

# MARKET DISCIPLINE THROUGH SUBORDINATED DEBT IN MEXICAN BANKS\*

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This article empirically studies market discipline through subordinated debt in Mexico. It assesses whether banks that issued subordinated debt present a lower bank risk in comparison to non-issuing banks. It tests the hypothesis that low-quality banks pay higher interest rates (returns) on subordinated debt and issue fewer securities. I use a sample of 37 banks, 14 of which issued subordinated debt during the period from December 2008 to September 2012. Analyzing these 14 banks as a natural experiment, I use dynamic panel models with the SYS GMM estimator to verify the market discipline hypothesis. The findings do not suggest the presence of discipline induced by subordinated debt holders.

*Key words:* market discipline, subordinated debt, bank risk, Mexico.

*JEL Classification:* E59; G21; G39.

**T**he Basel Committee, jointly with capital requirements and supervisory process, proposes market discipline (disclosure requirements) as one of the pillars to achieve a sound banking system. Accordingly, around the world many national monetary authorities include the Basel proposals in their banking regulations, or they at least offer banks the opportunity to adopt these recommendations (soft law).

The liability side of market discipline has been extensively tested in the literature. In the deposit market of developed countries in particular, the evidence suggests that depositors punish the banks because of their riskier behavior, demanding higher interest rates on deposits (a price-based mechanism of market discipline), withdrawing resources (quantity-based mechanism), or shifting the maturity of their deposits (maturity-based mechanism). In emerging economies, despite deposit insurance schemes, evidence for the market discipline hypothesis has also been corroborated [see Hasan *et al.* (2013), Martínez-Peria and Schmukler (2001), and Flannery (1998)].

It is worth noticing that subordinated debt (sub-debt) is considered to be a key instrument in exerting market discipline over banks [see Calomiris (1999), Lang and

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Robertson (2002), Evanoff, *et al.* (2011)]. Bank stakeholders should be the first to have an interest in bank risk-taking, and sub-debt holders especially have the greatest interest in bank monitoring, because they are the last in line to recover their financial assets should the bank fail. Therefore, sub-debt holders demanding higher returns (price-based mechanism) can directly discipline banks, and indirectly provide market signals to regulators about the fragility of the banks. This is in accordance with the monitoring and preventative influences as proposed by Krishnan *et al.* (2005).

It is important to test the presence of market discipline to support the Basel Committee's disclosure policy. Given this importance, this article is motivated by the following questions: In Mexico, do banks, which issued sub-debt, present a lower bank risk in comparison to their non-issuing peers? Which mechanisms of market discipline do Mexican sub-debt holders use to regulate the risky behavior of their banks?

These questions have a particular relevance for Mexico because over the last 20 years the monetary authorities have been adopting the recommendations of the Basel Committee, and the mandatory inclusion of sub-debt has been intensively discussed. The National Banking and Securities Commission (CNBV) declared that Basel III would operate in Mexico from January 2013. In this context, the sub-debt plays a relevant role where, to be included as regulatory capital, it must be convertible into equity, traded on the Mexican stock exchange (BMV).

Nevertheless, each bank decides whether to issue sub-debt or not. This is a result of negotiations by the Mexican Bank Association (AMB), which argues that a mandatory issue of sub-debt will weaken the international competitiveness of the Mexican banking industry, and will negatively affect small and medium banks, which would suffer losses, because the cost of being listed on the BMV is higher than its benefits. Additionally, the empirical evidence is mixed, and mandatory sub-debt policy is not a guarantee of market discipline [see Deyoung, *et al.* (2001), and Krishnan *et al.* (2005)]. Probably, this is due to a lack of a fully implemented sub-debt program [see Evanoff *et al.* (2011)].

The presence of market discipline induced by Mexican depositors was positively verified by Martínez-Peria and Schmukler (2001). Conversely, Tovar-García (2014) recently found only weak evidence of market discipline in the deposit market, which is particularly absent within market sectors. In addition, Mexican borrowers discipline their banks by paying higher interest rates on loans to high-quality banks (the asset side market discipline effect), but the largest and retail banks evade this discipline [see Tovar-García (2012)]. For the best of my knowledge, in Mexico, the discipline induced by sub-debt holders has not yet been tested. In Latin American countries, it seems that this hypothesis has only been studied in the context of Brazil, where the findings suggest a weak presence of market discipline [see de Mendonça *et al.* (2012), and de Mendonça and Villela-Loures (2009)].

This article is split into five sections. Section 2 presents the theory, the major findings of the empirical studies, and formalizes the hypotheses to be tested. Section 3 describes the data sets, a sample of 37 Mexican banks, 14 of which issued sub-debt during the period from December 2008 to September 2012. In the context of a natural experiment, section 4 specifies econometric models (dynamic panel models with the SYS GMM estimator), and it reports and discusses the results. Finally, conclusions, recommendations, and proposals for future research are outlined.

## 1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The market discipline hypothesis in the banking sector maintains that private economic agents (stockholders, debt holders, depositors, and even borrowers) take market actions to penalize banks' excessive risk-taking, which negatively influences their costs and profitability. Therefore, sub-debt holders should react to riskier behavior by their banks, because their losses show an inverse relationship with bank risk-taking. Moreover, sub-debt holders are uniquely positioned financial economic agents, since among banks' creditors, sub-debt holders are unlikely to recover their financial assets should the bank fail, after all senior creditors, including insured and uninsured depositors, have been paid.

