Alternative measures of liquidity on the Chilean government fixed income market

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Differences on long term swap spreads measures, both in nominal and real terms, have been very volatile and even negative in recent periods for the Chilean financial market, since the data has been registered these last four years. In this subject, various authors have attributed the discrepancy to some economic factors that have an impact on the degree of liquidity in these markets. This article empirically tries to identify changing conditions in the liquidity of this market using high-frequency data from several sources of the financial market. The validity of such hypothesis could help to build alternative liquidity indicators for Central Bank benchmark markets.

1. Introduction

Swap spreads in monetary and fixed income markets, typically defined as the difference between fixed-float swap derivatives interest rate contracts and the market interest rate of bonds issued by the Central Bank, of similar maturity, are considered a proxy of funding liquidity conditions. Closely related measures of break-even inflation are typically used as indicators of inflation expectations for future periods. In both cases, the use of fixed-float swap derivatives interest rate contracts to extract information in the Chilean monetary

market is relatively recent.[1] Its development has been attributed to a number of observable factors such as the impediments derived from current tax regulation that imposes a tax on capital gains for bond trading. This regulation creates a disincentive to attract foreign investor to the domestic monetary market, which eventually led to development of this alternative swap market (Alarcón and Malandre, 2008), not to mention a number of administrative barriers that also preclude foreign investor to enter the Central Bank instrument's market. These authors argued that these barriers do not allow off-shore agents to fully arbitrage differences between physical bond market rates and the swap rates, although there is no concrete evidence in this regard.[2]

After the subprime crisis several studies attempted to identify the factors behind the sharp increase in the Libor-OIS spread, and its counterpart in other developed markets. These factors are, basically, funding liquidity risk and counterparty risk, or a proxy of credit risk among large financial institutions, which are usually motivated from arbitrage models of interest rates. Taylor and Williams (2008a y 2008b) found that the main driver of the deterioration in financial conditions was associated with an increase in counterparty risk, and to a much less extent due to funding liquidity risk.

The purpose of this article is to identify whether the traditional factors mentioned in the literature had a significant impact on our measures of financial conditions in the monetary

[1] Registries of interest rates from these derivatives operations at the Central Bank dated back since January 2005.

[2] There are no official records of trading volume but inter-dealer broker operating in the Chilean market have reported an estimated size of 3.000 thousand of millions pesos, on average, per month, in the peso-swap market. They indicate that around 10 local banks (the local baking system has 25 banks) and a similar number of foreign banks, operating mainly in the New York market, participate in the peso and inflation-linked swap market, representing each group nearly half of the trading activity.

market and the swap fixed income market. The article briefly reviews the current and past literature in the subject which up to date refers only to international markets. Then, we present some evidence on the behavior of swap spreads in the Chilean market and discuss the results of the estimation exercise.

2. Literature review on liquidity measures in develop markets

An earlier contribution to this topic was provided by Brown and others (1994) which relates swap spreads with various measures of credit (counterparty) risk and hedging costs of market makers. They find that swap spreads are a function of a coupon bias and TED spread expectations. Grinblatt (1995) model swap spreads as a compensation for a liquidity yield associated with holding Treasury Notes, defined as a convenience yield. The yield in it case depends on short term rates and a liquidity advantage of holding long position in Treasuries during tight market conditions. Credit risk is found to be less important to explain the swap spread. Duffie and Singleton (1997) showed changes in swap spreads are related to changes in counterparty and liquidity risk. More recently, Liu, Longstaff and Mandell (2006), found similar results to Duffie and Singleton, where swap spreads are characterized by a persistent liquidity process, and a mean reverting default process.

