, following the approach discussed in (Semykina & Wooldridge, 2010) for panel data.

Table 2 Statistical distribution of selected outcomes: active vs. defaulted banks

	Active Banks			Defaulted Banks		
	Mean	**Min**	**Max**	**Mean**	**Min**	**Max**
RORWA	0.55%	-5.04%	13.1%	-0.10%	-3.06%	2.15%
Growth of Loans	11.1%	-11.3%	211%	1.31%	-13.2%	30.2%
Sanction Frequency	4.70%	3.01%	12.8%	10.8%	0.00%	50.0%

Either the diff-in-diff or the IV estimator described in the previous section as the main regression models for our analysis are not consistent if exit from the sample is not strictly exogenous conditional on the unobserved effect (random or fix effect). In order to correct for the attrition bias, we consider few estimators that combine a probability model for drop-out and a traditional random effects model of individual response.

First, the drop-out model of (Housman & Wise, 1979) and (Diggle & Kenward, 1994) builds on the assumption that if a unit is still in the sample at time *t*, its associated sequence of outcomes follows the same joint distribution as the latent series underlying all units performance, which is unobservable in case of drop-out. Hence, they allow the conditional probability of drop-out to depend on the history of the latent outcome process up to and including the time of drop-out, and they consider a logistic linear model. In our case, we consider a fully informative drop-out process that assumes direct dependence on the contemporaneous (latent) outcome.[13] This model has the form:

$$Y_{i,t}^{*} = \begin{cases} Y_{i,t} & if\ d_{i,t} = 0 \\ missing & if d_{i,t} = 1 \end{cases}$$

[13](Diggle & Kenward, 1994) distinguish three cases of drop-out: i) completely random drop-out (CRD) when the drop-out and the measurement process are independent; ii) random drop-out (RD), when the drop-out process depends on the past observed measurements; iii) informative drop-out (ID), when the drop-out process depends on the contemporaneous unobserved measurement, hence on those that would have been observed if the unit had not dropped out (latent outcome variable).

$$Y_{i,t} = \beta X_{i,t} + \alpha_i + \varepsilon_{it} \quad \textbf{(3)}$$

$$\Lambda\left(Pr\left(d_{i,t}=1\right)\right) = \gamma_0 + \gamma_1 Y^*_{i,t} + \varsigma_i + \upsilon_{i,t} \quad \textbf{(4)}$$

Where $Y^*_{i,t}$ is the latent outcome variables, which is observable only when unit is measurable, while $Y_{i,t}$ is the observed outcome. $d_{i,t}$ indicates whether the unit drops-out of the panel.

Second, we consider a different approach to the drop-out model to account for the direct effect of the sanction on the default. Indeed, including the dummy for the sanctioning event also in the selection model compromises the correct identification of the causal effects of enforcement actions on default risk because this variable is highly correlated with the outcome variable (either observed or latent). To this extent, we follow (Semykina & Wooldridge, 2010), who propose a parametric correction based on conditioning the probability of default on few observables that must be always observable for all banks and that must be strictly uncorrelated with idiosyncratic shock but not with the unobserved heterogeneity. Differently from them who focus on fixed effect, we apply their correction to a random coefficient Heckman 2SLS selection model considering a logistic linear model for the drop-out process. The econometric specification reads as:

$$\Lambda\left(Pr\left(d_{i,t}=1\right)\right) = \gamma_0 + \gamma_1 Z_{i,t} + \gamma_2 X_{i,t} + \varsigma_i + \upsilon_{i,t} \quad \textbf{(5)}$$

$$Y_{i,t} = \begin{cases} \beta X_{i,t} + \lambda\varsigma_i + \varepsilon_{it} & if\ d_{i,t}=0 \\ missing & if\ d_{i,t}=1 \end{cases} \quad \textbf{(6)}$$

where $Y_{i,t}$ is the observed outcome and $d_{i,t}$ indicates whether the unit drops out of the panel.

