A Test of the Modigliani-Miller Theorem Using Market Evaluations of Kazakhstani Banks

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Abstract
Modigliani and Miller state that while in general the capital structure of a company does not affect its market value, companies in higher risk categories have to pay higher returns to their shareholders. Using market data for Kazakhstani banks before and after a currency devaluation of unexpected magnitude, we test whether the market discounts the exchange-rate-induced change in foreign currency denominated debt liabilities at a higher rate if a bank has less equity. We reject the hypothesis that equity has an impact on the bank specific discount rate – suggesting that differences in equity across Kazakhstani banks do not result in systematic differences in capital market evaluations.

1. Introduction

Recent discussions about the effect of increasing capital (i.e. equity) requirements for banks have focused on the question of how such a policy is going to affect the equilibrium cost of capital. One view is that the need to provide more capital in relation to assets will either result in an increase in the price of capital or in a scaling down of bank assets (see, e.g., Kashyap, Steinand May, 2010). Others have argued that more stringent capital requirements are going to reduce the risk of banks which may result in a reduction of the cost of capital (see, e.g. Admati and Hellwig, 2013).

The latter argument is based on the Modigliani-Miller theorem which states that total financing cost for firms in one risk category is not affected by their financial structure but investors demand a higher return on equity if a firm is in a category with greater risk. Correspondingly, the rate at which investors discount future income from this source should be greater if the firm is in a worse risk category.

In this paper we suggest a method for testing the Modigliani-Miller theorem using market evaluations of Kazakhstani banks. The problem with testing the theorem is that reliance on observed return on equity can be misleading: It is a technical feature of the balance sheet that an increased leverage results in a higher return on equity. The interesting variable is not so much the return on equity actually paid but rather the unobserved discount rate which market participants employ when evaluating future dividend streams.

In this paper we derive differences in discount rates from observed evaluations for Kazakhstani banks before and after the currency devaluation of August 2015. At the time, the National Bank moved from a peg against the dollar to a currency float. Although the policy change followed the advice of the IMF and a currency devaluation was widely expected (see, e.g. Pech, 2014), its magnitude came as a surprise and resulted in a change in the leadership of the National Bank.[1] Moreover, the observation that banks throughout the sector experienced a substantial decrease in market value during the observation period suggests some major unexpected event. Assuming that at least a part of the currency devaluation was unexpected, its effect on financial markets between July and October 2015 can be considered a natural experiment.

Banks with higher level of foreign currency denominated debt are expected to experience a greater fall in market evaluations, but the original Modigliani-Miller

[1] See Blomberg.com, "Kazakh Leader Dismisses Central Bank Head After Tenge Tumble", 2 November 2015.

framework suggests that this correction would be smaller if a firm's dividends are discounted at a greater rate. This test of course assumes that banks' exposure to foreign currency debt is not perfectly hedged. While we have no data on hedging activities, we know that less than full hedging is optimal if the firm is exposed to macroeconomic shocks whose insurance commands a risk premium (see e.g. Homström and Tirole, 2000). In the context, it would seem difficult to buy insurance against the exchange rate risk at all. Moreover, in the case where a bank holds corresponding foreign currency claims against private investors in the Kazakhstani economy, it is hedged against the immediate currency shock but not against the follow-on risk that these investors go bankrupt.

In our paper we reject the hypothesis that equity has an impact on the discount rate – suggesting that differences in equity across Kazakhstani banks do not result in differences in capital market evaluations. This suggests that different Kazakhstani banks are not perceived to be in different risk categories, despite the variation of their equity ratios. We suggest that this finding may be explained by implicit risk-sharing in the Kazakhstani banking sector.

Section 2 gives an overview of the literature. Section 3 introduces our method. Section 4 provides the results of our estimation. Section 5 explores an alternative approach. Section 6 concludes.

2. Literature Review

The question of how different capital requirements affect the cost of capital has attracted wide interest. Yang/Tsatsronis (2012) in a study of eleven countries estimate that an increase in the leverage results in higher cost of equity. Kashyap/Steinand/May (2010) estimate that a 10% increase in the capital requirement results in an increase in the weighted cost of capital of between 25- and 45 basis points. Baker/Wurgler (2015) apply the CAPM model to construct a relationship between the beta-value of a stock and the equity ratio. They estimate the relationship using return and capitalization data and find a "low –risk anomaly" where the return demanded by investors increases as the capital requirement increases. They estimate that a 10% increase in the capital requirement results in an increase of between 60 and 90 basis points in the weighted cost of capital.