There also several articles that try to identify the influence of liquidity and credit risk premia on the short term Libor-OIS spread and it similar measures in other developed countries. The interest on understanding its behavior increased markedly after the sharp increase in the Libor-OIS spread at the onset of crisis. Taylor and Williams (2008) found that during the subprime crisis counterparty risk emerged as an important factor to explain the surge in the Libor-OIS spread, and that liquidity risk play a minor role. Their results

generated an intense debate, because others questioned the result on liquidity risk. However, they provide the high observed correlation between secured (Libor-Repo spread) and unsecured (Libor-OIS) funding as evidence that liquidity was less of a problem in the interbank market. Similar results are obtained by Hui, Genberg and Chung (2009) in the sense that, previous to the crisis, funding liquidity risk was the main determinant in swap spreads, but when the crisis was in place, counterparty risk was also an important factor.

3. Evidence on swap spreads in the Chilean markets

A number of stylized facts are worth mentioning about swap spreads measures in the Chilean case. First, it has been noticed that up until the end of 2007, swap spreads in pesos and in contracts linked to past inflation, showed a negative persistent trend, see graph 1. There is also no significant premium for longer term contracts and no significant difference in the volatility pattern, see table 1.[3]

Table 1. Summary statistics of swap spread measures

	Pre-Crisis				Post-Crisis			
	mean	sd	min	max	mean	sd	min	max
Swap-Spread 5y	17	25	-36	70	-26	30	-83	52
Swap-Spread 10y	24	32	-44	100	-35	26	-80	28
Prime-Swap 3m	36	20	0	100	49	48	-20	300
Prime-Swap 6m	42	19	0	90	74	51	10	300
Prime-Swap 12m	57	21	20	110	91	57	0	330

Source: Authors' calculations.

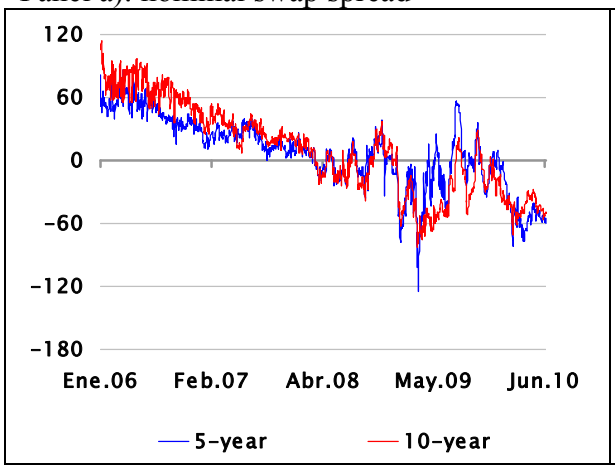
The behavior changes in 2008, around the bankruptcy of Bearn Stern. Swap spreads started to oscillate around zero for nominal contracts, and set below zero for inflation linked contracts. This behavior presents a puzzle since it implies that bank counterparty risk is lower than rates on Central Bank paper, that are supposed to be risk free or instead view as a lower bound for pricing instruments at the terms. The negative values of swap spreads

[3] For a detailed description of the Chilean swap markets, see Varela (2007) and Alarcón and Sotz (2007).

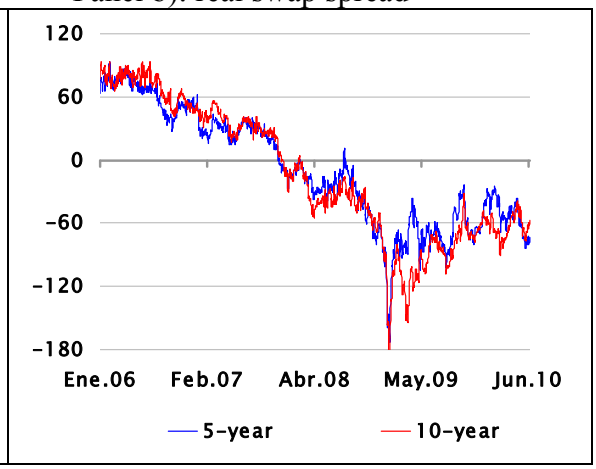
were observed until the end of 2008, a peculiar feature of the Chilean derivatives markets, except for Greece. However, during 2009 and afterwards, Spain and even the UK have showed negative values of the swap spreads, at similar maturities, see graph 2. In the case of these European countries, a plausible explanation for the negative values has been the large deficits incurred in those countries to rescue their financial systems, which in turn has had a negative impact on interest rates on government securities.[4] In contrast, in the Chilean case the dynamic has been more of changes in the swap rates, explained by some authors due to the lack of financial integration in the fixed income market, because of a number of tax issues and the low stock of Central Bank instrument, which had led foreign investor to prefer to take positions in the curve through the swap market.

