Banco Central de Chile
Documentos de Trabajo

Central Bank of Chile
Working Papers

N° 516

Abril 2009

INTERBANK RATE AND THE LIQUIDITY OF THE MARKET

Luis A. Ahumada Álvaro García Luis Opazo Jorge Selaive

La serie de Documentos de Trabajo en versión PDF puede obtenerse gratis en la dirección electrónica: http://www.bcentral.cl/esp/estpub/estudios/dtbc. Existe la posibilidad de solicitar una copia impresa con un costo de $500 si es dentro de Chile y US$12 si es para fuera de Chile. Las solicitudes se pueden hacer por fax: (56-2) 6702231 o a través de correo electrónico: bcch@bcentral.cl.

Working Papers in PDF format can be downloaded free of charge from: http://www.bcentral.cl/eng/stdpub/studies/workingpaper. Printed versions can be ordered individually for US$12 per copy (for orders inside Chile the charge is Ch$500.) Orders can be placed by fax: (56-2) 6702231 or e-mail: bcch@bcentral.cl.

Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
Agustinas 1180
Teléfono: (56-2) 6702475; Fax: (56-2) 6702231

Documento de Trabajo
N° 516

Working Paper
N° 516

INTERBANK RATE AND THE LIQUIDITY OF THE MARKET

Luis A. Ahumada
Banco Central de Chile

Álvaro García
Banco Central de Chile

Luis Opazo
Banco Central de Chile

Jorge Selaive
Banco de Crédito e Inversiones

Resumen

En este trabajo estudiamos la dinámica diaria de la tasa interbancaria en Chile, con especial atención al rol de la liquidez provista a través de depósitos bancarios y operaciones de mercado abierto realizadas por el Banco Central. El principal objetivo de este trabajo es evaluar la información contenida en datos desagregados y de alta frecuencia de esas variables. Los principales resultados se encuentran relacionados a la significancia económica de la velocidad de convergencia, los efectos calendario y de las operaciones con pacto de retroventa (repo). El Banco Central juega un rol más importante drenando que inyectando liquidez por medio de operaciones monetarias discrecionales. Sin embargo, no hay asimetrías en términos de la efectividad de las inyecciones y drenajes discrecionales dependiendo de la liquidez del mercado. Adicionalmente, los bancos de mayor tamaño son menos receptivos a las operaciones monetarias, mientras que los bancos pequeños son los más sensibles a dichas operaciones, lo cual es consistente con el tradicional rol de estas categorías de bancos en la provisión de liquidez en el mercado interbancario. Finalmente, los depositantes privados no juegan un rol importante en la dinámica de la tasa interbancaria durante el período muestral.

Abstract

In this paper we study the dynamics of the interbank rate in Chile, with special attention to the role of liquidity provided by private depositors and by the central bank's open market operations on a daily basis. The main aim of this paper is the use of disaggregated and high frequency data on such variables. The most relevant findings are related to the statistical and economic significance of speed of convergence, calendar effects and repos operations. The Central Bank plays a more important role injecting than draining liquidity through discretionary operations. However, there are not asymmetries in terms of the effectiveness of the discretionary injections and drainages operations depending on the liquidity market status. In terms of effect by class of bank, large- and medium-size banks are less receptive to monetary operations; by contrast small-size banks are the most responsive, which is consistent with its traditional position as a liquidity demander. Finally, private deposits do not play an important role on the dynamics of the interbank rate during the sample period.

We thank Felipe Alarcón, Matías Bernier and Jorge Pérez for helpful suggestions, participants at internal seminars in Central Bank, and Carmen G. Silva who collaborated in a preliminary version of this work. We are also grateful to the Department of Open Market Operations for sharing with us the data used in this work. All errors are ours. E-mail: lahumada@bcentral.cl; agarcia@bcentral.cl; lopazo@bcentral.cl; jselaiv@bci.cl.

1. Introduction

The interbank money market rate (*ir*) stands at the shortest end of the yield curve, and is the operational target for the monetary policy rate (*mpr*). Therefore, understanding the factors behind the dynamics of the *ir* is relevant not only for participants in the interbank market, but also for private investors and monetary authorities. Indeed, the *ir* is a key benchmark for interest rates in the short-term money market and its movements may have effects on the whole term structure (Taylor and Williams, 2008 among others). Moreover, the interbank market represents the first stage of the monetary transmission channel, where monetary policy actions first come into contact with the rest of the financial system. An effective monetary policy requires that the overnight interest rate remains "at an average of around" the *mpr.* [1]

In this paper we study the dynamics of the *ir* in Chile, giving special attention to the role of the liquidity provided by private depositors and by the Central Bank's open market operations. Our paper extends the previous literature mainly in three aspects. Firstly, we study the effect of liquidity provision by both the central bank and private depositors on the dynamics of the *ir.* To the best of our knowledge, this paper is the first attempt in the literature to broadly incorporate this dimension into the analysis of the *ir*. Secondly, we provide novel evidence on the behavior of the *ir* in an emerging economy, which is useful to fill the gap created by preceding literature mainly focusing on industrial countries.[2] Finally, we take a systematic approach that involves both the time series and panel data dimensions, allowing us to have a broader picture of the factors behind the high frequency dynamics of the *ir*.

The liquidity of the market affects directly the amount of resources that commercial banks have at their disposal and which they will consequently be willing to lend in the interbank market. However, with the exceptions of Wurtz (2004) and Hamilton (1996),[3] previous empirical studies have not considered the effect of daily liquidity conditions on the analysis of the *ir*. In fact, the literature

[1] The functioning of the Chilean interbank market is similar in structure to US and Euro area cases. Appendix 1 describes in depth technical details related to the functioning of the interbank market in Chile.

