Credit Information Sharing and Firm Innovation: An Empirical Evidence

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Abstract

This paper investigates the effect of credit information sharing (CIS) on borrower's innovation activities. On the foundation of unique dataset from developed and developing countries, we find that public credit registries (PCRs) have significant positive relationship with firms' innovation. These findings contract the facilitative role of CIS in lowering firm's cost of capital and boost efficiency. Out findings are robust to different specifications and alternative measures. After the establishment of PCRs, firms may benefit more if these firms have more power in enforcing the contracts and have dispersed banking environment. These findings are aligned with the perspective that improvements in creditors' information sets leads to innovative portfolios and better financing opportunities.

Keywords: Credit Information Sharing, Firm Innovation, Public Credit Registry, Creditors

1. INTRODUCTION

The role of CIS in capital markets has attract interest from researchers and regulators in recent years. Whereas there is a consensus that credit information sharing "can reduce the extent of asymmetric information by making a borrower's credit history available to potential lenders" (Miller 2003, p. 26), the mechanisms through which that credit information sharing could influence borrowers' real business activities and its implications for firm innovation remain unknown to us. One stream of research posits that, by collecting and disseminating borrowers' credit history among lenders, credit information sharing helps firms' financing through improved availability and lower cost of credit (Barth et al. 2009; Brown, Jappelli and Pagano 2009; Dierkes et al. 2013; Sutherland 2014; Bos, De Haas and Millone 2015). Another stream of studies, however, contends that with banks manipulating firms credit rating before sharing, increased need for collateral when firms (especially high-risk borrowers) borrow from banks, and deteriorated overall information due to banks' free-rider problem, credit information sharing may worsen firms' financing especially for risky innovative projects (Gorton and Winton 2003; Hertzberg, Liberti and Paravisini 2011; Karapetyan and Stacescu 2014; Giannetti, Liberti and Sturgess 2017). As a result, the effect of credit information sharing on firms' financing and innovation is inconclusive in the literature.

In this study, we exploit the staggered initiation of public credit registries (PCRs) and mandatory information sharing affect borrowers' financing and innovation activities. Initiated and managed by government regulators, PCRs are data registries that collect and disseminate detailed statistics on individual and commercial borrowers' credit history (Jappelli and Pagano 2002). PCRs help to bridge the information gap between lenders and borrowers by providing and disseminating the data on borrower's payment history, general credit merits and overall debt exposure among lenders. Overall, this setting has several advantages. First, it helps to alleviate the concern on endogeneity issue by providing a plausibly exogenous change in banks' information set that is relevant to lenders' loan decisions. Secondly, since lenders and their borrowers are mandated to participate in PCRs, it will quite simple to identify treatment firms for a given country as well as the timing of this change. Thirdly, given that PCRs have been established in multiple countries at different time in the last few decades, we can explore various within country and cross-country variations that could help to further support our findings.

2. BACKGROUND OF THE STUDY

Public credit registries, known commonly as mandatory credit information sharing systems, is defined as "*an information system designed to provide commercial banks, central banks, and other supervisory authorities with information about the indebtedness of firms and individuals vis-à-vis the whole banking system*"[1]. Germany is the very first economy to initiate a PCR in 1934, followed by France who set up a similar system in 1946. Since then, PCRs have been established in over 90 economies/territories and provide borrower's credit (loan) history across banks (Djankov, McLeish, and Shleifer 2007). The mandatory exchange of credit information distinguishes PCRs from private credit bureaus, where the latter encourage financial institutions voluntarily participate in the system[2]. PCRs share many common features around the world. Typically, PCRs are initiated and managed by central banks. All the financial institutions under the supervision of the central banks are required to contribute data to the PCR compulsorily, which constitute the first flow of information to the PCR. The return flow of information on borrowers' total indebtedness is the second flow of data to the PCR. By collecting and disseminating this two-way flow of data on credit borrowers, PCRs can reduce information asymmetry between borrowers and potential lenders (Miller 2003). For example, according to the promotion page of credit information sharing from Central Bank of Sri Lanka, "When the credit (loan) history of a borrower is fully available to financial institutions, they are able to make better assessments about a customer's credit worthiness. This also reduces cost and time taken for loan processing. Further, it promotes discipline of the borrower and prevents the borrower becoming over-indebted to many financial institutions at the same time. These benefits promote a good credit culture in the country and contribute to a stable and sound financial system." PCRs, however, have substantial differences across jurisdictions as well. These differences generally come from the heterogeneity in PCRs' information content, coverage of borrowers and data accessibility (Jappelli and Pagano 2002). Some PCRs have minimum reporting threshold while others do not have. For example, in Israel the minimum reporting threshold is 169,500 (US$), while in Chile the limit is zero. PCRs also differ in data types collected in the system. For example, in Argentina the PCR reports default rate, arrears, total loan exposure and guarantees, while in Jordan the PCR only reports arrears and total loan exposure. Besides, the format and frequency of PCRs distributing credit information can vary across countries. PCR reports may be

[1] According to the Committee of Governors of the European Central Bank.
[2] For an overview of functions, history and credit market outcomes of credit information sharing, please refer to Jappelli & Pagano (2000), Miller (2003) and Brown & Zehnder (2010).

delivered via internet or through hard copies or even in person. As for the reporting frequency, PCR reports can vary notably from country to country. For example, in Uruguay the credit reports issued (millions) is only 8,000 in 1997 while in Brazil that number is 4,000,000 for households and 6,000,000 for firms.