Graph 1: Chilean Swap spreads
(basis points; updated as of Jun-10)

Panel a): nominal swap spread



Panel b): real swap spread

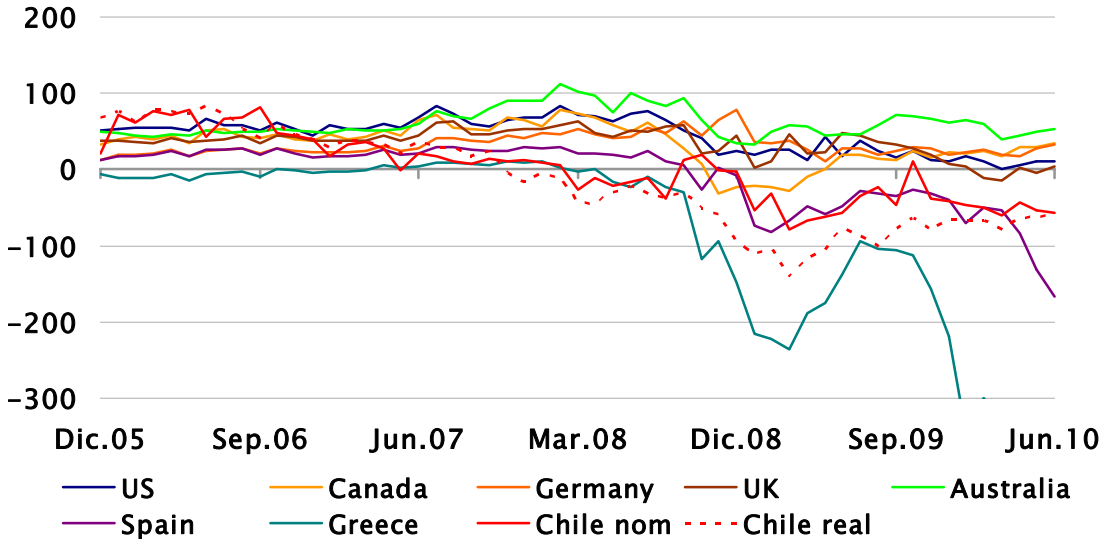


Source: Central Bank of Chile and Bloomberg

Graph 2
International comparison: Swap Spread 10 year

[4] Preliminary panel cross country regression shows that the fiscal deficit is significant to explain the negative values in swap spreads.

(basis points; updated as of Jun-10)