3.4. Overall estimator description

Following the identification strategies detailed above, we addressed jointly the randomization bias and the attrition bias by designing the substantive equation of the Heckman 2SLS selection model, eq. **(6)**, following the diff-in-diff specification with conditional independence assumption, eq. **(1)**. The proposed estimator has the following form:

$$\Lambda\left(Pr\left(d_{i,t+1}=1\right)\right) = \gamma_0 + \gamma_1 Z_{i,t} + \gamma_2 X_{i,t-1} + \delta\, I_{i,t} + \varsigma_i + \upsilon_{i,t+1} \quad \textbf{(7)}$$

$$Y_{i,t+1} - Y_{t-1} = \left[\beta X_{i,t-1} + \delta\, I_{i,t} + \lambda\varsigma_i + \varepsilon_{it+1}\right]\left(1-d_{i,t}\right) + \lambda\,\Lambda\left(Pr\left(d_{i,t+1}=1\right)\right) \quad \textbf{(8)}$$

We estimate this model exploiting the hierarchical structure by means of the Generalized Linear Latent and Mixed Model of Rabe-Hesketh, et al. (2002), (2005) and Rabe-Hesketh & Skrondal (2012) with three different random effect levels: logit model (first level); least squares regression (second level) and the panel random effect component (third level).

4. Results

4.1. Relevance of the default risk

In Table 3 we compare the different identification strategies to overcome both the attrition bias and the randomization bias due to the endogeneity of the sanction with respect to RORWA. In particular, we assess the relevance of the attrition bias which depends on the correlation between banks' performance, measured by the return on risk-weighted assets (RORWA), and the probability of default. In fact, whether RORWA will be observable or not depends on the same factors affecting the performance itself.

Firstly, we start providing support to the existence of a randomization bias for both RORWA and banks' default risk by regressing individually those variables on a dummy taking value one after the first sanction and zero otherwise. Columns 1 and 2 report, respectively, the causal effect of sanctioning (δ in eq. (1)), with the difference between the two models being the inclusion of some factors, which are indicative of the probability of incurring in enforcement actions. Accounting for those observables allows for the assumption on (conditional) independence of the sanction to hold. Looking at the bottom part of Table 3, we notice that the effect of sanctions on RORWA is upward biased by the endogeneity of the sanctioning activity. Indeed, under the baseline specification (diff-in-diff without controls) the causal effect is highly significant and largely negative while, once controlling for the factors leading to the sanctions, its effect is largely reduced and only weakly significant. As reported in the upper part of Table 3, the randomization bias is even stronger when estimating the impact of sanction on banks' default risk, which turns from positive to negative, although still not significant. The issue of endogeneity is further supported by the significant coefficient of the lagged value of RORWA because it implies that both the probability of default and profitability depend on the history of the latter.

Secondly, we assess the magnitude of the attrition bias in our sample looking at the loading factor for the common factors affecting both the probability of default and bank performance. Column 3 reports the estimates for the drop-out model of (Housman & Wise, 1979) and of (Diggle & Kenward, 1994). Following the classification in (Diggle & Kenward, 1994), we can read the bank default as an informative drop-out process because it does depend both on the historical values for profitability and on the unobserved measurements. This evidence is summarized by the coefficient of the latent variables for RORWA (γ_1 in eq. (4)), which is indeed highly significant and negative, hence suggesting a negative association between performance and risk. In fact, very low values of RORWA are typically not observable because its distribution is left-tail truncated due to the occurrence of the default.

Comparing however the effect of sanctions on bank performance in the drop-out model (column 3, lower part of Table 3) with the one reported in column (2), we find that the influence of the attrition bias on this coefficient is not as large as the one observed due to the lack of randomization. This evidence suggests that a stronger association

may exist between micro-prudential policy and bank performance than between bank profitability and default risk. However, these results also highlight that accounting for the attrition bias is important because the causal coefficient δ is further upward biased by the dependency of the drop-out on the measurement process. As we can observe, by combining the drop-out model with the diff-in-diff approach, the estimated impact of sanctions on profitability reduces from -0.371 to -0.342 and loses all its (although weak) significance.

The (Housman & Wise, 1979) and (Diggle & Kenward, 1994) specification does not allow to quantify the direct effect that enforcement actions have on the probability of failure which may work beyond the indirect effect through the distribution of returns (% of RWA). To account also for this phenomenon, as a first attempt, we design the selection model as a diff-in-diff for the sanctioning event, including the controls as in the substantive model. The results are reported in column 4 and point out an improvement in the estimates of the causal effect of sanctions on RORWA, especially in terms of significance, pointing out that the trade-off between profitability and default risk is not fully addressed simply correcting for the attrition bias. Henceforth, it is important to account for the direct effect of sanctions on the probability of failure. Indeed, once this additional channel for the transmission of regulatory shocks on RORWA is explicitly included, the importance of the attrition bias is largely downsized.

