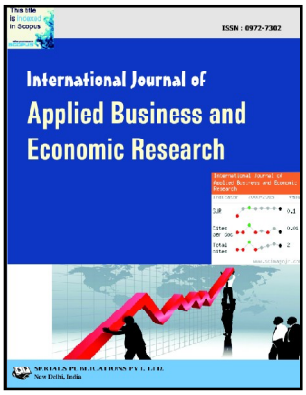

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Deposit Insurance and Industrial Volatility: An International Evidence

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Abstract: This paper investigates how the adoption of explicit deposit insurance affects industrial volatility and growth. Prior studies have examined the impact of explicit deposit insurance schemes on financial market development and stability. However, the empirical evidence on the impact on non-financial sectors is scant. This paper fills this gap by documenting novel evidence that the adoption of explicit deposit insurance significantly influences industrial growth volatility. Furthermore, using international data on industry value-added growth and estimating the proxy for its conditional volatility, following the approach suggested by Morgan, Rime, and Strahan(2004), I explore the disproportionate effect of deposit insurance across industries with different levels of dependence on external finance. This paper shows that the volatility of industry value-added growth increases on average after a deposit insurance scheme is formally introduced. It also shows that the impact is significantly weaker for the industries with greater dependence on external finance. Overall, the findings here are consistent with the assertion that explicit deposit insurance encourages risk-taking by banks and their borrowers. There, however, exists an offsetting effect: Deposit insurance relaxes financial constraints faced by industries with high dependence on external finance during economic recessions, thereby alleviating the adverse effect of explicit deposit insurance schemes.

Keywords: Explicit Deposit insurance, industrial volatility, industry value-added growth, external finance dependence

JEL Classifications: G21, G28, O47

INTRODUCTION

There have been long-standing debates on the role of deposit insurance. While the seminal research by Diamond and Dybvig (1983) shows that deposit insurance prevents bank run and buttresses the role of liquidity provision by banks, recent studies show that deposit insurance can be detrimental to financial developmentand stability by aggravating moral hazard problems in banks, impeding stock market development, and even increasing the likelihood of banking crisis (Cecchetti & Krause, 2005; Robert Cull, Senbet, & Sorge, 2002; R. Cull, Senbet, & Sorge, 2005; Demirgüç-Kunt & Detragiache, 2002).

Notwithstanding the empirical evidence for the pernicious effects of deposit insurance on financial stability, most developed and developing countries have adopted explicit deposit insurance with the aim of avoiding systemic failure of banking sectors; 112 countries have adopted explicit deposit insurance schemes up to 2013 while only 32 countries had introduced explicit insurance schemes before the 1990s. These conflicting views between academics and policy makersstem at least partially from the lack of evidence for the overall effect of formal deposit insurance schemes on real economy. The extant literature has examined the impact of deposit insurance on the stability of financial markets and institutions but how an adopted deposit insurance scheme affects the growth and stability of non-financial sectors remains an open question.

This paper fills the gap in the extant literature by investigating the impacts of explicit deposit insurance on the industrial volatility and growth. If the introduction of deposit insurance schemesrelaxes the financial constraints for borrowing firms during economic contractions, then industrial volatility may decrease. On the contrary, if explicit deposit insurance significantly exacerbatesthe banks' moral hazard problems andtherebyencourages risk-seeking by borrowing firms, industrial volatility can indeed increase after an explicit deposit insurance scheme is adopted. Importantly, these effects are mutually non-exclusive, suggesting that the overall impact remains unclear. This paper sheds light on the issue by using the international data on industryvalue added over the period 1990 to 2009.

This study establishes novel evidence that the presence of explicit deposit insurance significantly increases industrial growth volatility on average but the impact is less pronounced in the industries highly dependent on external finance. Interestingly, this paper findsno statistically significant evidence that the introduction of explicit deposit insurance increases the average industrial growth. The findings here are consistent with assertion that explicit deposit scheme encourages banks' risk-seeking, thereby increasing risk-taking by borrowing firms as well. However, there exists a counteracting effect: During the economic recession periods, explicit deposit insurance helps reduce industrial growth volatility by relaxing financial constraints faced by borrowing firms in industries with greater need for external finance. Therefore, the overall impact of explicit deposit insurance scheme on industrial volatility becomes smaller in industries highly dependent on external finance.