[2] Evidence for the European overnight interbank rate (EONIA) and for the federal funds rate can be found in Spindt and Homeister (1988), Hamilton (1996), Balduzzi *et al.* (1997, 1998), Gaspar (2004), Nautz and Offermanns (2006), Prati *et al.* (2003) and Cocco *et al.* (2009), among others.

[3] These authors consider the daily reserve surplus, i.e. current account holdings minus reserve requirements, as an indicator of the liquidity conditon.

generally analyzes the functioning of the interbank market using a general framework in which banks' reserve positions are affected by random shocks and where the interbank market allows banks to fulfill their monthly reserve requirement (e.g., Ho and Saunders, 1985; Freixas et al, 2000; Allen and Gale, 2000). Within this scheme, an important number of empirical papers have studied the effect of periodic events affecting banks' reserve positions. Indeed, a bulk of empirical evidence points out that variables like the last day of the reserve maintenance period, the last day of the month, the prior day to a Holy day or the day of the monetary policy meeting are relevant for explaining the daily dynamics of the *ir* (Hamilton, 1996; Sarno and Thornton, 2001; Prati *et al.*, 2003; Moschitz, 2004; Nautz and Offermans, 2006; Benito *et al.*, 2007).

As mentioned above, we make use of a unique database containing detailed information about the different types of open market operations as well as deposits by depositors at the bank level. This dataset allows us to test the role of money market operations through permanent credit lines and repos. Liquidity provision by the central bank usually involves drainage and injection of funds through repo operations at *mpr* (discretionary operations hereafter), combined with permanent draining and injection of funds at *mpr* – 25 bps and *mpr* + 25 bps, the "floor" and "ceiling" of market rates around the target, respectively. The use of discretionary operations, instead of credit facilities, could be interpreted as a high degree of commitment of the central bank to take the *ir* close to the *mpr*, which could lead to the gap between these rates being closed faster. In this line of research, Nautz and Offermanns (2006) explore the role of the repo auction format in the Euro zone, and Prati *et al.* (2003) study central banks' operating procedures and intervention styles for the Euro zone and G-7 countries.

The modeling strategy for the time series follows Sarno and Thornton (2001), and Nautz and Offermanns (2006), who employ an error correction model to characterize the dynamics of the *ir* allowing for non-linearities.[4] Given that we have high frequency data of the monetary policy operations and deposits at banks, we complement the strategies of these studies by evaluating the economic impact of different types of interventions on the short run dynamics. We also evaluate whether deposits from pension funds (PF hereafter)

[4] Benito et al. (2007) follow a more statistical approach to model the EONIA. They employ several models containing jump components – for instance ARCH-Poisson-Gaussian process.

have a different impact on the *ir* from that of the others depositors. We supplement time series estimations with panel data analysis that exploits the variation of the *ir* across banks. The estimation strategy is a standard fixed effect panel using instrumental variables to control for potential endogeneity of some regressors.

Our results indicate that the *ir* and the *mpr* move together very closely and, when these variables deviate from each other, the speed of convergence is around 30% per day. In term of the explanatory variables, the calendar effects and open market operations –especially the discretionary operations- are the most relevant in explaining the dynamics of the *ir*. With respect to the calendar effects, they play an important role on the dynamics of the *ir* –which is consistent with previous findings in this area- a situation that poses questions on which frictions drive this finding. Regarding the relevance of market liquidity provided by the central bank, we find that the central bank played an important role during the sample period, while private depositors do not help to significantly improve the explanation of the dynamics of the *ir*. For example, if we consider the average daily monetary operation and long-run PF's deposits, the effect of discretionary injections, drainages and long-run PF's deposits on the *ir* is 1.7, 3.4, and 0.05 bps, respectively. The permanent credit lines are not statistically significant; this situation could be due to the fact that this instrument is available on a daily frequency and, therefore, the market has internalized its operation in the valuation of the *ir*. The results also show a more active role of central bank injecting than draining liquidity. The effect of draining and injection operations on the *ir* are quite similar, but the magnitude of drainages are close to two time the injections. At the bank level, the most relevant asymmetry is due to the distinction of banks according to their size. Concretely, the large banks are less sensitive to monetary operations –which could be associated to their condition of liquidity providers- meanwhile small-size banks are the most responsive to central bank's instruments.

The rest of this paper is structured as follows. Section 2 presents the data. Section 3 performs time and panel data estimations. Section 4 concludes.

2. Data

2.1. Description

In this paper we use three main data sets. The first consists of detailed information for each loan granted in the Chilean interbank market on a daily basis for the period of June 2006 to August 2008 (532 trading days). The data is from the Central Bank of Chile[5] and include 29 banks that are active traders in the money market. It also identifies lenders and borrowers, as well as the interest rate and volume involved in each operation.

With the previous information, we compute the daily *ir* at which banks borrow from each other as the weighted average of its operations for each day. Similarly, we construct the aggregated *ir* as the weighted average of the individual *ir*, where the weights are computed as the ratio of the volume involved in each operation to the aggregated traded volume.

The other two datasets contain information with proxies of the liquidity conditions at the banking system. The first dataset comprises daily information of the operations carried out by each bank with the Central Bank of Chile (i.e., repos, auctions of promissory notes, etc.). The second dataset contains information on deposits in commercial banks grouped by PF and other investors. This last dataset was built with information provided by the *Superintendencia de Bancos e Instituciones Financieras* (SBIF) and the *Superintendencia de Pensiones* (SP).