However, while the drop out is still informative (i.e. the coefficient of the latent factor for RORWA is significant), the estimates are significant neither for the sanctioning event nor for the controls (not shown). As already discussed in section 3.3, this striking result may be attributed to the high correlation between the latent factors of RORWA and the other regressors. Such a strong association is, indeed, highlighted by the results for the substantive model. To overcome this latter issue, we decide to compare the estimates obtained with the extended drop-out model with the ones obtained by employing an alternative estimator which directly addresses the endogeneity of the default risk. Namely, by a Heckman 2SLS estimator we attempt to disentangle the causal effects of sanctions on both performance and default, by including a set of instrumental variables in the selection model. Differently from the drop-out model, the 2SLS IV specification accounts for the impact that exogenous variations of the default risk exert on RORWA. Moreover, alike the drop-out model, the estimator factors in the dependence of the default on the profitability values that would have been observed if the bank had not exited the sample.

Specifically, we select as instruments few indicators having three key characteristics: i) they are explicative of the probability of failure; ii) they are uncorrelated with the outcome variables and with the idiosyncratic innovations in its process; iii) they are observables even when the RORWA is not, due to drop-out. We instrument the probability of default by a set of three variables which includes: i) the share of listed banks (% active banks in the year); ii) the share of sanctions inflicted by CONSOB (% of total number of sanctions); iii) the Herfindahl-Hirschman index for banking system concentration (Rhoades, 1993), cross-bank variance of total assets shares (%). Those variables, beyond being always observable due to aggregate nature, are in fact expected to significantly

affect the probability of default but not the profitability ratios or other performance measures. Column 5 shows the results of the Heckman 2SLS estimator.

The first stage estimates allow us to assess the strength of the selected instruments. First, although listed banks usually achieve higher profitability, on the one side, more listing in the banking sector does not affect the performance of the individual intermediary, beside a weak effect through strengthened competition. On the other side, listed banks are typically associated with more proactive monitoring by the supervisory authorities and by market operators. In fact, banks on average increase risk-taking when they transition from private to public ownership (Falato & Scharfstein, 2016) making them crucial for overall stability of financial markets. The higher threats they pose to the financial system due to the systemic risk and the diffuse ownership may drive "too important to fail" policies by regulators aimed at investors protection. For those reasons, as the share of listed banks increases, the system tends to become sounder and safer, as pointed out by the estimated negative correlation with the probability of default.

Second, CONSOB tends to inflict more sanctions during periods of financial distress at the national level, and this applies particularly to the sample period under investigation, which covers the financial crisis and the sovereign debt crisis. Accordingly, we expect that higher intensity of supervision by this authority to be associated with higher financial distress. However, we find a weak significance of the coefficient associated with the share of sanctions imposed by CONSOB in the selection equation once we factor in the impact of sanctions and their determinants.

Third, although it is highly debated if increasing concentration improves banking sector soundness, it is largely acknowledged that more concentrated systems may call for interventions motivated by the "too big to fail" or to the "too important to fail" rationales. In fact, regulators have little choice to avoid systemic bailouts but intervening, hence they may be unwilling to let large and systemically important banks to fail (Farhi & Tirole , 2012). On the contrary, markets which are dominated by a large number of small intermediaries, as the Italian cooperative segment (BCC), are typically characterized by higher frequency of defaults, as reported in (Fiordelisi & Mare, 2013). Accordingly, the estimated impact of the Herfindahl-Hirschman index on the probability of default is negative and significant.

Once assessed that the proposed identification strategy is robust, we look at the impact of sanctions on the probability of default as reported in the top panel of Table 3. Two main findings arise: sanctions do not exert any direct impact on default risk while, instead, lower past values of RORWA are associated with higher probability of failure broadly in line with the results from the drop-out model (i.e. negative sign of the loading factor). However, despite the evidence of a left side truncation in the distribution for RORWA due to the occurrence of default, the positive loading factor estimated by the Heckman 2SLS model suggests that riskier banks, with a larger probability to default, may have also a larger profitability. Henceforth, the results point towards the existence of

an asymmetric link between performance and riskiness because there is evidence of both a positive and a negative association between the two variables.