The paper is organized as follows. Section 1reviews the related literature and Section 2 describes empirical strategies and discusses data respectively. Sections 3 and 4 gives the empirical results and discusses robustness tests. Section 5 concludes.

1. RELATED LITERAURE

This paper contributes to extant literature in several ways. First, this paper establishes novel evidence to literature on the link between financial development and economic growth. Prior literature has provided ample evidence of the beneficial impact of financial development, proxied by private credit to GDP, on economic growth (Levine, 1997; Levine, Loayza, & Beck, 2000; Rajan & Zingales, 1998). Such literature, however, has largely ignored the influences of specific changes in financial systems. This paper highlights the importance ofunderstanding the impact of explicit deposit insurance schemes on economic growth.

Second, this paper adds new findings to the deposit insurance literature. Several studies have focused on the impact of deposit insurance on financial sectors. They show that the adoption of explicit deposit insurance hamperscapital market developments and induces banks to engage in excessive risk-taking

activities(Cecchetti & Krause, 2005; Robert Cull, Senbet, & Sorge, 2002; R. Cull, Senbet, & Sorge, 2005; Demirgüç-Kunt & Detragiache, 2002). In contrast, this studyfocuses on the impact of explicit deposit insurance scheme on non-financial sectors.

Finally, this paper extends literature by exploring the disproportionate impact of explicit deposit insurance across different industries within an economy. Extant studies have focused the divergent impacts of explicit deposits across countries. However, the effects of adopting a deposit insurance scheme can differ among firms with a different level of external finance dependence.By exploiting technology-based differences in the needs for external finance, suggested byRajan and Zingales (1998), this paper explores the interindustry effect of explicit deposit insurance schemes.

2. EMPIRICAL STRATEGY

This paper investigateshow explicit deposit insurance affectsnon-financial sectors. To do so, one set of empirical equations are estimated: industry value added growth and volatility determination equations.

I begin the investigation by identifying the impact of deposit insurance on industrial growth volatility. Following the methodology suggested by Morgan, Rime, and Strahan (2004), the proxy variable for conditional volatility is estimated. Morgan *et al.* (2004)examinedhow banking industry integration in the U.S. influencesindustrial volatility. In the first stage, they estimate the expected value of localeconomic growth and subtract the estimated value from the local economic growth in order to extract the information about the deviationaway from the conditional average economic growth. In the second stage, they define *fluctuation* as the absolute value of the deviation and regress the value on the banking market integration measure. I use a similar approach to construct the proxy variable for conditional volatility of industrial growth. I estimate a conditional mean of industryvalue added growth for given year t, country c, and industry $i$and then subtract the estimated value from the observed industrial value-added growth. I define $Fluctuation_{cit}$ as the absolute value of the deviation from the conditional mean. As Morgan et al. (2004) pointed out, the proxy variable increases monotonically with conditional volatility. The specific equations are the followings:

$$Growth_{cit} = c_c + c_i + c_t + v_{cit} \tag{1}$$

and

$$Fluctuation_{cit} = |v_{cit}|,, \tag{2}$$

where $Growth_{cit}$is defined as log growth rate of industrial value added for country c, industry i(3-digit ISIC) and year t. c_c, c_i, and are c_t dummy variables for country, industry and year respectively. v_{cit} is the residual from regressing *Growth* on industry, country, and year dummy variables. Finally, $Fluctuation_{cit}$ is defined as the absolute value of v_{cit}.

Next, I regress $Fluctuation_{cit}$on the dummy variable for the presence of explicit deposit insurance and its interaction with the proxy variables for industry-specific external financial dependenceby using the following Tobit regression models:

$$Fluctionation_{cit} = \beta_1 \cdot (Dependence_i) + \beta_2 \cdot (Dependence_i) \times (DI_{ct}) + \beta_3 \cdot (DI_{ct}) + \beta_t + \epsilon_{cit}, \tag{3}$$

and

$$Fluctionation_{cit} = \beta_3 \cdot (Dependence_i) + \beta_4 \cdot (Dependence_i) \times (DI_{ct}) + \beta_c + \beta_i + \varepsilon_{cit}, \quad (4)$$

where $Dependence_i$ is a continuous variable for an industry *i*'s dependence on external finance β_c, β_i, and β_t are fixed effects for countries, industries and years respectively. DI_{ct} is a dummy variable which is one if explicit deposit insurance scheme is introduced and otherwise zero. $Dependence_i$ is constructed followingRajan and Zingales (1998).Rajan and Zingales (1998) measure technology-driven dependence on external finance for each industry using the U.S. publicly traded firm data under the assumption that publicly traded firms in the U.S. are relatively less financially constrained. $Dependence_i$ is defined asthe gap between capital expenditures and internal funds from operating incomes during the period of 1980-1990.