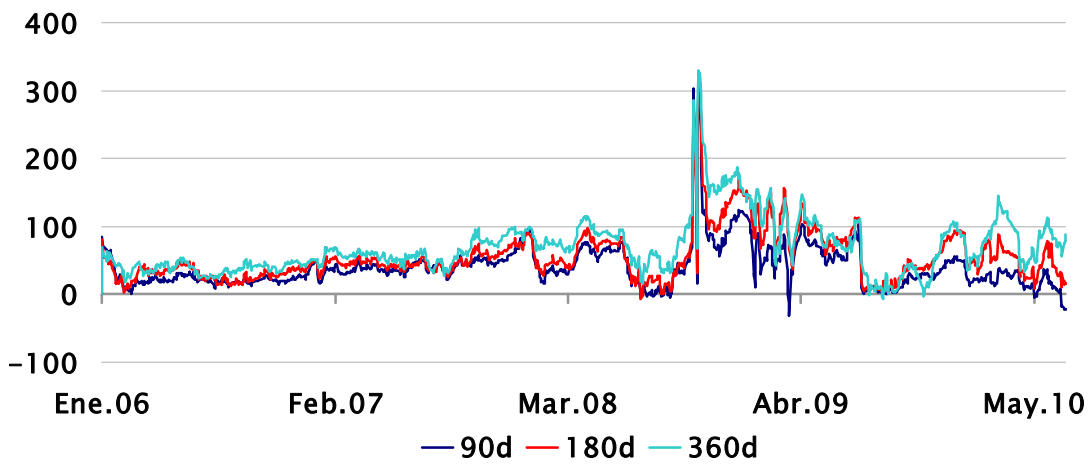


Source: Central Bank of Chile and Bloomberg

In relation with swap spreads for maturities equal or less than a year we use what we call the prime-swap spread, which is negotiable at 90, 180, and 360 days. The prime rate corresponds to time deposit rates paid by banks to pension funds, mutual funds, and to other banks. It is the Chilean equivalent to the Libor rate quoted in develops markets, since there is only a daily interbank market in Chile. The prime-swap spread shows high volatility when compared to its international equivalents, in particular after the bankruptcy of Lehmann, see graphs 3 and 4. Also, before the crisis there were no sizeable distinctions between contracts at different maturities, also see table 1, suggesting a liquidity premium was not very relevant. However, after the crisis, in particular after the second semester of 2009, this changes and there is, on average, a 25 basis point difference between the 90 days prime-swap spread and 180 days contract, even though the Central Bank put in place a standing facility for 180 days repos using Central Bank instruments and banks' time deposit as collateral.

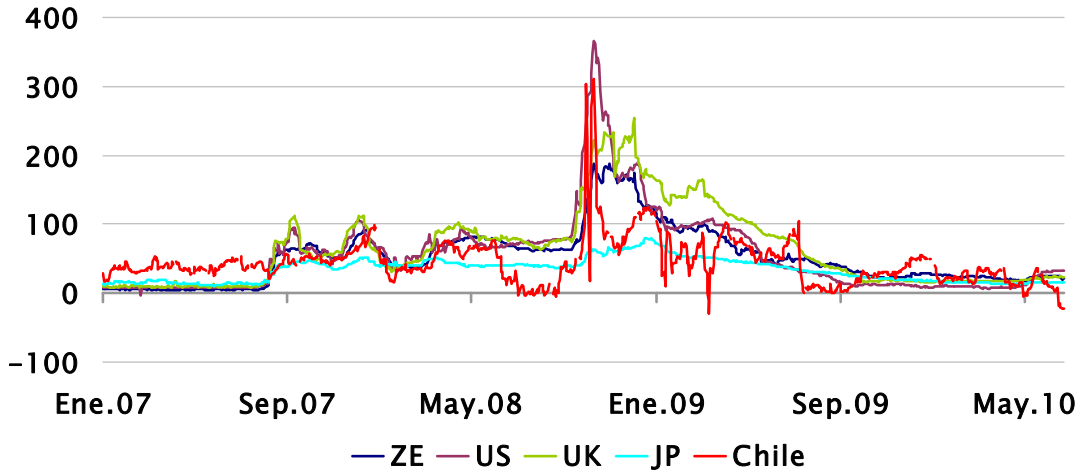
Graph 3

Chilean Prime Swap spread:
(basis points; updated as of Jun-10)



Source: Central Bank of Chile and Bloomberg

Graph 4
International comparison: Libor-OIS 3 month spread
(basis points; updated as of Jun-10)



Source: Central Bank of Chile and Bloomberg

4. Empirical evidence on determinants of swap spreads

The estimation of swap spreads at different maturities required to explore the volume of transactions in each market, to control for potential lack of trading liquidity in particular

points in the curve. As a result, we only estimate the behavior of swap spreads for nominal 10 year maturity, and the 6 month maturity in the case of the prime-swap spread, which undoubtedly are the most deep and active markets.