It is worth noting that the market discipline hypothesis induced by sub-debt holders has been mostly tested in developed countries, due to their large stock markets. In the USA, Avery *et al.* (1988), Gorton and Santomero (1990), and Krishnan *et al.* (2005) found evidence against the presence of market discipline, and Kwan (2004) found mixed evidence for the hypothesis. Conversely, Flannery and Sorescu (1996), Jagtiani *et al.* (2002), Covitz *et al.* (2004), Goyal (2005), Evanoff *et al.* (2011), and Schaeck *et al.* (2012) found evidence to support the market discipline hypothesis.

It seems that the key difference between empirical studies, which found evidence both for and against the market discipline hypothesis, depends on American banking regulations and market beliefs about government intervention. In 1991 was established an insurance scheme called the Federal Deposit Insurance Corporation Improvement Act, and soon after this, empirical studies began to find evidence in favor of the market discipline hypothesis. It appears that the first empirical studies found evidence against the hypothesis because of implicit guarantees (in particular the implicit too-big-to-fail policy). However, the subprime crisis in 2007 and bank bailouts revived the implicit guarantees. In 2010, a new regulation, the Dodd-Frank Wall Street Reform and Consumer Protection Act, succeeding in restoring some market discipline, but remained advantages only for the largest banks, in particular discounts on yield spreads [see Balasubramnian and Cyree (2014)].

Evidence for the presence of market discipline was found in Australia [see Esho *et al.* (2005)], and in the UK banking industry [see Hamalainen *et al.* (2010)], although Zhang *et al.* (2014) found that sub-debt yield spreads are sensitive to credit ratings, and unaffected by accounting measures. In Canada, there is evidence to support the market discipline hypothesis, but banks can evade it, waiting for the best moment to issue sub-debt [see Caldwell (2005)]. Moreover, the six largest Canadian banks face a weaker discipline, thanks to implicit guarantees, which have been operating in Canada since the 1920s. Interestingly, until now, there have been no bank bailouts in Canada [see Beyhaghi *et al.* (2013)].

Using a sample of 14 European countries and over the period 1991- 2000, Sironi (2003) found evidence for market discipline, which is increasing over time. Using a sample of 16 European countries, Pop (2009) found evidence in favor of the quantity-based mechanism of market discipline.

In Latin American countries, the hypothesis has been tested in Brazil, with some mixed results. In general, the evidence suggests the presence of discipline induced by sub-debt holders, although this discipline may be considered rather weak [see de Mendonça *et al.* (2012), and de Mendonça and Villela-Loures (2009)].

Nguyen (2013) tests the hypothesis using cross-country data for listed commercial banks, examining a maximum of 76 countries between 2002-2008. The findings suggest that sub-debt lessens bank risk-taking. However, there is a threshold level; to find the desirable effect a strong institutional framework and financial development (absent in developing countries) should be implemented. The sample included only four Mexican banks, and so the results are not reliable enough for conclusions to be drawn about Mexico itself.

Lang and Robertson (2002) emphasize that sub-debt is uninsured and unsecured; there are no government guarantees; no protection; and sub-debt holders do not receive higher returns from risk-taking by their banks (contrary to equity holders). Consequently, sub-debt holders are very sensitive to risk. Calomiris (1999) highlights that the optimum way of exerting market discipline is through sub-debt. Higher levels of sub-debt should strongly favor market discipline in the banking system, because the costs and the access to additional resources are more sensitive to risk. Sub-debt holders can give signals about risk-taking to other banks' creditors (such as depositors) and regulators. As a result, we can expect that sub-debt issuing banks present lower levels of risk in comparison with their non-issuing peers. Therefore, in this research the first working hypothesis is stated as follows:

H1. In Mexico, banks that issue sub-debt have lower bank risk in comparison to their non-issuing peers

Theoretically, a bank's riskier behavior would change sub-debt holders' preferences, which would shift the supply curve of debt toward the left, requiring higher rates of return on debt and/or offering a smaller quantity of debt. Just as in the deposit market, banks debt holders can use two mechanisms to regulate the bank's risky behavior: price-based and quantity-based<sup>1</sup>. Therefore, this particular bank should modify its risk-taking. We assume that sub-debt holders have the ability to monitor bank conditions and the ability to influence a bank's actions [see Bliss and Flannery (2002), and Flannery (2001)]<sup>2</sup>.

The empirical literature focuses on the price-based mechanism, where, in a regression analysis, usually the dependent variable is the spread of sub-debt (defined as the difference between the yield to maturity of the issue and the yield of an equivalent free-risk obligation). The key explanatory variable is bank risk. A significant positive effect of higher levels of bank risk on the sub-debt return indicates the pres-

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(1) To test market discipline induced by depositors a third mechanism is suggested in the literature: maturity-based, where depositors shift their resources from long- to short-term due to their bank's riskier behavior [see Goday *et al.* (2005)]. This mechanism might be an option for sub-debt holders, but most of the issued sub-debt is fixed-rate and long-term (5, 10, 15 years), including perpetual. Nevertheless, maturity is a relevant characteristic, because "there is now much empirical evidence to suggest that credit spreads of different maturities for the same firm may move in different directions" [Krishnan *et al.* (2005: 344)].