We consider several other sources of information for external and domestic variables that we include in the analysis as factors that could potentially affect the aggregated liquidity conditions. On the external side, we use the Libor-OIS spread and the VIX. On the domestic side, we consider a measure for shocks on the expected *mpr*, corresponding to the difference between the expected *mpr* derived from forward contracts and the current *mpr*.

2.2. The Interbank Rate and the Overnight Money Market

Within the sample period, the *ir* has followed the policy rate closely, generally being only 1.8 bps above the *mpr* (see Figure 1a). In this dimension, the Central Bank has been successful in steering the short-term interest rates

[5] The functioning of the Chilean interbank market is similar in structure to U.S. and European area cases. Appendix 1 describes in depth the technical details related to the functioning of the interbank market in Chile.

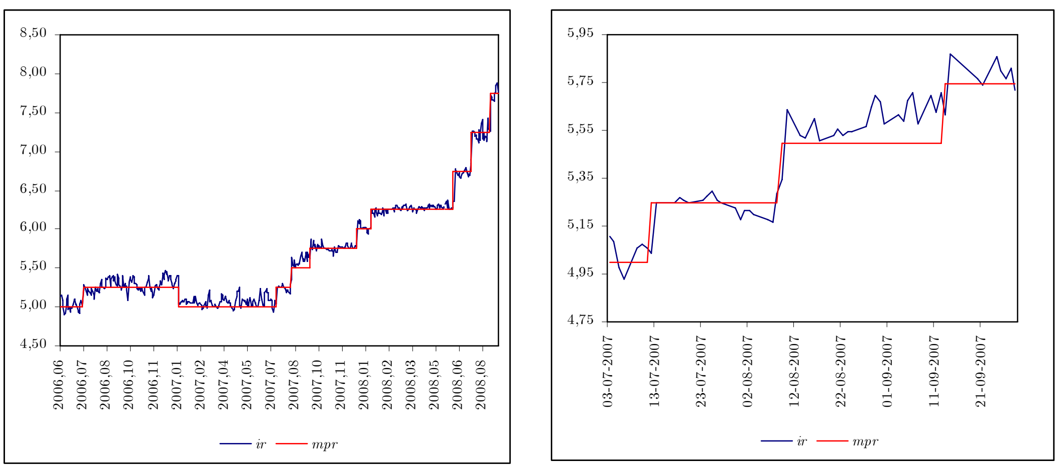
towards the *mpr*, in spite of the large variations of the *mpr* during the sample period—from 5.00 to 8.25 percent and the financial turbulences derived from the sub-prime crisis. Indeed, there are only a few episodes where the *ir* decouples significantly from the *mpr* and these episodes have been highly transitory: for instance, mid-2007 (see Figure 1b). Nonetheless, there is considerable heterogeneity of these variables across time. In fact, the average deviation during 2007 was close to 5 bps which contrasts with the 0.5 bps observed during years 2006 and 2008 (Table 1). And, in terms of volume in the interbank market, its peak in the sample occurred in 2007 (30% and 15% higher with respect to 2006 and 2008, respectively), which suggests a high appetite for liquidity coming from commercial banks at the beginning of the financial turbulences derived from the sub-prime crisis.

Figure 1

Chilean Monetary Policy Rate and Interbank Rate

Panel (a) **2006.06-2008.08**

Panel (b) **2007.07-2007.09**



Source: Authors' calculations based on information provided by the Central Bank of Chile.

Table 1

Interbank Market's Descriptive Statistics (2006-2008)

	2005	2006	2007	2008	2005-2008
ir (%)	3.91	5.02	5.35	6.72	**5.61**
ir* - *mpr (bps)	0.8	0.5	4.8	-0.5	**1.8**
Average Volume	262.8	256.7	333.5	290.9	**294.8**

Note: Interbank rate is expressed in percent points, the difference between the interbank and the target rate in basis points. Average interbank volume is in billions pesos.

Source: Authors' calculations based on information provided by the Central Bank of Chile.

In the previously mentioned decoupling of mid-2007 (see Panel (b), Figure 1), for almost an entire month the *ir* was systematically above the *mpr*, with a spread that reached a peak of 21 bps at the beginning of September 2007. This decoupling could be related to different drivers happening simultaneously, making the identification of the incidence of these factors an extremely difficult task. First, the Chilean and international financial markets were severely hit by turbulences derived from the sub-prime crisis.[6] Second, on August 9th the maximum regulatory limit on foreign assets held by PF was increased from 30 to 35 percent of the total portfolio.[7] Finally, there were high expectations of an increase of the *mpr* on the monetary policy meeting of September 13th of that year and commercial banks seemed to anticipate a 25 bps increase in that meeting.

On the quantity side, Table 2 presents some descriptive statistics of the open market operations during the sample period. A few points deserve to be mentioned. First, the average interbank operations are of similar magnitude to most of the monetary operations managed by the Central Bank.[8] Second, the sample period considers the significant activity of both liquidity and draining discretionary operations, which will allow us to identify if the market responds differently to these operations. Third, if we compare the frequency of liquidity and drainages with the *ir-mpr* spread, it is not evident that discretionary or

[6] Indeed, during August 2007 the Chilean stock market experienced a phase of unusual high volatility, falling almost 10% between the 9th and the 13th of August and fully recovering these losses in the following four trading days.

[7] It was common in this period to observe Chilean money managers declaring in the current press, the possibility that pension funds could be affecting market liquidity. PF accounts on average around 20% of total deposits held by commercial banks.