3. Implementing the Modigliani-Miller framework

Assume that the interest rate is r and that bank *i* experiences an increase in the value of its outstanding debt by ΔD. This reduces the value of the bank for its shareholders due to the interest payments on this outstanding debt, discounted at ρ_i.[2] So the change in bank *i*'s stock market value must be

$$\Delta V_i = -\int_{t=0}^{\infty} r \Delta D e^{-\rho_i t} dt \tag{1}$$

or

$$\Delta V_i = -\frac{r\Delta D}{\rho_i}.$$

Thus, the greater the change of the value of its debt, the greater is the decrease in a bank's stock market valuation. For any given increase in the value of its debt, this effect is the greater, the smaller its discount rate. The latter relationship allows us to make predictions on the relationship between equity ratio and

[2] If the home country bank reports in Kazakhstani tenge, a devaluation of the tenge results in an increase in the value of foreign-currency dominated debt in terms of tenge.

change in stock market evaluation depending on whether or not a different equity ratio places the bank in a different risk category:

Assume that the rate by which the marginal shareholder discounts a banks' liabilities is unaffected by its equity ratio. In this case we obtain

Hypothesis 1: Following an unexpected depreciation of the exchange rate, a bank's decrease in its market evaluation is greater, the greater its value of outstanding foreign-currency denominated debt and the change is unrelated to the bank's equity ratio.

This hypothesis reflects the text book account of the Modigliani-Miller theorem which emphasises the statement that differences in capital structure do not affect the overall value of the bank. Accordingly, we also call *Hypothesis 1* the "simple Modigliani-Miller hypothesis".

On the other hand, Adamati and Hellwig argue that a bank with a higher equity ratio may fall into a lower risk category and the marginal shareholder will apply a smaller discount rate. In this case we obtain

Hypothesis 2: Following an unexpected depreciation of the exchange rate, a bank's decrease in its market evaluation is greater, the greater its value of outstanding foreign-currency denominated debt and the change is greater, the greater the bank's equity ratio.

If a greater equity ratio comes with a smaller discount rate, a bank will be more negatively affected by an unexpected increase in the value of their outstanding debt. As this relationship involves a comparison across different risk categories, we call *Hypothesis 2* the "extended Modigliani/Miller hypothesis".

In order to distinguish which version of the Modigliani/Miller hypothesis applies we indirectly estimate the relationship between investors' discount rate and equity ratio by estimating how market values of banks with different levels of foreign currency denominated debt and equity ratios are affected by the devaluation of the tenge. Because we look at an instance of deteriorating evaluations, we multiply the equation by (-1) to avoid taking logarithm of negative values.

$$\ln(-\Delta V_i) = \alpha + \beta \ln \Delta D + \gamma \ln \rho_i \ .$$

Hyopothesis 2, the extended Modigliani-Miller hypothesis, implies that discount rate and equity ratio are negatively related, i.e. $\rho_i \sim \frac{1}{equity\,ratio}$.

Then we can estimate instead

$$\ln(-\Delta V_i) = \alpha + \beta_1 \ln \Delta D + \beta_2 \ln equity\,ratio$$

with predicted coefficients $\beta_1>0$, $\beta_2>0$, i.e., the greater the equity ratio – and, hence, the smaller the discount rate – the greater the change in valuation. While our theory makes no more specific prediction on the precise form of the relationship between equity ratio and the relative change of valuation, it turns out that the best fit is obtained when the independent variable is a change in the equity ratio as well.

4. Results

We observed the change in market valuation in the Kazakhstani stock exchange (KASE) for 14 Kazakhstani banks for which we could obtain the necessary data.[3] Three of these were excluded from our sample because they reported zero foreign currency denominated debt or the data was implausible. For the others we observed foreign debt and equity ratio before the currency devaluation of August 2015 and market valuations before and after the currency devaluation. We obtain the following result for our model 1:[4]

Dependent Variable: LOG(-DV)
Method: Least Squares
Date: 02/23/17 Time: 20:41
Sample: 1 11
Included observations: 11
LOG(-DV)=C(1)+C(2)*LOG(D01)+C(3)*LOG(ER)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	10.85326	2.721515	3.987948	0.0040
C(2)	0.316614	0.238280	1.328746	0.2206
C(3)	-0.783366	1.326153	-0.590705	0.5710

R-squared	0.275418	Mean dependent var	14.13992
Adjusted R-squared	0.094273	S.D. dependent var	1.116594
S.E. of regression	1.062659	Akaike info criterion	3.186426
Sum squared resid	9.033953	Schwarz criterion	3.294943
Log likelihood	-14.52534	Hannan-Quinn criter.	3.118022
F-statistic	1.520426	Durbin-Watson stat	2.747686
Prob(F-statistic)	0.275645		

We define DV = change of market valuation, D01 = foreign currency denominated debt in July and ER = equity ratio in July.

Hypothesis 1 predicts that $c(2) > 0$ and $c(3) = 0$ while *Hypothesis 2* predicts that $c(2) > 0$ and $c(3) > 0$. Our results suggest that the relationship between discount factor and equity ratio is insignificant and the coefficient c(3) has the wrong sign. More

[3] Previous research (see, e.g. Arenova, 2013) has cast doubt on the efficiency of the KASE. Yet even if market evaluations do not reflect all publicly available, historical information, this does not suggest that rational investors would want to calculate the change in market value by any other formula than (1).
[4] The appendix contains further details.

surprisingly, this is also true of the coefficient of foreign currency denominated debt. Overall, our results are not conclusive.