Comparing the estimates of the equation for RORWA in the bottom panel of columns 3 and 5, it is straightforward to notice that the negative causal coefficient of the sanction becomes statistically significant in the Heckman 2SLS model, while the impact of the NSF ratio increases with respect to the drop-out model. These results suggest that, once filtering out the indirect effect that those indicators exert on profitability through the default process, then RORWA strongly depends on supervisory activity, namely on enforcement actions and regulatory requirements (NSF ratio). However, as stated above, we observe that the sanctioning activity does not significantly impact default. This evidence is further supported by the negative sign of the autoregressive coefficient for RORWA in the substantive equation. Together, these findings indicate that most of the dependence of the profitability ratio on its history may indeed be attributable to the effects that past values have on the probability of both sanctions and default. Overall, the Heckman 2SLS estimator seems to perform particularly well as indicated also by the associated log likelihood, which is in fact extraordinary low.

4.2. The impact of enforcement actions on profitability and liquidity

Danisewicz, et al. (2016) has indicated the liquidity creation and the lending channel as the main transmission mechanisms through which the consequences of regulatory interventions affect the real economy. With regards the lending channel, further support is provided by Caiazza, et al., (2015) arguing that enforcement actions discourage credit risk taking in the medium run and by Deli, et al., (2016) showing a negative association of sanctions with syndicated loans price terms and a positive one with other characteristics. Furthermore, (Berger, et al., 2016) provide evidence of dropping liquidity creation, to the extent of the difference between liquid and illiquid balance sheet activities.

In light of these considerations, we decided to extend the analysis also to the dynamics of gross loans. In fact, on the one side, a tightening of the credit standards and/or a spike in the spread on syndicated loans triggers a credit crunch. Declining gross loans growth reflects also a more prudent credit risk management. On the other side, being the Italian economy mainly bank-based, the consequences of falling liquidity creation is mostly channeled through a cut in bank lending to the real sector. However, our credit measure is not able to fully collect credit risk because it does not consider changes in impairments, although severe inadequacies in the credit process are reflected in the bank default risk.

Furthermore, since we consider both investment and commercial banks, banks liquidations and acquisitions (or merging) are much more concentrated at the lower end of the loans growth distribution than at the lower end of RORWA's one. For instance, the frequency of the banks default at the first decile of either the RORWA or the growth of gross loans distribution are respectively 9% or 32%. Indeed, mainly during financial crisis, decreasing

loans growth rate is motivated by increasing nonperforming loans ratio (NPL), which is highly indicative of the financial health of the intermediaries, especially for Italian commercial banks.

Table 4 reports the estimates for a 2SLS IV estimator for the selection model as proposed by (Semykina & Wooldridge, 2010) with a diff-in-diff with selection on observables identification strategy for the causal effect of sanctions on both the probability of default and the dependent variable. As discussed above, we focus on two main dependent variables: profitability and credit, namely RORWA and growth of gross loans. Concerning the selection of instruments for the probability of default, as discussed in the previous section, we identify three main variables: i) the share of listed banks (% active banks in the year); ii) the share of sanctions inflicted by CONSOB (% of total number of sanctions); iii) the Herfindahl-Hirschman index for banking system concentration.

As highlighted in the previous section, the estimates for RORWA point to sanctions having a significant effect on profitability but not on default probability. Hence, bank default risk is affected by sanctions only through the effect exerted by the decline in RORWA after the enforcement action. However, a positive and negative association between profitability and risk coexists, as captured by the positive sign of the loading factor and the negative coefficient for past RORWA values in the selection model.

Comparing those results with the ones for growth of gross loans, we observe that the impact of both sanctions and of regulatory requirements (NSF ratio) on the growth of loans is aligned with ones on RORWA, although strongly amplified: after an enforcement action, the growth of gross loans falls by more than 6 p.p. Furthermore, loans growth depends on the history of profitability as well, but negatively. This finding is in line with the stylized fact that banks typically search for profitability in non-interest activity, like trading. Since defaults are more frequent at low values of RORWA, then a negative correlation exists between loans growth and risk due to the lower exposure to market risk. Therefore, we observe a positive loading factor, although smaller, indicating the existence of common factors increasing both growth of gross loans and the probability of failure.

Turning to the selection model, it is striking that, in this case, sanctions significantly decrease the probability of default by more than 4 p.p. The identification through the instrumental variables is robust across the two specifications as proved by the similar coefficients for the instruments across the two specifications. However, the model fully identifies the direct role played by enforcement actions for financial stability, because, through loans' growth, it accounts for the key dynamics of intermediaries' soundness, namely higher profits and less NPL.