[8] The average of each type of operation is calculated using only the days that register each type of operation.

permanent operations work in a counter-cyclical fashion with respect to degree of decoupling of the *ir* –i.e., injections (drainages) relatively more important when the *ir* is above (below) the *mpr*. In this sense, the frequency of injections or drainages of liquidity does not seem to depend only upon the *ir* running above or below the *mpr*. This could suggest that market liquidity condition is not only measured by the $ir - mpr$ spread. We take this situation into account in our econometric estimations by using several controls. However, and just for expositional purposes, we define a liquid market the cases when the $ir<mpr$ and vice versa.

Table 2

Descriptive Statistics of the Interbank Market (2006-2008)

Average Operation Volume (in billions pesos)

Variable	Mean	Median	Maximum
Interbank Operations	288.6	286.2	658.6
Discretional Injections	297.0	242.9	1,202.5
Discretional Draining	600.5	545.6	1,397.2
Permanent Liquidity Facilities	47.5	21.9	513.7
Permament Deposits Facilities	266.7	195.7	1,253.1

Share of the Time with Positive Op	**Overall**	**Illiquid Market Conditions ($ir > mpr$)**	**Liquid Market Conditions ($ir < mpr$)**
Interbank Operations	100%	100%	100%
Injections	22%	25%	15%
Draining	6%	7%	5%
Permanent Liquidity Facilities	88%	89%	91%
Permament Deposits Facilities	100%	100%	100%

Note: Discretional Operations excludes swap operations. The average only consider days with positive operations

Source: Authors' calculations based on information provided by the Central Bank of Chile.

2.3. Bank-Level information

The aggregate information allows us to understand global and domestic factors behind the dynamics of the average *ir*, but it hides the heterogeneity of the liquidity needs of each commercial bank. For this reason, we also explore the cross-section dimension of the data to determine whether the adjustment of the *ir* depends on specific characteristics of each bank.

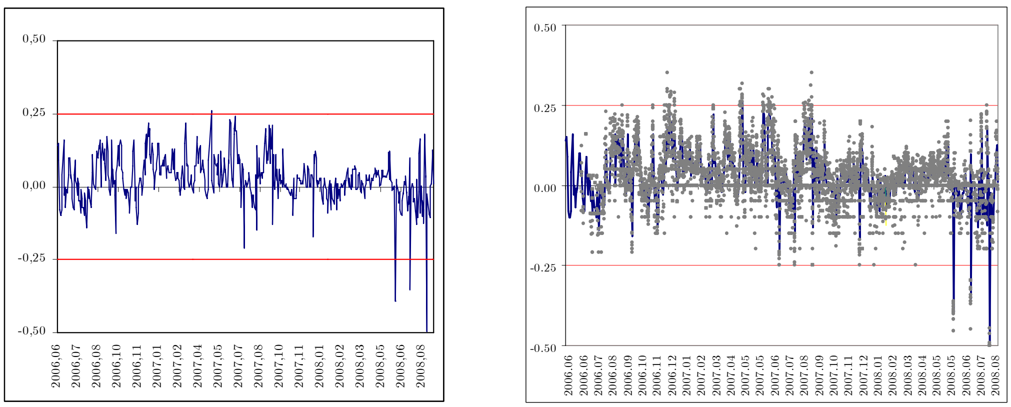
To illustrate the degree of heterogeneity of the *ir* at the bank level, Figure 2 contains the aggregate *ir* – *mpr* spread (left panel) and the spread for each bank (right panel) from June 2006 to October 2008. It is interesting to notice that the *ir* exhibits significant variation across banks, covering practically all the range of +/-25 bps, with a few exceptions where the spread exceeds the ceiling of +25 bps during 2007, while the opposite occurs at the end of the sample period.

Figure 2

Interbank Rate - Monetary Policy Rate Spread

Panel (a) — ***ir-mpr* Spread: Banking System**

Panel (b) — ***ir-mpr* Spread: Level Bank**



Source: Authors' calculations based on information provided by the Central Bank of Chile.

In order to shed some light on this heterogeneity, Table 3 presents interbank market information for large-, medium- and small-size banks.[9] Three facts emerge: a) the medium- and small-scale banks exhibit an asking *ir* approximately two times larger than large banks -1.4 vs. 3.3 and 2.5 bps, respectively;[10] b) the larger-banks are willing to lend to a lower *ir* (2.8 bps) than medium- (3.5 bps) and small-banks (4.0 bps); and c) the size of the loans as percentage of assets is quite higher in small-scale banks (2.0%) than in large-

[9] These categories of banks are the most relevant in the Chilean banking system both in terms of assets and number. More importantly, for our study, they explain more than 70% of the interbank market activity.

[10] One possible explanation for the lower asking *ir* of large-scale banks is that these banks are able to finance their reserve needs at a lower cost. To verify if large banks have higher funding costs than medium-scale banks, we build a measure of funding costs as the ratio of monthly interest payment to total liabilities of each bank relative to the average banking system. Values higher than one of this measure reflect funding cost higher than the average. On the contrary, values lower than one reflects cheaper funding cost than the banking system. The results show that large-scale bank are able to obtain funding almost 1.2 percent cheaper than the average bank, while medium-scale banks have an average funding cost 3.5 percent higher than the average.

and medium-size banks -0.2% and 0.6%, respectively. These findings suggest that different class of banks participate in the interbank market for different purposes, while larger tend to use the interbank market to drain liquidity, the medium-scale participate to obtain liquidity.