(2) Most empirical studies do not test the hypothesis of preventative influence in market discipline as proposed by Krishnan *et al.*, (2005), due to data limitations and the impossibility of controlling for other factors. Note that the banks' reactions may be as a result of pressures from regulators, who can use market signals to indirectly identify risky banks, and later to discipline them [see Chen and Hasan (2011), and Krishnan *et al.* (2005)].

ence of market discipline. In other words, sub-debt holders monitor bank risk-taking, and they discipline their banks by demanding higher returns, that is, riskier banks pay higher returns on sub-debt. This leads to the second working hypothesis:

H2. In Mexico, issuing banks pay returns on sub-debt which are consistent with their risk-taking (price-based mechanism of market discipline)

Following the same logic, there are a few studies exploring the quantity-based mechanism; whether riskier banks are less likely to issue sub-debt [see Caldwell (2005), Covitz *et al.* (2004), Kwan (2004), Nguyen (2013), and Pop (2009)]. A significant negative effect of higher levels of bank risk on the amount of sub-debt issued indicates the presence of market discipline in the sub-debt market. Therefore, considering only issuing banks, a third hypothesis is formulated as follows:

H3. In Mexico, riskier banks issue less sub-debt (quantity-based mechanism of market discipline)

Tests for the three hypotheses contribute to the empirical literature in three ways. First, testing H1, the Mexican case presents conditions for a natural experiment (section 4 details this characteristic). Second, this research tests the price (H2) and quantity (H3) mechanisms of market discipline in Mexico, which have not been previously tested. Third, this research employs panel data in a dynamic model with a SYS GMM estimator [see Blundell and Bond (1998)], but this model has been rarely utilized for market discipline analysis.

## 2. DATA

Following Tovar-García (2014), the data employed in this research are drawn from the historical statistics of the National Banking and Securities Commission (CNBV), from December 2008 to September 2012 (quarterly), during the global financial crisis. During this period, Mexico experienced a negative GDP real growth rate in 2009 (-4.7%) and positive rates in 2008 (1.4%) 2010 (5.1%), 2011(4.0%), and 2012 (3.8%).

I was able to analyze 4 years of data, but the information for the previous years is incomplete for many banks and time periods. The period under analysis covers 37 banks, 14 of which issued sub-debt, but not all of them are listed in the BMV, and not all listed banks issued sub-debt (including holding companies).

I expect that Mexican sub-debt holders carefully monitored their banks during the years of analysis, in accordance with the wake-up call [ see Martinez-Peria and Schmukler (2001)]. In other words, sub-debt holders are less likely to be vigilant during more tranquil periods [see Evanoff *et al.* (2011) referring to Covitz *et al.* (2000)].

### 2.1. Measures of the mechanisms of market discipline

“It has been difficult to analyze and compare sub-debt spreads across banks in a time-series analysis because of difficulties involved in finding homogeneous sub-debt issues in the market. In addition to having different characteristics (features, options, maturities, etc.), sub-debt issues vary significantly in terms of trading volumes” [Evanoff *et al.* (2011: 10)]. Given this, I use data from accountability reports.

To test the price-based discipline mechanism I use an implicit interest rate as a dependent variable: the ratio of the change in monthly interest payments on sub-debt to the amount of outstanding sub-debt, which is adjusted annually (IIRSD). The implicit interest rates “directly incorporate the market’s marginal information” [Goday *et al.* (2005: 180)], and they are well-accepted in the empirical literature.

To test the quantity-based mechanism of market discipline I use the growth of the amount of outstanding sub-debt (GROWTHSD:  $\text{sub-debt}_t / \text{sub-debt}_{\text{last-quarter}}$ ). This measure is used because absolute amounts can be biased by bank characteristics such as size and business orientation [see Park and Peristiani (1998) and Park (1995)].

On average, IIRSD equals 7.24% and the standard deviation is 2.59%. The mean GROWTHSD is 1.04 and the standard deviation is 0.14 (see Table 1).

## 2.2. Measures of bank risk or bank fundamentals

Recent empirical studies employ directly bank fundamentals to observe which variables (types of risk) are influencing market discipline. Accordingly, in this research the key explanatory variables are approached using the CAMEL methodology: capital adequacy, asset quality, management, earnings and liquidity<sup>3</sup>.

This research uses several indicators developed in Tovar-García (2014). Capital adequacy is measured with the ratio of capital to total assets (CAPITALR). For asset quality, I use reserve for loan losses (RESERVE) defined as the balance at quarter end of provisions for possible credit losses divided by nonperforming loans, and nonperforming loans divided by total loans (DOUBTFUL). For management, the ratio 12-month managerial expenses to annual average total assets (MANAGEMENT1) and the ratio 12-month managerial expenses to 12-month total income (MANAGEMENT2). Earnings are captured with the 12-month return on assets (ROA) and the 12-month return on capital (ROE), and for liquidity, I use the ratio short-term (circulating) assets to total assets (LIQUIDITY1) and the ratio short-term assets to short-term liabilities (LIQUIDITY2).

In addition, the Z-SCORE is used to approach bank risk, defined as the 3-year average of the 12-month return on assets (ROA) plus the 3-year average ratio capital to total assets (CAPITALR), divided by the 3-year standard deviation of ROA. This indicator has been extensively used in the literature to capture the bank risk of insolvency [see Distinguin *et al.* (2013), and Schaeck *et al.* (2012)]. A higher Z-SCORE value indicates a lower probability of bank failure, that is, low-risk bank.

Previous empirical studies found that the bank’s size is a relevant independent variable, in particular for the decision to issue or not sub-debt. Therefore, in this investigation the size effect is captured introducing the natural logarithm of total assets (SIZE).

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(3) Credit rating (Moody’s, S&P and Fitch Ratings) is a popular option, too. Unfortunately, these ratings are available only for a few Mexican banks, consequently I do not use them in this research.