This study considers diverse predictions about the role of deposit insurance. If an adopted formal deposit insurance scheme makes more credit available to risky borrowers, industrial growth volatility of external finance-dependent industries will be higher, indicating that $\beta_1 > 0$ and $\beta_3 > 0$.

If explicit deposit insurance schemes encourage banks to take on extreme risk by making more loans during economic recession periods, industrial volatility may shrink for firms with higher need for external finance, predicting that $\beta_2 < 0$ and $\beta_4 < 0$. On the contrary, if,in the presence of deposit insurance, credit constraints to borrowing firms are more relaxedduring the economic boom periods than during the economic recession periods, I expect that growth volatility of the external finance-dependent industries will indeed increase, implying that and $\beta_2 > 0$ and $\beta_4 > 0$.

In the second part of this paper, I investigate how a formal deposit insurance scheme influences industrial growth. As Rajan and Zingales (1998) showed, financial development disproportionately encourages the growth of industries with higher needs for external finance. Therefore, if the introduction of an explicit deposit insurance scheme accelerates financial development, it may also enhance the industrial growth disproportionately among industries. This paper investigates this possibility by estimating the following growth determination OLS regressions.

$$Growth_{cit} = \gamma_1 \cdot (Dependence_i) + \gamma_2 \cdot (Dependence_i) \times (DI_{ct}) + \gamma_3 \cdot DI_{ct} + \gamma_t + \delta_{cit}. \quad (5)$$

and

$$Growth_{cit} = \gamma_4 \cdot (Dependence_i) \times (DI_{ct}) + \gamma_c + \gamma_i + \gamma_t + \theta_{cit}, \quad (6)$$

where γ_c, γ_i, and γ_t are fixed effects for country, industry and year respectively.

3. DATA

The primary data for this study is INDSTAT 4 (2012) from the United Nations Industrial Development Organization (UNIDO). The original data covers 134 countries for the period of 1990 to 2009. The advantage of this data is that they include comprehensive information of industrial value added for both listed and unlisted firms around the world. UNIDO's value added is originally stored in local currency. To make data comparable across countries, the value is converted to U.S. dollar using exchange rates from International Financial Studies (IFS).

I carefully hand-match the data with the industry-level proxy for external fund dependence fromBehn, Haselmann, Seru, and Vig (2014). Under the assumption that U.S. financial markets are the most frictionless,

Rajan and Zingales (1998) construct a proxy for the technology-driven demand for external funds in each industry using U.S. publicly traded firm data. Specifically, for each 3-digit ISIC Rev. 2codes, they define the financial dependence as capital expenditures (Computat # 128) minus cash flow from operations divided by capital expenditures (Compustat # 110+decreases in inventories, decrease in receivables, and increases in payables.). Behn *et al.* (2014) update the data for ISIC Rev. 3 codes following Rajan and Zingales (1998).

The information about the date when an explicit deposit insurance scheme was introduced to each countryis obtained from financial structure data provided by Demirgüç-Kunt, Kane, and Laeven (2015). Since the main goal of this analysis is to investigate how an explicit deposit insurance alters the industrial growth and volatility, it is critical to control for the effects of potentially confounding events around adoptions of explicit deposit insurance schemes. Thus, the sample is limited to the subsample using a [-5, +5] year window and the observations for a [-1, +1] year window are excluded. Further, the sample is also limited to countries with at least two observations before and after a deposit insurance introduction. After the prior studies, I also confine industries to manufacturing firms (U.S. SICs 2000-2999) and exclude Thailand, U.S., Kuwait, Hong-Kong, and Taiwan. The final data includes 2,450 observations for Indonesia, South Korea, Latvia, Malaysia, Romania, Singapore, Slovenia, Sweden, and Uruguay. The values are deflated using CPIs from the World Bank's International Financial Statistics (IFS).