Table 3

Interbank Market Statistics

June 2006-December 2007

	Large-Scale Banks	Medium-Scale Banks	Small-Scale Banks	Average Banking System
Average Asking Spread (bps)	**1,4**	**3,3**	**2,5**	**2,9**
Average Lending Spread (bps)	**2,8**	**3,5**	**4,0**	**2,9**
Average daily Interbank Asking Volume*	**25,8**	**14,1**	**5,4**	**10,5**
% of Assets	0,2%	0,5%	2,0%	**0,4%**
% of Financial Investment	1,7%	6,4%	8,8%	**3,4%**
Average daily Interbank Loans Volume*	**37,4**	**9,7**	**4,7**	**10,5**
% of Assets	0,3%	0,4%	1,7%	**0,4%**
% of Financial Investment	2,5%	4,4%	7,6%	**3,4%**

Source: Authors' calculations based on information provided by the Central Bank of Chile.

3. Empirical Analysis

In this section we present time series and panel estimations to disentangle the main driving forces behind the dynamics of the *ir*, considering both global and individual liquidity needs. A time series approach is useful to analyze the role of aggregate shocks, while the panel estimation allows us to exploit the heterogeneity of the *ir* across banks. Jointly, we will be able to study the differential effect of shocks across different types of banks.

3.1. Time Series Analysis

From a time series perspective, modeling economic variables requires evaluating if the series are stationary. Stationary variables and integrated series demand completely different modeling strategies. As Table A in Appendix 2 shows, the *ir* and the *mpr* behave very persistently during the sample period. In fact, the half-life of a shock on the *ir* is longer than one year, while the half-life of the *mpr* is even more persistent. Part of these dynamics could be explained by the discrete changes in the *mpr*.[11] However, in order to avoid the problem of spurious results, it is necessary to test the existence of unit roots.[12] We apply a battery of unit-root tests to both series, including the traditional Augmented Dickey-Fuller test, the Elliot et al. (1996) efficient test, denoted as DF-LS, and the KPSS and Phillip-Perron tests. Results successively confirm for each of these tests that it is not possible to reject the null hypothesis of a unit root for *ir* and the *mpr* series.

Since the *ir* and the *mpr* move closely together and sporadically deviate from each other (see Figure 1, panel (a)), we evaluate the presence of a long-run relationship between both series. Evaluating this hypothesis is equivalent to testing whether the residual of an OLS regression between *ir* and *mpr* is non-stationary against the alternative that it is stationary. Results reject the null of unit-root for residuals, confirming the presence of a long run relationship.[13] The low value for the half-life of the *ir-mpr* spread (less than 2 trading days) seems to confirm the stationary nature of this variable.

Given the non-stationary behavior of the *ir* and its co-integration with the *mpr*, the most natural approach is an error correction model (ECM) with the *mpr* as the long term anchor.[14] This approach is not novel in the literature. In fact, it has been applied by Nautz and Offermanns (2006), and Sarno and Thornton (2002) to model the EONIA in the Euro zone and the federal funds rate in United States, respectively.

The ECM we estimate is formulated as follows:

$$\Delta ir_t = \alpha_0 \left(ir_{t-1} - mpr_{t-1} \right) + \alpha_1 \Delta mpr_{t-1} + \alpha_2 \Delta ir_{t-1} + \delta' X + \varepsilon_t \,, \tag{1}$$

where ir_t is the interbank rate, mpr_t the monetary policy rate, X other explanatory variables, and Δ the first-difference operator. The parameter α_0 is the rate at which the deviations of *ir* from the *mpr* are closed each day. The vector of other explanatory variables, X, involves several monetary operations

---

[11] Testing for unit root in the *mpr* is challenging because this rate changes discretely and its increments are irregularly spaced in time. An overwhelming majority of the literature fails to reject a unit root based on the low power of unit root test when dealing with series that present infrequent changes (Hamilton and Jorda, 2002).

[12] In practice, both stationary and non-stationary modeling strategies for the *mpr* are considered in the literature. We take one of the stands in the literature testing for the presence of unit root in the *ir* and the target rate.

[13] Table A, third column.

[14] It is worth mentioning that an error correction specification could also be obtained from a more general specification where the *ir* is just modeled as a function of its own lags, lags from the *mpr* plus other controls.

variables, regulatory capital requirements, institutional investor deposit variables, *mpr* surprises, external variables and calendar effects.

Regarding monetary operations, we consider discretionary operations that provide liquidity (repos) and those that reduce it (liquidity deposits), and non discretionary instruments (permanent credit facilities) expressed in net terms, that is, liquidity injections minus drainage. It is worth mentioning that the distinction between discretional and permanent monetary operations matters for the analysis of the determinants of the *ir*. While the first group comprises of agreements on an occasional basis issued at the *mpr*, the second one corresponds to operations in which every bank is allowed to deposit (withdraw) at 25 bps below (above) the *mpr*. From a policy standpoint, to determine the effectiveness of discretional instruments is relevant for better fine-tuning in extraordinary episodes of decoupling of the *ir* from the *mpr* and.

Regulatory capital requirements are also included since they correspond to indirect instruments used by the Central Bank to drain liquidity.[15] Additionally, we consider deposits in commercial banks by PF and by other investors (i.e., insurance companies, mutual funds, households, etc.). The inclusion of PF deposits may be relevant because the share of its maintained deposits' portfolio in whole deposits of the system is above 20 percent and, therefore, could end up influencing the *ir*.[16] We divide PF deposits into short term and long term, corresponding to less or more than 90 days respectively. Since there is no information to classify the non-PF deposits by term, we only consider the aggregates.