Table 1: DESCRIPTIVE STATISTICS

Variable	Sample 37 banks				Subsample 14 issuing banks (a)			Subsample 23 non-issuing banks			Mean-comparison test (c)		
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	t	p-value
Sub-debt* (b)	196	7017.96	13655.90	0.58	67899.84	195	7048.80	13684.21	1	1005.19	-	-	-
IIRSD (b)	193	7.27	2.61	1.10	18.07	192	7.24	2.59	1	12.40	-	-	-
GROWTHSD	191	1.04	0.14	0.80	2.13	191	1.04	0.14	0	-	-	-	-
Capital*	592	14665.46	29863.31	103.54	146238.9	224	21379.26	32536.64	368	10578.8	27361.06	-3.47	0.001
Assets*	592	140438.4	279564.6	127.5	1295406	224	239174.4	338551.6	368	80338.2	215968.8	-6.32	0.000
CAPITALR	592	15.89	14.12	1.27	81.21	224	10.81	11.00	368	18.98	14.90	8.63	0.000
RESERVE	484	803.94	4354.53	45.26	57772.31	203	160.81	80.51	281	1268.54	5673.46	2.5	0.013
DOUBTFUL	489	4.11	4.87	0.01	30.27	208	3.22	2.51	281	4.78	5.96	3.08	0.002
ROA	590	-0.55	8.98	-83.91	19.76	224	0.53	2.56	366	-1.21	11.17	-2.81	0.005
ROE	590	5.80	21.40	-131.3	66.60	224	10.67	10.82	366	2.82	25.37	-5.07	0.000
MANAGEMENT1	586	8.37	10.49	0.24	79.31	224	6.01	7.19	362	9.83	11.87	4.33	0.000
MANAGEMENT2	571	102.25	142.03	10.70	1978.65	211	75.74	19.97	360	117.80	176.47	3.22	0.001
LIQUIDITY1	591	11.24	9.32	0.10	65.88	224	9.25	4.46	367	12.46	11.13	3.69	0.000
LIQUIDITY2	497	63.03	66.97	6.11	801.72	197	41.00	26.38	300	77.49	80.34	5.59	0.000
ZSCORE	588	27.94	22.56	-1.57	155.66	224	29.15	17.08	364	27.20	25.34	-0.15	0.879
EXPOSURE	588	19.19	24.39	0.00	100	224	15.79	17.40	364	21.28	27.66	2.08	0.038

(a) It includes: ABC Capital, Afirme, American Express, Banca Mifel, Banco Azteca, Banorte, Banregio, BBVA Bancomer, HSBC, ING, Interacciones, Ixe, Santander, and Ve por Más.

(b) Multiva issued sub-debt only in one period (September, 2012). The full sample includes this observation, but I did not include this bank in the subsample of issuing banks.

(c) Between subsamples. Ho: difference = 0 Ha: difference  $\neq$  0 Confidence level 95%.

\* Balances at quarter end, in millions of Mexican pesos; the rest of variables are ratios in percent, excepting GROWTHSD and Z-SCORE.

Source: Own elaboration.

### 2.3. Descriptive statistics and subsample of issuing banks

Summary statistics of the mentioned variables can be seen in Table 1. It includes information of the full sample (37 banks) and subsamples of non-issuing banks (23 banks) and sub-debt issuing banks (14 banks), which issued sub-debt during the period of analysis, although the issuance could be interrupted.

The mean of total assets in the subsample of issuing banks is 1.7 times larger than the mean of the full sample, and around 3 times larger in comparison with the non-issuing banks. It is worth noticing that the subsample of issuing banks includes four of the seven largest Mexican banks<sup>4</sup>. The other ten banks are medium and small sized banks.

The capital ratio (CAPITALR), the indicators about liquidity (LIQUIDITY 1 and 2), and the reserve for loan losses (RESERVE) in the issuing banks are below the mean of the full sample and below the mean of the non-issuing sample, that is, on average issuing banks are in a worst position.

The indicators about earnings (ROA and ROE), managerial efficiency (MANAGEMENT 1 and 2), and nonperforming loans (DOUBTFUL) show that, on average, the issuing banks are in a better position in comparison with the full sample of banks, and the non-issuing subsample. Note that the t-test for mean comparison shows that these differences are statistically significant.

On average, Z-SCORE equals 27.94 in the full sample, 27.20 in the non-issuing subsample, and 29.15 in the subsample of issuing banks, that is to say, they are 1.95 points less risky than non-issuing banks. But this is statistically irrelevant; the t-test shows that the difference is not statistically different from zero.

The correlation matrix (see Table 2) shows relevant positive relationships among total assets, capital and the amount of outstanding sub-debt, suggesting that larger banks are most likely to issue sub-debt. The CAMEL indicators show some high correlations among them (unsurprisingly), therefore, in the regression analysis these variables are included with caution to avoid multicollinearity concerns.

## 3. EMPIRICAL MODELS

A regression analysis is used to test discipline induced by sub-debt holders. Note that the dependent and independent variables present endogeneity concerns. Consequently, it is necessary to use instrumental variables, and to take into account the autoregressive character of the dependent variables.

Under these conditions, a dynamic panel data model is preferable [see Goday *et al.* (2005), Hasan *et al.* (2013), de Mendonça *et al.* (2012), and de Mendonça and Villela-Loures (2009)]. Following Tovar-García (2014) I use the two-step SYS GMM estimator of Blundell and Bond (1998), I allow one lag of the dependent variable to be entered as regressors, and I use a maximum of 2 lags of the independent variables (in the first differences and in levels) to be used as instruments correcting endogeneity. It is assumed that the error term is not serially correlated and Sargan's over-identification test is employed to validate the instruments.

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(4) Banorte, BBVA Bancomer, HSBC, and Santander.