3. RESEARCH DESIGN AND DATA

Our empirical analyses are based a novel global data set of firm financial characteristics merged with patent information and country-specific details of credit reporting systems. We obtain data on the establishment year of PCRs from Djankov, McLiesh and Shleifer (2007), supplemented by Balakrishnan and Ertan (2017) and (2020). Table 1 presents PCRs introduction years in the sample countries. According to the survey, establishment of PCRs is not a persistent procedure. Some countries could abolish the PCR at some time point and then re-establish some years later. In our sample, we do not observe any reverse establishment of PCRs thus far. Our sample starts from 1987 and ends in 2015. The reason of starting from year 1987 is its availability in Capital IQ Global, therefore any countries that have established PCR before the sample period (especially for those advanced European countries) will not be included. As a result, our sample mainly consists of emerging markets. Even though this constraint does not weaken the importance or validity of our study, which aims to answer the important economic question as to whether mandatory credit information sharing promotes firm innovation, our findings have limited ability to explain the impact of a probable implementation in other economies. Nonetheless, the comparison results on the sample firm characteristics to that in US and Western European public innovation firms reveal that our sample is very similar to that of their counterparties in more advanced economies. Untabulated results show that firms' Size (total assets), Leverage (total debt to total assets), ROA (return on assets) are pretty much the same as in US. The number of patents and citations in the sample countries are similar to that in US but on average slightly higher than that in other OECD countries. Overall, firms in our treatment sample seem to be comparable to their counterparties in advanced economies.

Table 1. Establishment of Public Credit Registries across the world

This table presents the list of treatment and matched control countries/territories during the sample period from 1987 to 2015.

Panel A. Year Breakdown of Treatment and Control Countries/Territories

Year	Treatment Country/Territory	Control Country/Territory

1991	Argentina	Trinidad & Tobago
1992	Taiwan	South Korea
1994	Colombia	Jamaica
1997	Brazil, Slovakia, Mozambique	Canada, Finland
1998	Nigeria, Qatar	Kenya, Macedonia
2000	Bulgaria, Romania	Greece, Poland
2001	Malaysia	Philippines
2002	Czech Republic	Hungary
2005	China, Mauritius	Japan, Uganda
2006	Oman	Kuwait
2008	Ecuador, Albania, Latvia	Bahamas
2015	Malta	Bahrain

We use global patent data from World Patent Statistical Database (here after PATSTAT), maintained by European Patent Office, to measure a firm's innovation outcome[3].

4. THE EFFECTS OF INFORMATION SHARING ON FIRM INNOVATION

Panel A of Table 3 presents the results of the baseline regression. Column 1 and 2 report the results on patent counts from pooled OLS regressions with country, industry, and year fixed effects. Country fixed effects absorb time-invariant unobservable variables that could affect both PCR establishments and firm innovation. Consistent with our first hypothesis, the coefficient estimates on interaction terms are positive and significant at 1% level across all the specifications. Column 3 and 4 show the results on patent citations. Similarly, the estimated coefficients on interaction terms are all significantly positive at 1% level. These results suggest that there is a significant positive effect of PCRs on firms' innovation outcomes, both in patent quantity and quality.

For firm-level control variables, the estimated coefficients on firm size are positive and significant, suggesting that larger firms patent more and receive more citations. Firms generating high internal cash tend to innovation more. Firms having higher leverage ratio, on the other hand, are associated with lower innovation output. Firms having higher asset growth tend to have high innovation output. Firms having higher return on assets, however, are associated with less innovation. Market competition has non-linear effects on firm innovation. All these results are in general consistent with previous studies, e.g., Luong et al. (2017). For country-level control variables, the coefficients on GDP Growth are

[3] The raw patent data is downloaded in two batches: the first batch is retrieved from PATSTAT 2016 Autumn version, and the second part is retrieved from PATSTAT 2017 Spring version.

negative but not consistently significant across all the columns, suggesting that countries with higher GDP Growth seem to be associated with less innovation output, but the evidence is not strong enough to support this argument. We only include the basic firm-level controls and GDP Growth in our baseline estimation to keep the sample as large as possible, in untabulated results, however, our inference is robust to the inclusion of various country-level and firm-level control variables. A latent weakness of the full-window sample is that our estimates may be more vulnerable to confounding effects that could be the drivers of the results after the PCR treatment. For example, regulations or economic changes that take place later than the PCR adoption could drive our results. To alleviate this concern, we repeat the estimations based on a narrower window sample. Panel B of Table 3 shows that our findings are robust to a narrow window of three years before and after the treatment. The economic effects are still significant but smaller than what we find for the full-window sample. For example, the coefficient on Treatment × Post for regression on patent counts is 0.419 (column 1), constituting about 20 percent of the sample standard deviation of patent counts (1.804). Taken together, being consistent with our predictions, the results in Table 3 indicate that mandatory sharing of credit information overall is positively associated with firm innovation.