Table 1 reports the dates when explicit deposit insurance schemes were introduced in each country and the average industry value added growth and the average external finance dependence for each country. Industrial volatility is the country-level average $Fluctuation_{cit}$ calculated by estimating equation (1). While the country-level average industrial volatility and external financial dependence do not show a significant relationship, I find that industrial volatility is weakly related to external financial dependence: The correlation coefficient is 0.01.

Table 1
Summary Statistics

	Year of explicit deposit insurance introduction	*Value-added growth*	*Industrial volatility measure*	*External finance dependence*
Indonesia	2004	0.03	0.42	0.38
South Korea	1996	0.01	0.24	0.37
Latvia	1998	0.10	0.32	0.37
Malaysia	2005	0.02	0.18	0.38
Romania	1996	-0.75	0.47	0.30
Singapore	2006	0.01	0.29	0.42
Slovenia	2001	-0.03	0.18	0.41
Sweden	1996	-0.08	0.18	0.40
Uruguay	2002	-0.01	0.21	0.25
Total	-	-0.08	0.28	0.37
Obs.	2,450			

The information about years when deposit insurance schemes are formally introduced in each country is from the Deposit Insurance database described in Demirgüç-Kunt *et al.* (2015). Industrial growth is defined as log growth of value added from UNIDO INDSTAT 4 (2012) database and $Dependence_i$ is defined as the industry-specific need for external finance and hand-collected from Behn *et al.* (2014).

Figure 1 presents the distribution of industrial volatilities before and after the adoption of deposit insurance. Surprisingly, we find no significantly different patterns between the two distributions. One potential interpretation of this pattern is that there are no significant effects of introducing a formal deposit insurance scheme. However, as highlighted by Rajan and Zingales (1998), the simple comparison before and after an institutional change is likely to be subject to crucial bias due to uncontrolled confounding effects around the event. They argue that it is necessary to explore disproportionate impacts of financial institutions by exploiting industry-level difference of borrowing firms, particularly a level of external financial dependence.