Table 2: CORRELATION MATRIX (PAIRWISE)

	Sub-debt	IIRSD	GROWTHSD	Capital	Assets	CAPITALR	RESERVE
Sub-debt	1						
IIRSD	-0.22	1					
GROWTHSD	0.08	0.14	1				
Capital	0.90	-0.37	0.03	1			
Assets	0.92	-0.34	0.05	0.98	1		
CAPITALR	-0.04	-0.18	-0.08	-0.07	-0.12	1	
RESERVE	-0.12	-0.27	-0.06	-0.04	-0.05	0.03	1
DOUBTFUL	-0.06	0.02	0.11	-0.19	-0.17	0.29	-0.37
ROA	0.15	-0.28	-0.08	0.23	0.22	-0.51	0.26
ROE	0.24	-0.10	-0.04	0.28	0.29	-0.44	0.38
MANAGEMENT1	-0.16	-0.14	-0.04	-0.22	-0.24	0.35	-0.02
MANAGEMENT2	-0.24	-0.03	0.07	-0.33	-0.31	-0.17	-0.33
LIQUIDITY1	0.17	-0.29	0.09	0.37	0.36	0.07	0.03
LIQUIDITY2	-0.13	-0.26	0.08	0.04	0.00	0.57	0.11
ZSCORE	0.18	-0.13	0.03	0.24	0.25	-0.13	0.22
EXPOSURE	-0.29	0.24	-0.07	-0.34	-0.36	0.10	0.17
CETES	-0.01	0.28	0.29	-0.05	-0.01	-0.03	-0.04

Include only issuing banks.

Source: Own elaboration.

Table 2: CORRELATION MATRIX (PAIRWISE) (continuation)

	DOUBTFUL	ROA	ROE	MANAGEMENT1	MANAGEMENT2	LIQUIDITY1	LIQUIDITY2
DOUBTFUL	1						
ROA	-0.20	1					
ROE	-0.27	0.81	1				
MANAGEMENT1	0.46	-0.24	-0.17	1			
MANAGEMENT2	0.44	-0.47	-0.66	0.37	1		
LIQUIDITY1	0.26	0.14	0.10	0.51	0.19	1	
LIQUIDITY2	0.43	0.22	0.07	0.09	-0.08	0.30	1
ZSCORE	-0.35	0.00	0.16	-0.26	-0.17	-0.20	-0.28
EXPOSURE	0.01	0.11	-0.01	-0.04	-0.03	-0.14	0.18
CETES	0.03	-0.11	-0.07	0.00	0.06	0.17	0.14
	ZSCORE	EXPOSURE	CETES				
ZSCORE	1						
EXPOSURE	-0.30	1					
CETES	-0.05	-0.01	1				

Include only issuing banks.  
Source: Own elaboration.

### 3.1. The bank risk-subdebt issue nexus: H1 in a natural experiment

The Model [1] is used to test H1: Banks that issue sub-debt have lower bank risk in comparison to their non-issuing peers.

It is worth noting that the Mexican case has the characteristics of a natural experiment (quasi-experiment). In an ideal randomized experiment the causal effect of sub-debt issue on bank risk is measured by randomly selecting banks (from the total population) and forcing them to issue sub-debt (this is the treatment). If the treatment is assigned at random, it is distributed independently of other determinants of bank risk, eliminating the omitted variable bias<sup>5</sup>. Evidently, this experiment is impractical in the real world.

Nevertheless, the subsample of 14 issuing banks can function as a treatment group and the rest of the banks (23) as the control group. In accordance with the Mexican Central Bank's classification [see Tovar-García (2012)], and in comparison with the full sample, the subsample of issuing banks includes four out of the seven largest Mexican banks (known as the G7), seven of the 14 medium and small sized commercial banks, two of the nine retail banks, and 1 of the seven investment banks. Additionally, the bank variables (see Table 1) show variability within the subsample, and in comparison with the full sample of 37 banks. The subsample can function as a treatment group because it has a wide variety of characteristics and, in this case, randomness is introduced by variations in individual bank circumstances that make it appear as if the treatment was randomly assigned<sup>6</sup>. In addition, the Model [1] includes other independent variables and a dynamic panel specification with instrumental variables controlling bias of the treatment.

$$Z - SCORE_{it} = \beta_1 TREATMENT_{it} + LnCAMEL_{it-1} \lambda + \gamma_1 SIZE_{it-1} + \gamma_2 EXPOSURE_{it} + \gamma_3 CETES_t + BANK_t \alpha + T_t \tau + u_{it} \quad [1]$$

Z-SCORE approaches bank risk. The key explanatory variable is TREATMENT, coded 1 for issuing bank, and 0 otherwise (the control group). LnCAMEL is working as control variable; it includes, in logarithms and one-quarter lag, combinations of the indicators of asset quality, management, and liquidity, taking into account collinearity concerns among them. SIZE is controlling bank size (the too-big-to-fail implicit policy). EXPOSURE is the ratio of interbank borrowing to total deposits, controlling the participation of an individual bank in the interbank deposit market (the too-interconnected-to-fail implicit policy). The reference interest rate CETES controls a possible influence of the monetary authority on the market, and other systemic risks. BANK is a dummy variable for each type of bank (G7, Commercial, Retail and Investment), where the G7 is the reference group, thus the model controls for other bank characteristics and markets.  $T$  is a dummy variable for years (not quarters)<sup>7</sup> controlling effects of unspecified macroeconomic and financial market conditions, which are assumed constant across banks.

(5) For a general review of experiments and quasi-experiments see Stock and Watson (2007: chapter 13)

(6) Similarly, Karas *et al.* (2010) use evidence from a natural experiment to study discipline in the Russian deposit market.