Other domestic variables included are monthly *mpr* surprises, measured as the difference between the effective *mpr* and the implicit expected rate in forward contracts two weeks before the monetary policy meeting. We also control for calendar effects through dummies extensively used in the literature: day of monetary policy meeting –generally the second Thursday of each month-, the day that banks must cover their reserve requirement –9th of each month-, and the day of value-added tax payment.[17] Finally, in order to capture the international liquidity conditions, we consider external variables such as the

[15] In Chile, banks are obligued to deposit the difference between their current liabilities and the amount equivalent to times and a half of their capital and reserves in an special account in the Central Bank.

[16] PF in Chile are important players in key asset prices. For instance, Cowan, Rappaport and Selaive (2006) provide evidence of the role of PF on the exchange rate.

[17] For instance, Hamilton (1996), Sarno and Thornton (2002), and Nautz and Offermanns (2006).

CBOE Volatility Index (VIX) and the Libor-OIS spread. While the Libor - Overnight interest swap spread capture the role of “liquidity contagion” coming from external markets, the VIX captures market expectations of near-term volatility.

3.1.1. *Results*

The OLS estimations rely on the assumption that the independent variables are predetermined or statistically exogenous. However, it is likely that monetary operations could be endogenous to the dynamics of the *ir*. Central banks respond to price signals when they decide the amount they will put in the lending window in the form of repos. Similarly, when commercial banks choose to obtain funds from the interbank market over the permanent facilities alternative, they are implicitly responding to the relative cost of both sources of liquidity. Finally, given that the *ir* represents the shortest end of the yield curve, movements of this price could affect the amount of deposits in commercial banks.

Following the previous reasoning, a straightforward OLS estimation could generate biased and inconsistent parameters. Thus, given the potential endogeneity of the covariates, we run the Hausman (1978) test to all variables. The test supports statistical exogeneity for all the variables with the exception of net permanent facilities. Therefore, we use Instrumental Variables (IV) procedure, choosing as external instruments for differences of net permanent facilities their lagged levels, lagged values of the *ir-mpr* spread, daily dummies and dummies for positive and negative values of the *ir-mpr* spread.[18] A similar approach using IV estimation has also been used recently by Cocco et *al* (2009).

Table 4 presents our estimates for the short-run dynamics of the *ir*, which include up to one lagged difference of the *ir* and the *mpr*. Several findings deserve attention. First, the speed of convergence of the *ir* to the *mpr* is relatively high (0.28-0.34, approximately) indicating that approximately one-third of the gap between these two variables is reduced in one day. This magnitude is a little higher but otherwise near to the estimates for the Euro interbank market by Nautz and Offermanns (2006), who find a speed of convergence of 0.26. Second, the short-run effect of changes in the *mpr* is

[18] The set of instruments includes lags of the endogenous variables and lags of the *ir-mpr* spread.

significantly positive, but does not entail a one-for-one change in the *ir*. In fact, the estimated coefficient in all the specifications lies in the range 0.15-0.22, which suggests that the effect on the *ir* of a one-time change in the *mpr* is distributed over time. This finding is also consistent with the evidence provided by Nautz and Offermanns (2006), Angelini (2002) and Linzert and Schmidt (2008).

In Col [1] of Table 4 we test some calendar effects that could potentially affect the liquidity position of the banks: the day of the monetary policy meeting (which takes the value of one for contemporaneous and following day of the meeting), the value-added tax payment day (which takes the value of one on the day of payment and on the previous day) and the preceding four days to the end of the maintenance period.[19] In addition, we include a dummy that takes the value of one in the first four days of the maintenance period in order to control for the higher demand because of the banks' obligation to comply with at least 90% of the required reserve by the 23rd of each month. The aim of this intermediate target is to encourage less volatility in the banks' reserve requirement compliance and thus the *ir*.

Our results suggest that the *ir* does not vary significantly in the final days of the maintenance period. On the contrary, our results show that in the days prior to the VAT's payoff day and on the days surrounding the monetary policy meeting, the *ir* increases approximately 2 bps, although in the case of the monetary policy meeting the increase is significant only in the three last specifications. Similarly, in each of the first four days of the maintenance period, the *ir* increases by 3 bps. This result is robust to different specifications of the length of dummy variables, and as we show in columns [2] to [4] of Table 4, they are also robust to the inclusion of alternative sets of control variables.

[19] Consistently with former theoretical models which consider monthly reserve requirements as the most important shock affecting banks' liquidity position (see Ho and Saunders, 1985; Freixas et al, 2000; Allen and Gale, 2000; King, 2004 among others), the end of maintenance period dummy variable is by far the most extensive calendar effect considered in the literature. See Hamilton (1996); Perez and Quiros (2002); Wurtz (2003); Prati et al. (2003) and Nautz and Offermanns (2006), among others.

