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The Stochastic Discount Factor and Liquidity during the International Financial Crises, The Mexico and Chile cases

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Market Liquidity

- Market liquidity refers to both the time and the costs associated to the transformation of a given asset position into cash and vice versa.

- During financial crises (e.g., Asia 1997, Long-Term Capital Management (LTCM) 1998, and Subprime 2008) liquidity can decline precipitously and even temporarily dry out

- Systematic liquidity risk is priced in equity markets (Pastor and Stambaugh (2003), Gibson and Mougeot (2004)).

The Theory

- Brandon and Wang (2013) show that liquidity risk can explain the performance of equity hedge fund portfolios.

- Getmansky, Lo, et al. (2004) and Aragon (2007) focus primarily on illiquidity as a cost factor that induces serial correlation in individual hedge fund returns.

- Sadka (2010) analyzes whether systematic liquidity risk is priced in the cross section of hedge fund expected returns

The Theory (continue)

- Cao, Chen, et al. (2013) shows that many hedge funds exploit their ability to time (i.e., predict) liquidity to decrease (increase) their single equity factor exposure as liquidity decreases (increases).

- Amihud and Mendelson (1986) uses Fama and MacBeth's (1973) approach to evaluate the impacts of the rate of return and risks of the market to odds ratio between selling and buying prices for a portfolio of NYSE stocks from the period 1960 to 1980

The Theory (continue)

- Chan and Faff (2005) provide strong evidence for the important role of liquidity in the Australian stock market.

- Archarya and Pedersen (2005) analyze the impact of liquidity as an adjustment to the CAPM model for the NYSE and AMEX from June 1962 to 1999.

- Wang and Di Iorio (2007) apply Fama and French's (1992) model with liquidity being one of them, which is measured by the turnover ratio. They analyze the Chinese stock market from 1994 to 2002

- The article considers the effect of liquidity on excess return measures (i.e. alphas and appraisal ratios), as in Agarwal and Naik (2004) and Getmansky, Lo, and Makarov (2004).

The model

$$MaxE_t[\sum_{j=0}^{\infty} \delta^j U(C_{t+j})]$$

$$W_{t+1} = \sum_{i=1}^{I}((R_{i,t} - R_{f,t})*w_{i,t} + R_{f,t})(W_t + y_t - C_t)$$

The FONC

$$U'(C_t) = \delta E_t(R_{i,t+1}U'(C_{t+1})|\Psi_t)$$

$$1 = E_t(R_{i,t+1}m_{t+1} | \Psi_t)$$

- Market Efficiency requires that the following conditions are satisfied

$$E\left(m_t\left(R_{it}\right)\right)=1 \text{ and} \qquad E\left(m_t\left(R_{it}-R_t^f\right)\right)=E\left(m_t R_{i,t}^e\right)=0$$

- If the CAPM is satisfied, m can be written as,

$$m = a + bR_{i,t}^e$$

$$1 = E\left(\left(a+bR_{m,t}^e\right)\left(R_{it}\right)\right) = aE\left(R_{m,t}^e\right) + bE\left(\mathrm{R}_{m,t}^e\,R_{it}\right),$$

$$E\left(m_t R_{i,t}^e\right) = E\left(\left(a+bR_{m,t}^e\right)R_{i,t}^e\right) = aE\left(R_{i,t}^e\right) + bE\left(R_{i,t}^e R_{m,t}^e\right) = 0$$

Measure Liquidity

- The effect of liquidity was considered in two ways: the effect on the constant or on the beta of the stochastic discount factor. The effect is statistically measured using a Chow test. The variable I has a value of one if the stock has more than 200 quotes in the year and zero otherwise. The moment conditions become

$$1 = a_o E\left(R_{m,t}^e\right) + a_g E\left(R_{m,t}^e\right) I + b_0 E\left(\mathrm{R}_{m,t}^e R_{it}\right) + b_g E\left(\mathrm{R}_{m,t}^e R_{it}\right) I,$$

$$0 = a_0 E\left(R_{i,t}^e\right) + a_g E\left(R_{i,t}^e\right) I + b_0 E\left(R_{i,t}^e R_{m,t}^e\right) + b_g E\left(R_{i,t}^e R_{m,t}^e\right) I$$