(7) With quarters the models presented collinearity concerns.

The fundamental hypothesis of interest is that bank risk is lower (Z-SCOREs are higher) for banks under treatment (issuing banks). That is, a positive and statistically significant coefficient for TREATMENT is interpreted as evidence for market discipline induced by sub-debt holders.

Table 3 summarizes the main results. In columns there are results of the regressions using combinations of the control variables, which are entered in the model taking into account problems of multicollinearity, and consequently they work checking robustness by substitution (read each regression vertically). It is noteworthy that the dynamic panel is justified; the dependent variable as regressor shows statistically significant coefficients. The Sargan tests do not reject the over-identification restrictions, but there are some troubles with serial correlation tests, in particular, the regressions in column 3 and 4 did not pass the autocorrelation tests, the regression in column 1 pass the first order serial correlation test and the regression in column 2 pass the second order test<sup>8</sup>.

The coefficients of TREATMENT show statistical significance, but the relationship is negative, see columns [1], [3] and [4]. That is, issuing banks (under treatment) present higher bank risk (lower Z-SCOREs), in comparison with the control group. This result differs from the t-test of means, where the mean is statistically the same in both groups. Nevertheless, it is worth noticing that both tests show evidence against H1.

In general, the control variables present the expected sign, although they are not statistically significant in all cases. Note that bank size shows statistically significant coefficients with a positive sign, that is, larger banks show lower levels of risk. The dummies for commercial and retail banks, in particular, enter with negative and statistically significant coefficients. Therefore, these types of banks have lower Z-SCOREs (they are riskier) in comparison to the largest banks (G7, the reference group). The dummies for year 2011 and 2012 present positive and significant coefficients in all regressions, as it was expected, because Z-SCORE has a positive trend in the last years.

### 3.2. Price-based mechanism

Taking into account only the issuing banks the Model [2] is used to test the price-based mechanism of market discipline (H2). The dependent variable is the implicit interest rate on sub-debt (IIRSD). Note the use of the reduced-form specification comprehensively employed in the literature on market discipline due to data limitations to analyze simultaneously demand and supply schedules [see Park (1995)].

The key explanatory variables are lagged by one-quarter to account for the fact that the information is available to the sub-debt holders with a certain delay, and the variables enter in logarithms. In this manner, the model achieves linearity and the coefficients measure elasticities<sup>9</sup>.

$$\begin{aligned} \ln IIRSD_{it} = & \ln CAMEL_{it} + \gamma_1 ZSCORE_{it-1} + \beta + \gamma_1 SIZE_{it-1} \\ & + \gamma_2 EXPOSURE_{it-1} + \gamma_3 CETES_t + T_t' \tau + u_{it} \end{aligned} \quad [2]$$

(8) The model was transformed in different forms, but it was not possible to correct this problem, consequently the results presented in Table 3 must be treated with a fair amount of caution because the serial correlation diagnostics are not satisfactory.

(9) ROA, ROE and Z-SCORE are not in logarithms, because they can present negative values.

Table 3: NATURAL EXPERIMENT: BANK RISK UNDER TREATMENT OF SUB-DEBT ISSUE

		Dependent variable: Z-SCORE			
	Pred Sign	(1)	(2)	(3)	(4)
Lagged Dependent		0.72***	0.68***	0.71***	0.70***
TREATMENT	+	-5.76**	-4.73	-7.75**	-5.27*
RESERVE	+	2.11			
MANAGEMENT1	-	-8.83	-5.57***		
LIQUIDITY1	+	2.22***	1.38***		
DOUBTFUL	-			-2.25*	
MANAGEMENT2	-			-5.41	-1.11
LIQUIDITY2	+			2.01	1.13**
SIZE		2.51***	4.40***	4.23**	3.60***
EXPOSURE		0.01	-0.0001	0.02	-0.01
CETES		0.49***	0.33***	0.52***	0.48***
Commercial Banks		-14.50**	-32.54***	-12.77*	-23.00***
Retail Banks		-34.76***	-45.54***	-45.86	-65.69***
Investment Banks		-4.02	-30.02***	-9.73	-22.57*
Year 2010		0.58	0.06	0.91*	0.50
Year 2011		4.41***	2.21***	5.04***	4.40***
Year 2012		2.55***	0.96**	3.96***	3.05***
Period		December, 2008 – September, 2012			
Observations		447	543	399	457
N x T		32 x 15	37 x 15	29 x 15	33 x 15
Sargan test (p-value)		17.89 (0.99)	24.95 (0.93)	14.13 (0.99)	18.01 (0.99)
First order serial correlation test (p-value)		1.38 (0.16)	1.71 (0.09)	1.97 (0.05)	1.74 (0.08)
Second order serial correlation test (p-value)		-1.88 (0.06)	-1.54 (0.12)	-1.82 (0.07)	-1.73 (0.08)

Regressions are estimated using the dynamic SYS GMM estimator [Blundell and Bond (1998)].

(\*) [\*\*] y {\*\*\*} indicate statistical significance at the (10%) [5%] and {1%} levels.

Source: Own elaboration.

Similarly, as noted in Model [1], the CAMEL variables and Z-SCORE are included in the model taking into account collinearity concerns, and these variables check robustness by substitution. The control variables are: the logarithm of total assets (SIZE), the ratio of interbank borrowing to total deposits (EXPOSURE), the reference interest rate (CETES), and  $T$  is a dummy variable for years.