Table 4

IV Estimations

Dependent Variable: Δir_t

May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
ir (t-1)	-0.342 ***	-0.299 ***	-0.295 ***	-0.286 ***
mpr (t-1)	0.343 ***	0.299 ***	0.295 ***	0.286 ***
Δ *mpr*	0.215 **	0.179	0.175	0.142
Δ *ir* (t-1)	-0.092 ***	0.032	0.026	0.031
Δ *mpr* (t-1)	0.230 *	0.251 **	0.261 **	0.223 *
Calendar Effects				
MP Meeting day	0.021	0.03 **	0.032 **	0.034 **
VAT Payoff day	0.026 **	0.02 *	0.018	0.015
Pre- End of Maintenance Period	-0.006	-0.004	-0.003	-0.003
Post- End of Maintenance Period	0.028 ***	0.03 ***	0.027 **	0.028 **
Central Bank's Open Market Operations				
Δ Injections		-0.057 ***	-0.061 ***	-0.062 ***
Δ Injections (t-1)		-0.003	-0.007	-0.007
Δ Draining		0.014	0.011	0.007
Δ Draininng (t-1)		0.056 **	0.054 **	0.059 **
Δ Mandatory Reserve Requirement		0.011	0.015	0.011
Δ Mandatory Reserve Requirement (t-1)		0.111 **	0.112 ***	0.116 ***
Δ Net Permanent Facilities		0.102 *	0.103 *	0.111 **
Δ Net Permanent Facilities (t-1)		-0.091	-0.083	-0.095
		[0.055]	[0.057]	[0.058]
Private Investors Depositors				
Δ Other Investors' Deposits			-0.008	-0.004
Δ Other Investors' Deposits (t-1)			-0.006	-0.004
Δ Short-Run Pension Funds Deposits			0.091	0.093
Δ Short-Run Pension Funds Deposits (t-1)			-0.112 *	-0.123 *
Δ Long-Run Pension Funds Deposits			0.110	0.118
Δ Long-Run Pension Funds Deposits (t-1)			-0.142 *	-0.141 *
Other External & Domestic Variables				
Forward IR - MPR				-0.043
Forward IR - MPR (t-1)				-0.030
Libor-Ois				0.027
Libor-Ois (t-1)				-0.022
VIX				0.017
VIX (t-1)				-0.044
Observations	795	795	795	795

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations.

The estimates considering monetary operations are presented in the block named "Central Bank's Open Market Operations" in Cols. [2] to [4]. Both contemporaneous and lagged discretionary injections and drainages have the expected signs and similar magnitudes. The difference between injections and drainages lies in the timing of impact. While injections are statistically significant contemporaneously, drainages reach significance one period lagged (both coeffcients are statistically significant at the 95% confidence level).[20] The estimated coefficients for these variables are robust along all the specifications and, more importantly, they are economically significant. However, the size of the average drainages and injection operations are quite different -$ 600 and $ 300 billion, respectively (Table 2). Therefore, in practice, when the central bank had operated through repos, the impact on the *ir* has been two times higher in draining than injecting liquidity. In effect, if we employ the average (median) size of each type of operation, the expected effect of drainages and injections on the *ir* is 3.4 (3.1) and 1.7 (1.4) bps, respectively. These results suggest that taking the *ir* to the *mpr* by the Central Bank is equally effective when the market has liquidity shortage with respect to liquidity abundance in the interbank system, but the average intervention implies that drainages are economically more significant than liquidity injections.

Regarding permanent monetary operations, we obtain a positive contemporaneous effect, and a negative lagged effect of similar magnitude that offset the initial positive effect on the *ir*. In fact, it is not possible to reject the null hypothesis that the sum of both coefficients is statistically equal to zero at usual confidence intervals. In other words, the estimates imply that "*changes*" in the volume of the operations through permanent facilities do no affect permanently the *ir*. However, this does not imply that existence of this mechanism does not affect the dynamics of the *ir.* The reason behind this clarification is that this instrument is available every day and, therefore, the market could have internalized its operation in the valuation of the *ir* and, therefore, the use (or not) of this facility is already incorporated in the *ir*.[21] Finally, the lagged change in the reserve requirement—which is proportional to

[20] Hereafter we will refer to discretional injections and draining simply as "injections" and "draining".

[21] To test formally if the existence of this mechanism affects the dynamics of the *ir*, we should have data covering a period without the operation of the permanent facilities, which is not available. However, such analysis goes beyond the purpose of this paper.

the capital of each bank—is strongly significant, suggesting that higher reserve requirements reduce the liquidity of the banks and, therefore, increase the *ir*.

In Cols. [3] and [4] we test the relevance of private deposit variables which supposedly provide liquidity to the banking system. We test the effect of deposits by splitting overall deposits into three categories: deposits by PF with duration of up to 90 days (short-run deposits), deposits by PF with duration longer than 90 days (long-run deposits) and deposits by other private investors. The only statistically significant variables are the lagged short- and long-run PF deposits.[22] In order to evaluate the economic significance of long-run PF deposits, we employ the average daily change of short- long-run PF deposits — -$0.53 and $4.15 billion respectively—, leading to a potential effect on the *ir* reaching -0.006 and 0.05 bps. This magnitude is quite low. However, the potential effects of PF deposits could be quite important. In fact, if PF liquidate 25% of their short- and long-run deposits, the *ir* could go up by 30 bps (5.6 and 24.3 bps respectively).[23]

The final variables set we consider consists of *mpr* surprises (proxied by the forward *ir* – *mpr* spread) and two variables that capture the external environment: the Libor-OIS spread and the VIX. Neither of these variables prove to be statistical significant.

In sum, we have two sets of candidates that correlate significantly with changes of the *ir:* standard calendar effects and central bank's open market operations. In order to asses the relative statistical significance of those variables, in Table 5 we test the null hypothesis that all the regressors within a given variable set are non-significant for each specification. Results in the first row of Table 5 show lagged levels and differences of *ir* and *mpr* being strongly significant at the 1% level. Similarly, results in rows two and three confirm both calendar effects and central bank's operations being statistical significant at the 1% level. Rows four and five reveal that private investors deposit variables and other external and domestic variables are both non-significant at standard confidence levels. We also compute three additional measures for the fit of each regression: the Akaike and the Bayesian Information Criterions (AIC and BIC,

[22] We also consider deposits by private investors' variables overall deposits and overall PF deposits (both short- and long-run). The results are qualitatively similar and are therefore not reported.