5. Conclusions

Cases of default have often been excluded from analysis on the effectiveness of bank supervision, although defaulted banks constitute the most interesting sample for regulators themselves. We decided to exploit the information potential of our sample of Italian banks, including both active and inactive intermediaries, to provide the most complete assessment as possible for the impact that enforcement actions exert on banks profitability. To

the best of our knowledge, this is the first attempt to estimate the causal effect of sanctions on banks' performance while simultaneously correcting for the endogeneity of enforcement actions and drop-out. This strategy allows us to disentangle the direct effect that sanctions have on performance from the indirect one through default.

The contribution of this analysis is twofold. On the methodological standpoint, we combine new econometric identification strategies to overcome multiple endogeneity issues due to the nonlinear interlinkages among supervision, financial stability and banks' profitability. From the regulatory point of view, we provide new insights on the effectiveness of banking supervision in terms of safety and soundness of banks.

The results from the empirical analysis support our assumption about the existence of both an attrition and a randomization bias in the estimate of the causal effect of sanctions on banks performance. The causal effect of sanctions on RORWA is in fact largely upward biased, and it significantly declines once we control for the endogeneity of both enforcement actions and default. These results suggest that neglecting these issues may likely bias the evaluation of supervision effectiveness.

Once filtering out the indirect effect that the selected indicators exert on profitability through the probability of default, we find that RORWA strongly depends on supervisory activity, namely enforcement actions and regulatory requirements. Moreover, we observe that sanctioning activity does not have any significant direct impact on default. We also observe the autoregressive coefficient for RORWA turns negative once we accounted for the effects of past values of RORWA on sanctions and default risk. Taken together with previous results, this finding indicates that most of the dependence of profitability on its history may indeed be attributable to the effects that past values have on the probability of both sanctions and default.

Overall, the results point towards the rejection of the existence of a trade-off between banks profitability and financial stability. However, once we move our focus out of profitability towards lending and liquidity creation, we observe that in this case a trade-off for regulators exists. Due to the higher concentration of banks failure at the lower end of the loan growth's distribution, we find that, once considering the effects of enforcement actions on both those variables, sanctioning activity exerts indeed a significant impact also on the default risk. However, since enforcement actions decrease default risk at the cost of lower loans' growth, then a trade-off between bank stability and economic growth (through higher lending and liquidity) actually exists.

Table 3 Comparison of alternative identification strategies

Randomization bias:		**Baseline**	**Diff-in-Diff with selection on observables**			
Attrition bias:		**Baseline**	**Baseline**	**Drop-out model**	**Drop-out model**	**2SLS IV estimator**
		(1)	**(2)**	**(3)**	**(4)**	**(5)**
Selection Model	$Pr(d=1)=\gamma_1 Y^*_{i,t}+\gamma_1 Z_{i,t-1}+\gamma_2 X_{i,t-2}+\delta I_{i,t-1}+\epsilon_{2,i,t}$ $with$ $\epsilon_{2,i,t} \sim \Lambda(0,\sigma_2^2)$					
$\delta I_{i,t-1}$	***L1. Sanction (d)***	52.51 (43.52)	-1.651 (20.28)	No	Yes	-0.618 (1.196)
$\gamma_2 X_{i,t-2}$	***L2. Growth of Gross Loans (%)***	No	-0.175 (0.529)	No	Yes	-0.004 (0.009)
	L2. Margin Interm. Ratio (%)	No	0.043** (0.022)	No	Yes	-0.001*** (0.000)
	L2. NSF Ratio	No	-1.809*** (0.532)	No	Yes	0.000 (0.002)
	L2. RORWA (%)	No	-10.53* (6.156)	No	Yes	-0.634** (0.300)
$\gamma_1 Z_{i,t-1}$	***L1. Listed (Sh.)***	No	No	No	No	-3.218** (1.399)
	L1. CONSOB (Sh.)	No	No	No	No	-0.003 (0.038)
	L1. Concentration Index	No	No	No	No	-3.818** (1.680)
$\gamma_1 Y^*_{i,t}$	***RORWA***	No	No	-2.056*** (0.071)	-2.093*** (0.060)	No
Substantive Model	$Y_{i,t}=\beta X_{i,t-2}+\delta I_{i,t-1}+\epsilon_{1,i,t}+\lambda\epsilon_{2,i,t}$ $with$ $\epsilon_{1,i,t} \sim N(0,\sigma_1^2)$					
$\delta I_{i,t-1}$	**L1. Sanction (d)**	-0.570*** (0.209)	-0.371* (0.210)	-0.342 (0.225)	-0.372* (0.210)	-0.359** (0.149)
$\beta X_{i,t-2}$	***L2. Growth of Gross Loans (%)***	No	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	-0.002* (0.001)
	L2. Margin Interm. Ratio (%)	No	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
	L2. NSF Ratio	No	0.001** (0.000)	0.001** (0.003)	0.075** (0.034)	0.001*** (0.000)
	L2. RORWA (%)	No	0.380*** (0.056)	0.367*** (0.062)	0.379*** (0.056)	-0.138*** (0.031)
$\lambda\epsilon_{2,i,t}$	***Loading Factor***	N/A	N/A	-2.056	-2.093	1.150
	Log-Likelihood	-2283□	-1916□	-1951	-1940	-308.8