The model estimation adopted the following general specification:

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 x_t + \beta_3 z_t + \varepsilon_t \qquad (1)$$

Where y_t takes the following definitions:

$$swap\ spread = r_{0,10}^{SPC} - r_{0,10}^{BCP} \qquad (2)$$

$$prime - swap = i_{0,6}^{dp} - i_{0,6}^{SPC} \qquad (3)$$

The variable x_t comprises the set of determinants of interest for the different measures of swap spreads: i) funding liquidity in the interbank market, proxy by the spread between daily interbank rates and the monetary policy rate[5], ii) banking counterparty risk, proxy by the spread of bank senior and subordinated bonds over a Central Bank benchmark of similar duration; and iii) trading liquidity proxy by the ratio of transactions of the corresponding instrument to the total stock of the same instrument, which in the case of the definition of swap spread in equation (2) include Treasury and Central Bank instruments.

The variable z_t contains several controls factor including the Libor USD - OIS spread, to control for liquidity pressures in international markets, VIX index to control for global volatility, and a set of dummy variables to control for the term facility implemented by the Central from July of 2009 until May of 2010, that it has been noted that helped to tighten

[5] The motivation for including this variable is to control for liquidity pressures in the interbank market that could eventually be transmitted to these other markets. Despite the active participation of the Central Bank through Repo transactions and the existence of a 25 basis points upper and lower bounds, there are periods where the interbank rate diverges significantly of the monetary policy rate.

prime-swap spreads right after its introduction. We also included a dummy variable that take into consideration the period after the bankruptcy of Lehmann that take a value 1 starting off the second week of September 2008 until the second week of December 2008, and zero elsewhere. Data is sampled weekly.

The results for the estimation of the prime-swap spread suggest that counterparty risk in the Chilean case is not important, especially not when interacted with the crisis dummy, see table 2. Trading liquidity it also seems to be non significant, except during the crisis which takes a positive value, suggesting that during that period an increase in the volume in time deposits cause an increment in the spread. It is important to notice that during the second semester of 2008 and for the most part of 2009 pension funds, which at some point represented 35% of total banking time deposits, lowered substantially their position in time deposits, and expanded their position in foreign investment. It is also important to highlight that during more turbulent periods, like the third quarter of 2008 and the second quarter of 2010, pension funds did came back to the local time deposit market.

Table 2. Estimation Result for 6 month Prime-Swap spread

Variable	[1]	[2]	[3]	[4]	[5]
Lag 1	0.83	0.80	0.79	0.71	0.65
	9.88 (***)	9 (***)	8.56 (***)	5.96 (***)	5.23 (***)
Lag 2	-0.2	-0.3	-0.2	-0.1	-0.2
	-3.62 (***)	-3.55 (***)	-3.29 (***)	-1.8 (*)	-2.29 (**)
Spread (Libor-Ois) 6m	0.2	0.1	0.1	0.1	0.2
	1.18	1.07	1.41	1.38	1.86 (*)
Dummy Subprime Crisis	14.1	13.3	57.6	-47.5	-60.5
	0.76	0.71	0.62	-0.44	-0.61
VIX	-0.1	0.3	0.2	0.1	0.2
	-0.08	0.7	0.59	0.34	0.55
Lag Spread (Tib-Tpm)		0.2	0.3	0.3	0.3
		1.6	2.07 (**)	1.6	2.04 (**)
Crisis Interaction - Lag Spread (Tib-Tpm)		5.5	2.9	-0.5	0.3
		1.1	0.7	-0.2	0.1
Counterparty risk			0.1	0.1	0.0
			1.7	1.4	0.8
Crisis Interaction - Counterparty risk			-0.3	-0.2	-0.2
			-0.6	-0.5	-0.4
Trading Liquidity				511	386
				1.5	1.2
Crisis Interaction - Lag Trading Liquidity				5,698	5,738
				1.6	1.76 (*)
Pension Fund - Bank Deposits exposure					-46.9
					-3.17 (***)
Constant	13.7	9.8	2.3	-3.0	753
	1.6	1.4	0.4	-0.4	3.14 (***)
R-sq	0.75	0.75	0.75	0.77	0.78
Observations	225	225	225	222	221