Mean and Standard Deviation of the Daily Market Returns in Mexico and Chile

	IRT		M-Mexico		IPSA		M-Chile	
Year	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std. Dev.
2007-12	1.000591	0.014539	1.00565	0.005475	1.00046	0.012046	1.000613	0.004753
2007	1.000618	0.013519	1.009858	0.000254	1.00058	0.012185	1.000568	0.002521
2008	0.999248	0.022944	1.010616	0.000488	0.99916	0.018479	1.000167	0.002902
2009	1.001659	0.017057	1.000248	0.000307	1.00169	0.010248	1.00007	0.010231
2010	1.000818	0.009068	1.000799	0.000138	1.00130	0.007358	1.000163	0.004148
2011	0.99999	0.012328	1.013017	9.03E-05	0.99944	0.013888	1.000138	0.00007
2012	1.000739	0.007107	1.000194	0.000142	1.00013	0.005965	1.00015	0.000163

Table 2 Chow test for Mexico with the IRT Index, GMM with two steps

	a0			ag			b1			bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	Z	
2007	3.58	3.34	***	-4.11	-2.45	**	22.67	1.94	*	-37.19	-2.08	**
2008	2.33	5.2	***	-2.00	-3.07	***	-17.87	-4.76	***	25.91	5.38	***
2009	3.09	1.51		-2.89	-1.02		10.95	0.78		-14.75	-0.67	
2010	1.71	3.62	***	-1.05	-1.53		45.69	3.53	***	-68.38	-3.94	***
2011	2.76	5.53	***	-2.65	-3.66	***	-3.81	-0.64		5.18	0.59	
2012	2.14	1.39		-1.69	-0.74		92.88	3.02	***	-136.66	-3.54	***

Coefficients a0, a1 from assets with more than 50 quotes in a year, ag, bg with more than 200 quotes in a year.

***, ** and *, statistically significant at the 99, 95 and 90 percent level

Table 3 Chow test for Mexico with the IRT Index, iterated GMM

	a0			ag			b1			bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z	
2007	3.58	3.34	***	-4.11	-2.45	**	22.43	1.92	*	-36.83	-2.07	**
2008	2.24	5.13	***	-1.88	-2.94	***	-17.33	-4.74	***	25.38	5.39	***
2009	3.50	4.45	***	-3.45	-3.27	***	9.01	1		-11.45	-0.96	
2010	1.71	3.63	***	-1.06	-1.54		46.28	3.56	***	-68.89	-3.97	***
2011	2.76	5.53	***	-2.66	-3.66	***	-3.72	-0.63		5.04	0.58	
2012	2.60	1.86	*	-2.35	-1.15		89.69	2.75	***	-133.16	-3.27	***

Coefficients a0, a1 from assets with more than 50 quotes in a year, ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level

Table 6 Chow test for Chile with the IPSA Index, GMM with two steps

	a0			ag			b1			bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z	
2007	0.86	11.79	***	0.20	1.96	*	-7.41	-1.07		9.42	1.02	
2008	2.05	3.78	***	-1.51	-1.96	*	-44.25	-3.96	***	62.67	4.39	***
2009	0.85	8	***	0.24	1.5		52.64	3.53	***	-84.05	-3.78	***
2010	-4.80	-0.79		7.48	0.96		76.92	0.28		-72.04	-0.19	
2011	1.50	4.28	***	-0.68	-1.41		-14.88	-1.78	*	21.27	1.94	*
2012	1.01	107.21	***	-0.01	-0.92		-1.92	-0.96		2.64	0.98	

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Coefficients a0, a1 from assets with more than 50 quotes in a year,
ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level.

Table 7 Chow test for Chile with the IPSA Index, iterated GMM.

	a0			ag			b1			bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z	
2007	-1.11	-2.05	**	2.88	3.92	***	-49.26	-1.96	*	74.22	2.41	**
2008	2.09	3.87	***	-1.57	-2.05	**	-43.46	-3.93	***	61.63	4.36	***
2009	-1.42	-2.02	**	3.69	3.52	***	84.72	3.11	***	-127.26	-3.57	***
2010	-8.01	-1.15		11.61	1.3		-52.43	-0.15		107.78	0.24	
2011	4.04	3.2	***	-4.23	-2.44	**	-22.04	-1.12		35.13	1.37	
2012	1.00	7345.59	***	0.00	-1.24		0.00	-0.23		0.01	0.28	

Coefficients a0, a1 from assets with more than 50 quotes in a year,
ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level

Conclusions and recommendations

- The stochastic discount factor can provide evidence of mispricing of assets.