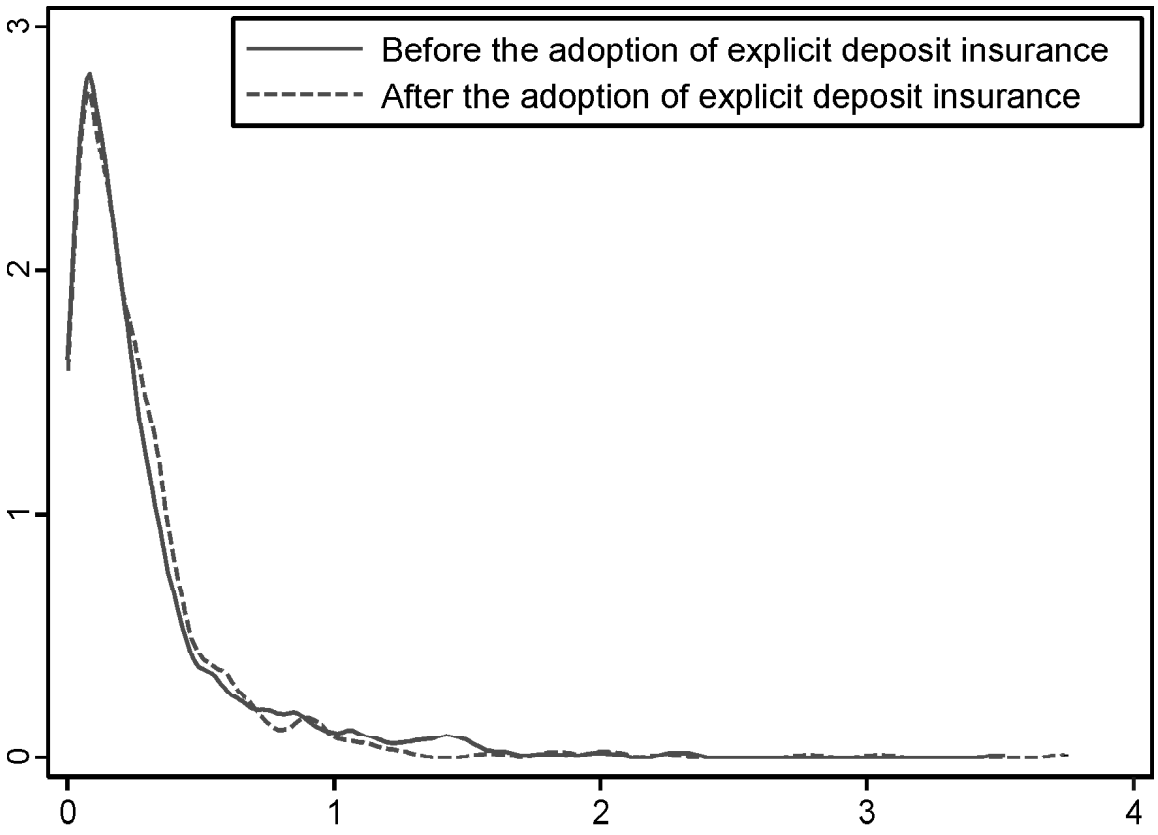

Figure 1: Conditional volatility of Industrial Growth and Explicit Deposit Insurance

Following Rajan and Zingales (1998)'s approach, Panel A of Figure 2 plots the distributions of $Fluctuation_{cit}$ for industries with high dependence on external finance before and after the introductions of explicit deposit insurance schemes, whereas Panel B of Figure 2 plots the distributions for industries with low dependence on external finance. Though rudimentary, the plots reveal that the introduction of an explicit deposit insurance scheme reduces industrial volatility of value added growth disproportionately for industries relatively more dependent on external finance. These findings, however, may be subject to biases due to uncontrolled industry, country and time effects. After controlling for diverse types of unobserved heterogeneity by including dummy variables for industry, country and year, I formally explore various possibilities by estimating equations (3) and (4) in the next section.

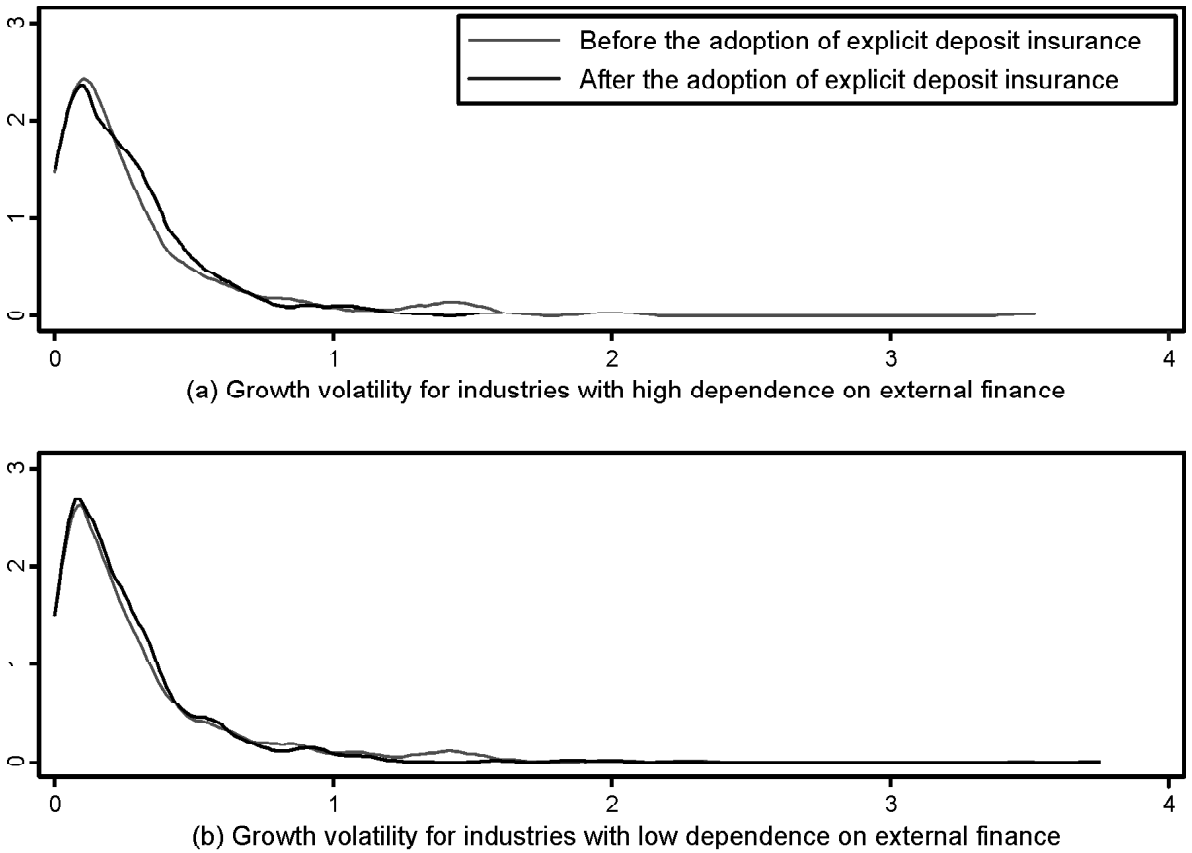

Figure 2: The Impact of Explicit Deposit Insurance and External Finance Dependence

4. RESULTS

Does explicit deposit insurance affect industrial volatility?