The central hypothesis of interest is that IIRSD is higher for banks showing low-quality bank fundamentals (higher bank risk). Therefore, the price paid on sub-debt (IIRSD) depends inversely upon the level of CAPITALR, RESERVE, ROA, ROE, LIQUIDITY1-2, and Z-SCORE, and positively upon the level of DOUBTFUL and MANAGEMENT1-2. This is interpreted as evidence for market discipline induced by debt holders through the price mechanism.

Table 4 summarizes the main results. The explanatory variables are in rows and empty cells indicate that the variable was dropped because of collinearity, or to check robustness by substitution. All reported estimations pass both the Sargan and the order serial correlation tests at conventional significance levels. But the dynamic model is not justified, the dependent variable as regressor does not enter with statistically significant coefficients. Nevertheless, it is better to conserve the dynamic model, because the lagged dependent variable works as control variable.

The findings do not show evidence in favor of the market discipline hypothesis through the price-based mechanism. There are very few statistical significant coefficients of the bank fundamentals, and in some cases they present a sign opposite to that expected based on the theory. Practically, only the reference rate (CETES) enters in the model with statistically significant coefficients at the 1% level, indicating that the implicit interest rate on sub-debt simply follows the basic financial market trend.

### 3.3. Quantity-based mechanism

The Model [3] is used to test the quantity-based mechanism of market discipline (H3). The dependent variable is the growth of the amount of outstanding sub-debt (GROWTHSD) in logarithms. Just as in former models, I use one-quarter lag and logarithmic transformation of the key explanatory variables.

$$\begin{aligned} \ln GROWTHSD_{it} = & \ln CAMEL_{it} + \gamma_1 SIZE_{it-1} \\ & + \gamma_2 EXPOSURE_{it-1} + \gamma_3 CETES_t + T_t \tau + u_{it} \end{aligned} \quad [3]$$

Again, the CAMEL variables and Z-SCORE are included in the model taking into account collinearity concerns. The control variables have similar functions and have been previously defined. The central hypothesis of interest is that GROWTHSD is lower for banks showing low-quality bank fundamentals. The amount of sub-debt, that an individual bank can attract, depends positively upon the level of CAPITALR, RESERVE, ROA, ROE and LIQUIDITY1-2, and inversely upon the level of DOUBTFUL and MANAGEMENT1-2. This is interpreted as evidence for market discipline through the quantity mechanism.

Table 4 summarizes the main results. All reported estimations pass the Sargan and the serial correlation tests. The dependent variable as regressor presents few statically negative significant coefficients.

Table 4: IIRSD: PRICE-BASED MECHANISM OF MARKET DISCIPLINE

		Dependet variable: IIRSD					
	Pred Sign	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Dependent		0.37	0.15	0.15	-0.39	0.09	0.67
ZSCORE	-					0.04**	-0.01
CAPITALR	-	-0.21	0.07	0.39	-1.51**		
RESERVE	-	0.44				-0.28	
ROA	-	-0.07	0.27*				
MANAGEMENT1	+	-0.04	0.09			-2.15	
LIQUIDITY1	-	-0.10	0.05			-0.65*	
DOUBTFUL	+			0.11			0.22
ROE	-			0.01	0.004		
MANAGEMENT2	+			0.30	0.37		-1.11
LIQUIDITY2	-			0.07	0.37*		-0.83*
SIZE		-0.03	0.14	0.23	0.11	0.36*	-0.50
EXPOSURE		-0.0001	-0.01**	-0.001	0.01	-0.04**	0.01
CETES			0.14***	0.15***	0.17***	0.16***	0.13***
Year 2010		0.05	0.01	-0.01	0.10	-0.04	-0.02
Year 2011		0.05	-0.04	-0.004	0.18	-0.20*	-0.01
Year 2012		-1.41	-0.10	0.38	3.95	-8.49**	2.36
Period		December, 2008 – September, 2012					
Observations		163	176	162	162	163	162
N x T		13 x 15	14 x 15	13 x 15	13 x 15	13 x 15	13 x 15
Sargan test (p-value)		9.34 (1.00)	5.25 (1.00)	0.51 (1.00)	0.66 (1.00)	0.33 (1.00)	0.11 (1.00)
First order serial correlation test (p-value)		0.08 (0.93)	-1.01 (0.31)	-0.53 (0.58)	-	0.19 (0.84)	-0.47 (0.63)
Second order serial correlation test (p-value)		-0.80 (0.42)	-0.82 (0.41)	-0.40 (0.68)	-	-	0.22 (0.82)

Regressions are estimated using the dynamic SYS GMM estimator [Blundell and Bond (1998)].

(\*) [\*\*] y {\*\*\*} indicate statistical significance at the (10%) [5%] and {1%} levels.

Source: Own elaboration.