- There is a liquidity premium factor in the Mexican and Chilean economies in some years of the period of study, 2006-2012.

- There is more frequent a liquidity premium is more frequently present if the pricing index is the IRT for Mexico or the IPSA for Chile than if it is a portfolio with weights that maximize the Sharpe Ratio in the previous year is used as market index.

Conclusions (continue)

- In Mexico, the sensibility of the stochastic discount factor to the IRT as market index is smaller if the stocks are more liquid in all years except for 2008 and 2011.

- In 2008, in the deep of the credit crisis, the relation is statistically significant, but with an opposite sign.For Chile, the differences given by liquidity in almost all of the years are not statistically significant.

- Only in 2009, the sensibility of the stochastic discount factor to the IPSA index as the market one is statistically lower for the more liquid stocks.

- Thank you

Table 4 Chow test for Mexico with the M-Mexico Index, GMM with two steps.

	a0			ag			b1		bg	
	Coef.	z		Coef.	z		Coef.	z	Coef.	z
2007	1.03	0.32		-0.07	-0.01		1.03	NA	0.02	NA
2008	2.99	0.33		-2.95	-0.22		1.16	NA	0.06	NA
2009	3.10	3.77	***	-2.89	-2.61	***	2653.20	1.47	-3689.81	-1.5
2010	3.70	2.45	**	-3.78	-1.72	*	-3372.20	-1.62	4622.49	1.52
2011	0.98	26.14	***	0.02	0.28		1.00	2.06 **	0.00 .	
2012	2.71	4.26	***	-2.49	-2.73	***	10326.25	1.55	-15459.4	-1.59

Coefficients a0, a1 from assets with more than 50 quotes in a year,
ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level

Table 5 Chow test for Mexico with the M-Mexico Index, iterated GMM

	a0			ag			b1		bg		
	Coef.	z		Coef.	z		Coef.	z	Coef.	z	
2007	NA	NA		NA	NA		NA	NA	NA	NA	
2008	NA	NA		NA	NA		NA	NA	NA	NA	
2009	3.08	3.79	***	-2.87	-2.61	***	2691.93	1.5	-3740.58	-1.53	
2010	3.41	2.29	**	-3.44	-1.59		-2869.51	-1.39	4031.52	1.34	
2011	0.98	26.63	***	0.02	0.28		1.00	2.1	**	0.00	.
2012	2.79	4.73	***	-2.62	-3.11	***	8640.72	1.53	-12815.6	-1.56	

Coefficients a0, a1 from assets with more than 50 quotes in a year,
ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level.

Table 8 Chow test for Chile with the M-Chile Index, GMM with two steps.

	a0			ag			b1			Bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z	
2007	1.44	6.27	***	-1.18	-1.95	*	84.06	0.51		-222.29	-0.51	
2008	1.64	9.02	***	-1.96	-3.6	***	-211.50	-2.39	**	707.65	2.66	***
2009	1.42	3.71	***	-1.28	-1.11		-321.04	-0.4		969.20	0.4	
2010	2.44	2.74	***	-3.36	-1.62		23.03	0.4		-53.65	-0.4	
2011	2.03	12.41	***	-2.62	-6.66	***	-2037.02	-1.66	*	5175.64	1.67	*
2012	1.18	170.67	***	-0.45	.		0.14	NA		-0.33	NA	

Coefficients a0, a1 from assets with more than 50 quotes in a year,
 ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level

Table 9 Chow test for Chile with the M-Chile Index, iterated GMM.

	a0			ag			b1			bg		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z	
2007	1.68	5.37	***	-1.79	-2.19	**	448.65	1.44		-1235.10	-1.53	
2008	1.65	8.93	***	-1.99	-3.59	***	-231.41	-2.54	**	762.92	2.79	***
2009	1.50	3.73	***	-1.51	-1.24		-367.67	-0.44		1111.51	0.44	
2010	2.48	2.78	***	-3.45	-1.66	*	17.96	0.31		-41.79	-0.31	
2011	2.02	12.44	***	-2.61	-6.65	***	-1991.85	-1.63		5061.20	1.64	
2012	NA	NA		NA	NA		NA	NA		NA	NA	

Coefficients a0, a1 from assets with more than 50 quotes in a year,
ag, bg with more than 200 quotes in a year.
***, ** and *, statistically significant at the 99, 95 and 90 percent level