T-statistic in parenthesis significance at 1% (***), 5% (**), and 1% (*)

On the other hand, the spread interbank-monetary policy rate is significant in two specifications. This suggests that liquidity pressures in this market might have transmitted to longer term monetary markets. Moreover, the Libor-OIS is also significant in specification [5] suggesting that more than an increase credit risk profile of domestic banks, concerns about accessing to adequate funding liquidity, either locally or internationally, were more relevant. This finding is consistent with the fact that the solvency of the Chilean banking system has never been put under strain since the beginning of the crisis.

The result for the 10 year swap spread are not very different from those encountered for its short-run equivalent, see table 3. There is a high and significant degree of persistent in the spread.[6] Although the crisis dummy is significant in specification [1], it is not robust to further changes in the estimation. Also, its interaction with counterparty risk, trading and funding liquidity risk is not significant. Unlike the previous results, counterparty risk by itself is significant in two specifications, [2] and [3], however it looses its relevance when we control for the stocks of Central Banks bonds available in the market. In fact, the swap spread can be explained quite well by its own lags. This finding possibly suggests that this market has been relatively immune to all the turbulences caused by the international crisis. The interbank spread was not significant under any specification, which could be explained by the fact the very low capital requirements are needed to enter into the swap market and, at the end of the contract only differences in interest rates are compensated.

[6] Traditional unit-root test reject the null hypothesis of non-stationarity in the swap spread variables.

Table 3. Estimation Result for 10 year Swap Spread

Variable	[1]	[2]	[3]	[4]
Lag 1	0.65	0.63	0.63	0.60
	8.74 (***)	8.23 (***)	8.26 (***)	8.04 (***)
Lag 2	0.25	0.23	0.23	0.20
	3.48 (***)	3.16 (***)	3.14 (***)	2.63 (***)
Spread (Libor-Ois) 3m	0.04	0.07	0.08	0.06
	1.24	2.03 (**)	2.05 (**)	1.39
Dummy Subprime Crisis	12.8	6.51	-86.26	-98.2
	1.99 (**)	0.53	-0.79	-0.88
VIX	-0.46	-0.75	-0.72	-0.54
	-2.7 (***)	-3.9 (***)	-3.59 (***)	-2.36 (**)
Counterparty risk		0.07	0.08	0.05
		2.72 (***)	2.74 (***)	1.6
Crisis Interaction Counterparty risk		0.06	0.16	0.17
		0.7	1.0	1.1
Trading Liquidity			-18.0	-29.9
			-0.9	-1.4
Crisis Interaction - Trading Liquidity			463.1	523.8
			0.8	0.9
Banks - Government bonds exposure				-16.1
				-1.6
Constant	7.2	4.1	4.1	232.1
	2.37 (**)	1.0	1.0	1.6
R-sq	0.91	0.91	0.91	0.91
Observations	208	208	204	204

T-statistic in parenthesis significance at 1% (***), 5% (**), and 1% (*)

5. Final comments

This paper represents the first attempt to identify whether counterparty and funding liquidity risk have played a role in the evolution of swap spreads in the Chilean monetary and fixed income markets. The results suggest that counterparty risk was not very relevant during the most turbulent periods since august 2007, at least in the monetary market for funding liquidity. This result is consistent with the resilience showed by the domestic banking system trough all this period. In contrast, funding liquidity pressures in the overnight interbank market, despite the active Central Bank involvement, seems to increase

funding pressures in the market where most banks obtain funding from institutional investors.

These preliminary results show that, if there is any funding liquidity risk in swap spread markets in the Chilean market, its identification is a task that remains pending. Traditional factors used in the literature to explain the evolution of swap spreads play a relatively minor role, given the high persistence in the swap spread itself. It is important to bear that swap markets in Chile are relatively recent and therefore and there are not official statistics for its level of activity.

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