Table 5: GROWTHSD: QUANTITY-BASED MECHANISM OF MARKET DISCIPLINE

		Dependet variable: GROWTHSD					
	Pred Sign	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Dependent		-0.37	-0.30*	0.42	-0.11	-0.49*	-0.20
ZSCORE	+					-0.0005	0.001
CAPITALR	+	0.19	-0.002	0.53*	0.11		
RESERVE	+	0.06*				0.04	
ROA	+	0.05	0.01				
MANAGEMENT1	-	0.39	0.07			0.25	
LIQUIDITY1	+	-0.11	-0.0002			0.02	
DOUBTFUL	-			-0.05			-0.03
ROE	+			0.004	0.01		
MANAGEMENT2	-			0.24	0.26		-0.10
LIQUIDITY2	+			-0.16*	-0.06		-0.05
SIZE		-0.10**	-0.01	-0.10	-0.10	-0.06	-0.24
EXPOSURE		-0.00005	0.0003	0.002	0.001	0.001	0.001
CETES		0.04*	0.02*	-0.05	0.01	0.04	0.02
Year 2010		-0.04***	-0.03***	-0.05***	-0.04**	-0.03***	-0.03**
Year 2011		-0.10	-0.01	-0.21*	-0.04	-0.04	-0.09
Year 2012		-0.12	-0.02	-0.21**	-0.05	-0.05	-0.09
Period		December, 2008 – September, 2012					
Observations		162	177	160	160	162	160
N x T		13 x 15	14 x 15	13 x 15	13 x 15	13 x 15	13 x 15
Sargan test (p-value)		0.63 (1.00)	2.82 (1.00)	0.002 (1.00)	4.61 (1.00)	1.39 (1.00)	1.84 (1.00)
First order serial correlation test (p-value)		-1.02 (0.30)	-1.64 (0.10)	-1.57 (0.11)	-1.41 (0.16)	-1.18 (0.23)	-1.64 (0.10)
Second order serial correlation test (p-value)		-0.71 (0.47)	-1.28 (0.19)	0.78 (0.43)	-0.39 (0.69)	-0.95 (0.34)	-0.83 (0.40)

Regressions are estimated using the dynamic SYS GMM estimator [Blundell and Bond (1998)].

(\*) [\*\*] y {\*\*\*} indicate statistical significance at the (10%) [5%] and {1%} levels.

Source: Own elaboration.



Once again, the findings do not show evidence in favor of the market discipline hypothesis. There are very few statistically significant coefficients. Only the dummy variable for year 2010 enters in the model with statistically negative significant coefficients, indicating the negative impact of the global financial crisis.

#### 4. CONCLUSIONS

The banking literature maintains that the best way of exerting market discipline is through sub-debt, and so consequently issuing banks should present lower levels of bank risk, and a mandatory sub-debt program is desirable to establish a sound banking system [see Calomiris (1999) and Evanoff *et al.* (2011)]. Sub-debt holders should monitor their banks, and they can punish banks for excessive risk taking, demanding higher rates of return on sub-debt (price-based mechanism), or acquiring fewer amounts of sub-debt (quantity-based mechanism). As a result, sub-debt holders can provide market signals to regulators, who can discipline banks (indirect market discipline).

Empirical evidence in favor of the discipline induced by sub-debt holders has been found in many developed countries, although there are studies which have found evidence against this hypothesis. In Latin American countries, the market discipline hypothesis through sub-debt was tested in Brazil, where the evidence in support of market discipline is weak [see de Mendonça *et al.* (2012), de Mendonça and Villela-Loures (2009)]. In this article, I explored the Mexican case from December 2008 to September 2012, in a natural experiment. First, using dynamic panel models (SYS GMM estimator) I did not find any evidence in favor of the market discipline hypothesis. Instead, I found that issuing banks (as a treatment group) present higher levels of bank risk (lower Z-SCOREs) than non-issuing banks (the control group). Second, I did not find evidence in favor of the market discipline hypothesis through price-based mechanism, and third, there was no evidence to support the quantity-based mechanism of market discipline. The findings suggest that the bank fundamentals (CAMEL indicators) and Z-SCORE do not present statistically significant relationships with the implicit interest rate on sub-debt or the growth of the amount of outstanding sub-debt. Therefore, sub-debt is not generally a way for Mexican banks to exert market discipline.

Although the findings for Mexico have some similarities to Brazil, they differ from recent findings in most developed countries. Chen and Hasan (2011) points out that sub-debt holders can effectively discipline banks if regulators impose ceilings on returns, prohibit collusion between banks and debt holders, and require convertibility into bank's equity, which gives control of the bank to debt holders. In addition, Nguyen (2013) identified a threshold within national bank regulations and in financial development. The findings of this research suggest that Mexico is below this threshold level.

It could be that sub-debt holders lost interest in monitoring banks due to government intervention. Debt holders may think that the monetary authorities would act in accordance with the too-big-to-fail policy [see Covitz *et al.* (2004), and Evanoff *et al.* (2011)]. Therefore, policymakers must develop a regulatory framework where debt holders have an incentive to monitor banks and sufficient information about a bank's actual riskiness, whilst minimizing government intervention.

The absence of market discipline might be a consequence of incorrect signals from the monetary authorities, an inefficient institutional framework, and a low level of financial development. Under the current financial conditions it is not sensible to discuss the idea of including a mandatory sub-debt program, but it is desirable to discuss bail-in mechanisms (for example, to convert debt to equity).

Future research for Mexico could attempt to investigate the market discipline hypothesis using direct information from each issuance of sub-debt, rather than just the accounting information.



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#### RESUMEN

El artículo estudia empíricamente la disciplina de mercado a través de la deuda subordinada en México. Examina si los bancos que emitieron deuda subordinada presentan menor riesgo bancario en comparación con los bancos no emisores. Se verifica la hipótesis de que los bancos de baja calidad pagan tasas de interés más altas (rendimientos) sobre la deuda subordinada y emiten menos obligaciones. Se usa una muestra de 37 bancos, 14 de los cuales emitieron deuda subordinada durante el periodo de diciembre de 2008 a septiembre de 2012. Se analizan estos 14 bancos como un experimento natural, y se usan modelos de panel dinámico con el estimador SYS GMM para verificar la hipótesis de disciplina de mercado. Los hallazgos no sugieren la presencia de disciplina inducida por tenedores de deuda subordinada.

*Palabras clave:* disciplina de mercado, deuda subordinada, riesgo bancario, México.

*Clasificación JEL:* E59; G21; G39.