5. An alternative approach

A better estimation of the change in market value is obtained when replacing foreign currency denominated debt with total liabilities. The decrease in market value is almost proportional to total liabilities, which implies that it is almost proportional to bank size. A possible explanation is that bank assets are indirectly affected by the currency devaluation and the simultaneous deterioration of the economy. In this case, the channel through which the currency devaluation works is not the tenge value of outstanding foreign-currency debt but a greater risk that loans are non-performing.

The results for the alternative model 2 are reported below. The coefficient of the equity ratio has positive sign but is still insignificant. Again, the equity ratio does not appear to affect the change in market evaluations.

Dependent Variable: LOG(-DV)
Method: Least Squares
Date: 02/20/17 Time: 20:38
Sample: 1 11
Included observations: 11
LOG(-DV)=C(1)+C(3)*LOG(ER)+C(4)*LOG(LIAB)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	3.034778	2.270171	1.336806	0.2181
C(3)	0.443335	0.796543	0.556574	0.5930
C(4)	0.929058	0.193856	4.792506	0.0014

R-squared	0.771508	Mean dependent var	14.13992
Adjusted R-squared	0.714386	S.D. dependent var	1.116594
S.E. of regression	0.596740	Akaike info criterion	2.032331
Sum squared resid	2.848791	Schwarz criterion	2.140848
Log likelihood	-8.177820	Hannan-Quinn criter.	1.963926
F-statistic	13.50612	Durbin-Watson stat	2.497345
Prob(F-statistic)	0.002726		

Here we define LIAB as total liabilities as of July 2015.

Our results suggest that we cannot reject a variant of *Hypothesis 1* of the form:

Hypothesis 1′: Following an unexpected depreciation of the exchange rate, a bank's decrease in its market evaluation is greater, the greater its value of outstanding liabilities and the change is unrelated to the bank's equity ratio.

6. Conclusion

Although the equity ratio varies from 8% (Center Credit, Tsesnabank) to 20% (Fortebank), its impact on bank evaluation is insignificant. Also, foreign currency denominated debt has an insignificant impact the change in bank evaluation. This change, however, is almost proportional to total liabilities, a proxy for bank size. This is compatible with the currency devaluation working through a general increase in the riskiness of the loan portfolio.

A possible explanation for our observation that the equity ratio has no effect on bank valuations is that there is effective risk sharing between banks, either in the form of government bail-outs or regulatory intervention: Shareholders of less exposed banks may expect that their banks will be called to the rescue of more exposed banks. The Kazakhstani banking sector had been in trouble since the financial crisis of 2008/2009 and some consolidation at the behest of the regulator was widely expected. In July 2017, second largest lender Halyk Bank bought the market leader Kazkommertsbank following a government bail-out for bad assets (see Financial Times, 2017). Our results are compatible with a scenario where shareholders perceive that banks are participating in an implicit insurance scheme to which each bank contributes in proportion to its size.

7. References

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8. Data Appendix

A. Banks in the sample

Kaspi Bank[5]

Tengri Bank[4]

Eurasian Bank

Eximbank[4]

Bank RBK

Kazinvestbank

Kazkommertsbank

Delta Bank

Nurbank

Qazaq Bank

Tsesnabank

Forte Bank

Bank of Astana

Bank CenterCredit

[5] Excluded from the sample because of a zero report.

B. Additional Details of Our Estimations

Heteroskedasticity tests for both our models were rejected:

Heteroskedasticity test for model 1, using foreign-currency denominated debt

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.646305	Prob. F(2,8)	0.1312
Obs*R-squared	4.379781	Prob. Chi-Square(2)	0.1119
Scaled explained SS	2.750691	Prob. Chi-Square(2)	0.2528

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/03/18 Time: 19:13
Sample: 1 11
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.396678	1.849390	-1.295929	0.2311
D01	0.000562	0.002033	0.276727	0.7890
ER	26.03100	12.53494	2.076676	0.0715

R-squared	0.398162	Mean dependent var	0.821268
Adjusted R-squared	0.247702	S.D. dependent var	1.327376
S.E. of regression	1.151301	Akaike info criterion	3.346663
Sum squared resid	10.60395	Schwarz criterion	3.455180
Log likelihood	-15.40664	Hannan-Quinn criter.	3.278258
F-statistic	2.646305	Durbin-Watson stat	2.299628
Prob(F-statistic)	0.131195		

Heteroskedasticity test for model 2, using total liabilities

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.142406	Prob. F(2,8)	0.3661
Obs*R-squared	2.443693	Prob. Chi-Square(2)	0.2947
Scaled explained SS	1.971800	Prob. Chi-Square(2)	0.3731

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 02/03/18 Time: 19:14
Sample: 1 11
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.227712	0.617986	-0.368475	0.7221
ER	4.837944	4.597918	1.052203	0.3234
LIAB	-1.11E-07	1.73E-07	-0.643028	0.5382

R-squared	0.222154	Mean dependent var	0.258981
Adjusted R-squared	0.027692	S.D. dependent var	0.474449
S.E. of regression	0.467834	Akaike info criterion	1.545594
Sum squared resid	1.750949	Schwarz criterion	1.654111
Log likelihood	-5.500769	Hannan-Quinn criter.	1.477190
F-statistic	1.142406	Durbin-Watson stat	2.499029
Prob(F-statistic)	0.366079		