Table 2 reports the results from estimating equations (3) and (4) with dependent variable $Fluctuation_{cit}$. Because, by definition, the dependent variable is always positive, I employ the Tobit regression approach. All of the estimates in Table2 are the marginal effects from Tobit regressions.

I begin in Column 1 with Tobit regression of $Fluctuation_{cit}$ on the dummy variable for the deposit insurance adoption with controls for three-digit ISIC code industry dummies, country dummies, and time dummies. Interestingly, the coefficient on the dummy variable for the explicit deposit insurance is positive and highly significant, indicating that industrial volatility of value-added growth increases on average by 13.2%. Columns 2 and 3 of Table 2 consider the interaction term between explicit deposit insurance and industry-level external finance dependence to examine the impact on value-added growth volatility for industries with a different level of dependence on external finance. Column 3 of Table 2 controls for unobserved industry specific effects by including industry fixed effects while Column 2 of Table 2 controls only for industry-level external financial dependence. The regression coefficients on the interaction term between the presence of an explicit deposit insurance and external finance dependence are always negative and statistically significant at the level of 0.05, suggesting that explicit deposit insurance reduces the fluctuation of value-added growth for the industries which depend relatively more on external finance.

Columns 4 and 5 of Table 2 check the robustness of the results. To examine non-linear effects of deposit insurance, werun the Tobit regressions with the dummy variables for external finance dependence: Rajan and Zingales (1998)'s technology driven demands for external finance is sorted in the ascending order and I (Dependence ≥ 66th) is defined as one if the proxy variable for external finance dependence is greater than or equal to its 66th percentile and zero otherwise. I(66th > Dependence ≥ 33rd) equals one if the external finance dependence is greater than or equal to 33rd percentile and less than 66th percentile. Columns 4 and 5 of Table 2 report the results. The qualitative results remain robust.

Overall, Table 2 show that the adoption of a formal deposit insurance increases industrial volatility but the effect is less strong for industries with high dependence on external finance. These findings support

Table 2
Explicit Deposit Insurance and Industrial growth volatility: Tobit Regression Analyses

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
DI(=1(yes)/0(no))	0.132***	0.156***	0.157***	0.168***	0.173***
	(0.037)	(0.039)	(0.039)	(0.040)	(0.042)
DI×(Dependence)		-0.072**	-0.071**		
		(0.033)	(0.032)		
Dependence		0.089***			
		(0.024)			
I(66th > Dependence ≥ 33rd) ´DI				-0.054**	-0.062**
				(0.024)	(0.027)
I(Dependence ≥ 66th) ´DI				-0.060**	-0.063**
				(0.025)	(0.026)
I(66th > Dependence ≥ 33rd)				0.038**	
				(0.015)	
I(Dependence ³ 66th)				0.065***	
				(0.017)	
Industry effects	Yes	No	Yes	No	Yes
Country effects	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.357	0.278	0.361	0.276	0.363
Observations	2,450	2,450	2,450	2,450	2,450

This table presents Tobit (industry, country and year effects) estimation results of the industrial volatility determination model (Equations (3) and (4)). The estimations use the proxy for the conditional volatility calculated following Morgan et al. (2004). Industrial growth is defined as log growth of value added from UNIDO INDSTAT 4 (2012) database and $Dependence_i$ is defined as the industry-specific need for external finance and hand-collected from Behn *et al.* (2014). indicates the dummy variable which equals one if the condition within the parenthesis is satisfied and zero otherwise. The information about years when deposit insurance schemes are formally introduced in each country is from the Deposit Insurance database described in Demirgüç-Kunt *et al.* (2015). The sampled industries include only manufacturing industries (ISICs Rev. 3 industry codes 151-369). The reported coestimates are marginal effects at mean and the standard errors in parentheses are corrected for heteroskedasticity and country-clustering. ***,**,* indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

the assertion that an explicit deposit insurance scheme significantly reduces the financial constraint of borrowing firms during economic recession periods although manufacturers in the economy take more risk after a deposit insurance scheme is formally introduced.