Table 3. Baseline Results

This table reports the estimation results of the baseline specification. Each observation is a firm-year. *Post* is a dummy variable that equals to one if at or after the year the establishment of PCR in an economy (or its matched control economy) and the data is taken from Djankov, McLiesh & Shleifer (2007), supplemented by Balakrishnan and Ertan (2017) and (2020). *Treatment* is a dummy variable equals to one if the economy where the firm operates set up a PCR within the sample period, and zero otherwise. *Treatment* is absorbed and thus omitted in the presence of country fixed effects. Panel A presents the estimation results based on the full window sample. Panel B presents the estimation results based on a three-year window sample. All variables are defined in the Appendix. Robust standard errors are clustered at country and year level and are reported in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Panel A. Full-Window Sample

	(1) $Patent_{t+1}$	(2) $Patent_{t+1}$	(3) $Citation_{t+1}$	(4) $Citation_{t+1}$
Treatment × Post	1.131***	0.904***	1.625***	1.390***
	(0.126)	(0.085)	(0.137)	(0.116)
Post	-0.219***	-0.298***	-0.558***	-0.656***
	(0.052)	(0.046)	(0.086)	(0.077)
Age		-0.047**		-0.017
		(0.023)		(0.026)
Size		0.467***		0.478***
		(0.019)		(0.030)
Cash		1.554***		1.662***

		(0.178)		(0.208)
Leverage		-0.452***		-0.505***
		(0.034)		(0.054)
ROA		-1.713***		-1.919***
		(0.114)		(0.141)
Asset Growth		0.091***		0.142***
		(0.019)		(0.021)
HHI		0.296***		0.382**
		(0.100)		(0.149)
HHI^2		-0.301***		-0.443***
		(0.079)		(0.118)
GDP Growth		-1.875**		-0.217
		(0.784)		(1.101)
Observations	98,000	98,000	98,000	98,000
Adjusted R-squared	0.184	0.313	0.300	0.391
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Cluster by Country and Year	Yes	Yes	Yes	Yes

Panel B. Years [-3, +3]

	(1) $Patent_{t+1}$	(2) $Patent_{t+1}$	(3) $Citation_{t+1}$	(4) $Citation_{t+1}$
Treatment × Post	0.594***	0.419***	0.919***	0.698***
	(0.121)	(0.111)	(0.170)	(0.159)
Post	-0.390***	-0.286***	-0.585***	-0.435***
	(0.103)	(0.085)	(0.150)	(0.135)
Age		0.048*		0.033
		(0.027)		(0.033)
Size		0.513***		0.639***
		(0.035)		(0.039)
Cash		1.747***		2.696***
		(0.265)		(0.309)
Leverage		-0.435***		-0.540***
		(0.054)		(0.069)
ROA		-1.579***		-2.222***
		(0.157)		(0.223)
Asset Growth		0.124***		0.178***
		(0.040)		(0.050)
HHI		0.853***		0.844***
		(0.153)		(0.239)
HHI^2		-0.733***		-0.669***
		(0.127)		(0.188)
GDP Growth		1.124		1.246

		(1.510)		(2.370)
Observations	27,814	27,814	27,814	27,814
Adjusted R-squared	0.287	0.372	0.291	0.422
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Cluster by Country and Year	Yes	Yes	Yes	Yes

5. CONCLUSION

In this study, we use the establishment of public credit registries (PCRs) to investigate whether information sharing among lenders promotes borrowers' innovation outcome through improved financing. We find evidence that information shared by PCRs helps lenders better understand borrowers' financial status and thus enhances lending decisions among loan providers. As a result, the improved information set among lenders facilitates innovators' patenting activities through lower cost of capital and enhanced capital allocation efficiency. The positive effect is stronger among firms with higher demand for external capital, less transparency of information, and in economies with dispersed banking systems and more power in enforcing contracts. The findings we present are relevant to the accounting literature specializing in the economic impact of lenders' improved information set on real business decision makings. As Zhong (2018) and Brown and Martinsson (2018) point out, improved transparency in the information environment matters for real business activities, especially in innovation. On the one hand, firms' innovation does not occur out of thin air, exploring various determinants of innovation is essential in promoting economic growth. On the other hand, we need to have a better understanding on the real impact of sharing credit information through public or private credit systems. Our findings about the impact of mandatory information sharing on firm innovation is one important piece of evidence contributing to this endeavor. Our findings are consistent with private information possessed by bank lenders creating an implicit barrier for firms' external debt financing, especially for those innovative borrowers, and that the average lender uses the improved information set through public information sharing for better capital allocation decisions among borrowers. With this regard, our study complements the findings in Zhong (2018) and Brown and Martinsson (2018) that credit information transparency is another important factor that promotes corporate innovation activities.

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