*s.e. in parenthesis; *** <0.01; ** < 0.05; * <0.10; □ The log-likelihood reported refers to the substantive model.*

Randomization bias: baseline model, regression of outcomes on the sanction dummy controlling only for banks' characteristics; Diff-in-Diff with selection on observables, (Banerjee & Mio, 2017) *identification strategy. Attrition bias: baseline model, estimation of two separated equations for the two outcomes (RORWA and Prob. of default); Drop-out model: identification strategy as in* (Housman & Wise, 1979) *and* (Diggle & Kenward, 1994)*; 2SLS IV estimator, identification strategy as in* (Semykina & Wooldridge, 2010)*.*

Table 4 The effect of sanctions on profitability, liquidity creation and default risk

Model:		Diff-in-Diff with selection on observables 2SLS IV estimator	
Dependent Variable:		RORWA	Growth of Loans
		(1)	(2)
Selection Model	$Pr(d=1)=\gamma_1 Z_{i,t-1}+\gamma_2 X_{i,t-2}+\delta I_{i,t-1}+\epsilon_{2,i,t}$ *with* $\epsilon_{2,i,t} \sim \Lambda(0,\sigma_2^2)$		
$\delta I_{i,t-1}$	*L1. Sanction (d)*	-0.618	-4.155***
		(1.196)	(0.752)
$\gamma_2 X_{i,t-2}$	*L2. Growth of Gross Loans (%)*	-0.004	-0.033***
		(0.009)	(0.005)
	L2. Margin Interm. Ratio (%)	-0.001***	-0.000
		(0.000)	(0.001)
	L2. NSF Ratio	0.000	0.000
		(0.002)	(0.002)
	L2. RORWA (%)	-0.634**	-2.076**
		(0.300)	(0.278)
$\gamma_1 Z_{i,t-1}$	*L1. Listed (Sh.)*	-3.218**	-3.446***
		(1.399)	(0.242)
	L1. CONSOB (Sh.)	-0.003	-0.006
		(0.038)	(0.014)
	L1. Concentration Index	-3.818**	-3.577**
		(1.680)	(0.279)
Substantive Model	$Y_{i,t}=\beta X_{i,t-2}+\delta I_{i,t-1}+\epsilon_{1,i,t}+\lambda\epsilon_{2,i,t}$ *with* $\epsilon_{1,i,t} \sim N(0,\sigma_1^2)$		
$\delta I_{i,t-1}$	*L1. Sanction (d)*	-0.359**	-6.555***
		(0.149)	(0.960)
$\beta X_{i,t-2}$	*L2. Growth of Gross Loans (%)*	-0.002*	-0.052***
		(0.001)	(0.003)
	L2. Margin Interm. Ratio (%)	-0.000	-0.001
		(0.000)	(0.002)
	L2. NSF Ratio	0.001***	0.002***
		(0.000)	(0.000)
	L2. RORWA (%)	0.138***	-3.658***
		(0.031)	(0.391)
$\lambda\epsilon_{2,i,t}$	*Loading Factor*‡	1.264	0.427
	Log-Likelihood	-308.4	-390.0

s.e. in parenthesis; *** *<0.01;* ** *< 0.05;* * *<0.10;* ‡ *The loading factor is scaled by* σ_1^2

Randomization bias: Diff-in-Diff with selection on observables, (Banerjee & Mio, 2017) *identification strategy. Attrition bias: 2SLS IV estimator, identification strategy as in* (Semykina & Wooldridge, 2010).

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