Deposit insurance and industrial growth

The previous section documents evidence consistent with the assertion thatthe explicit deposit insurance schemes encourage risk-seeking by borrowing firms. However, if the average industrial growth increases substantially after the introduction of explicit deposit insurance, it is difficult to conclude that the explicit deposit insurance is socially suboptimal. Thus, it is important to assess the impact of explicit deposit insurance schemes on the average industrial growth.

Table 3 explores the relationship between explicit deposit insurance scheme and industry value added growth by estimating different versions of equations (5) and (6). Column 1 begins by assessing the influence

Table 3
Explicit Deposit Insurance and Industrial Growth

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
DI(=1(yes)/0(no))	0.212***	0.219***	0.219***	0.214***	0.211***
	(0.062)	(0.065)	(0.065)	(0.066)	(0.068)
DI×(Dependence)		-0.019	-0.021		
		(0.054)	(0.053)		
Dependence		-0.007			
		(0.039)			
I(66th > Dependence ≥ 33rd) × DI				-0.008	-0.004
				(0.039)	(0.043)
I(Dependence ≥ 66th) × DI				0.002	0.006
				(0.041)	(0.043)
I(66th > Dependence ³ 33rd)				0.017	
				(0.025)	
I(Dependence ³ 66th)				-0.014	
				(0.028)	
Industry effects	Yes	No	Yes	No	Yes
Country effects	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.297	0.300	0.297	0.300	0.297
Observations	2,450	2,450	2,450	2,450	2,450

This table presents FE-OLS (industry, country and year effects) estimation results of the industrial volatility determination model (Equations (5) and (6)). The estimations use the proxy for the conditional volatility calculated following Morgan *et al.* (2004). Industrial growth is defined as log growth of value added from UNIDO INDSTAT 4 (2012) database and $Dependence_i$ is defined as the industry-specific need for external finance and hand-collected from Behn *et al.*(2014). indicates the dummy variable which equals one if the condition within the parenthesis is satisfied and zero otherwise. The information about years when deposit insurance schemes are formally introduced in each country is from the Deposit Insurance database described in Demirgüç-Kunt *et al.* (2015). The sampled industries include only manufacturing industries (ISICs Rev. 3 industry codes 151-369). The standard errors in parentheses are corrected for heteroskedasticity and country-clustering. ***,**,* indicate statistical significance at the 1-, 5-, and 10-percent levels, respectively.

of explicit deposit insurance on industry value-added growth. All the results show that the industry value added growth increases after the introduction of an explicit deposit insurance scheme. However, the signs of the coefficients on the interaction term between the existence of formal deposit insurance scheme and external finance dependence are mixed and none of the coefficients are statistically significant.

Overall, I do not find any statistically significant evidence that the adoption of explicit deposit insurance reduces nor increases value added growth for industries with higher dependence on external finance.

CONCLUSION

This study investigates the impact of deposit insurance on volatility and growth of industry value added. Extant literature predicts seemingly conflicting effects of deposit insurance. For instance, Diamond and Dybvig (1983) predict that deposit insurance can help to reduce financial constraints faced by borrowing firms, while Cecchetti and Krause (2005) predict that it can exacerbate the moral hazard problems of banks and then potentially encourage excessive risk-taking by borrowing firms. Indeed, both effects are not mutually incompatible. Therefore, it is important to assess the average overall effect of explicit deposit insurance. However, to my knowledge, no prior studies have examined the impact on real sectors but only on financial sectors. This paper attempts to fill the gap.

This study provides novel evidence that the presence of deposit insurance significantly increases the fluctuation of industrial growth on average but the impact is less pronounced for industries which heavily depend on external finance. Interestingly, I find no significant evidence that deposit insurance reduces or increases industry value added growth. In sum, the findings here are consistent with the claim that deposit insurance has a significant and negative impact on the real sectors of the economy by allowing banks to seek more risk and thereby their borrowers also take more risk.However, there is anoffsetting effect. The explicit deposit insurance appears to alleviate financial constraints during economic recessions, thus allowing industries with high debt capacity to reduce their industrial volatility.

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