[23] Notice that this estimation assumes perfect linearity -constant coefficient-, which could be a conservative assumption for this type of estimation.

respectively), and the regression's adjusted R-Squared. AIC suggests that the model including including monetary operations and private investors deposits as preferred to specification 1 and 2, while BIC points to a specification only the calendar effects better adjusts the data (specification 1). On the contrary, specifications including other external variables (specifications 3 and 4, respectively) are never preferred by AIC or BIC to the more parsimonious specifications 1 and 2. Finally, the last row in Table 5 confirms that the inclusion of monetary operations into the model improves the adjusted R-Squared from 0.30 to 0.34, while the inclusion of further variables is unable to improve significantly the fit of the regression.

Table 5

Wald Tests

Dependent Variable: Δir_t

May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
Lagged Levels and Differences of *ir* and *mpr*	105.97 ***	67.22 ***	68.02 ***	61.43 ***
Calendar Effects	19.41 ***	19.59 ***	16.67 ***	16.98 ***
Central Bank's Open Market Operations		70.32 ***	73.34 ***	70.38 ***
Private Investors Depositors			5.21	5.31
Other External & Domestic Variables				1.59
Observations	795	795	795	795
Akaike Information Criterion	-2041.7	-2066.4	-2074.4	-2047.1
Bayesian Information Criterion	-1999.6	-1986.8	-1966.8	-1911.4
R-squared	0.30	0.34	0.35	0.34

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations.

3.1.2. *Asymmetric Effects*

In this subsection we explore whether our estimates are sensitive to aggregate market liquidity, i.e. to positive and negative values of the *ir* - *mpr* spread. For such a purpose, we consider the specification excluding other domestic and external variables (Col. [3], Table 4).[24] Operationally, we estimate a regression in which the speed of convergence, the contemporaneous and lagged changes in the *ir* and in the *mpr*, discretional monetary operations and deposits

[24] The results are robust to different specifications of the *ir* dynamics.

variables are interacted with a dummy variable that takes the value one if the spread is positive and 0 otherwise. In order to determine whether the coefficients are statistically different in both cases, we compute Wald tests.

Table 6 presents the coefficients for negative and positive spreads in Cols. [1] and [2] respectively, while Col. [3] shows the statistics of the Wald test under the null hypothesis of non-asymmetric coefficients –i.e., that the coefficients are not statistically different. The results reveal asymmetric effects on just some of the variables. The first source of asymmetry emerges from the lagged *ir* – *mpr* spread, which is significantly higher when the market is illiquid than with a liquid market (0.46 vs. 0.32). Secondly, results reveal the change in *mpr* being also asymmetric. In fact, when the spread is positive, changes in the *mpr* are translated into a one-to-one basis to the *ir*, but the pass-through is significantly lower if the spread is negative (less than one-fifth). Finally, we also find some evidence of asymmetries in mandatory reserves.

Table 6

Testing Asymmetric Coefficients

	[1] Illiquid Market $ir > mpr$	[2] Liquid Market $ir < mpr$	[3] Chi2
ir (t-1)	0.462 ***	0.324 ***	[2.31]
mpr (t-1)	-0.455 ***	-0.329 ***	[2.80] *
Δ *mpr*	1.050 ***	0.130	[19.89] ***
Δ *ir* (t-1)	-0.086	-0.067	[0.07]
Δ *mpr* (t-1)	0.488 ***	0.198	[1.43]
Central Bank's Open Market Operations			
Δ Injections	-0.041 ***	-0.070 **	[0.66]
Δ Injections (t-1)	-0.017	-0.068	[1.18]
Δ Draining	-0.024	0.015	[2.00]
Δ Draining (t-1)	-0.006	-0.049	[3.25] *
Δ Mandatory Bank Reserve Position	0.027	-0.050	[5.48] **
Δ Mandatory Bank Reserve Position (t-1)	0.067 **	-0.023	[8.52] ***
Private Investors Depositors			
Δ Other Investors' Deposits	-0.025	-0.078	[1.93]
Δ Other Investors' Deposits (t-1)	-0.022	0.017	[0.76]
Δ Short-Run PF Deposits	0.118	0.175	[0.35]
Δ Short-Run PF Deposits (t-1)	-0.151 **	0.026	[0.09]
Δ Long- Run PF Deposits	0.000	0.068	[0.18]
Δ Long- Run PF Deposits (t-1)	0.061	0.023	[1.00]
Observations	680		

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Source: Authors' calculations

3.1.3 Disentangling the Determinants of the ir: August 2007

In this section, based on the fourth specification in Table 4 (Col. [4]), we decompose the incidence of each one of the considered variables in the dynamics of the *ir* at the end of August 2007. This exercise is relevant because during this period the *ir* was systematically above the *mpr*—averaging 10.5 bps between August 10th and September 12th, with a peak of 21 bps—(Figure 1) and, additionally, it is not clear what were the main drivers behind this dynamic, i.e., PF deposits, international turmoil, expectations on the next monetary policy meeting, etc.

Figure 3 presents the performance of the model in terms of explaining the *ir* (panel a) and, complementary, the contribution to the *ir* dynamics of the different explanatory variables (panel b). In general terms, the model has a relatively good performance at the beginning of August—recall that the model has a daily frequency—but it does a poor job between the end of August and the monetary policy meeting of September 13th. In particular, during the second week of September, the explanatory variables are able to explain just a minor part of the *ir* decoupling. In some sense, this behavior is consistent with the mix of uncertainty associated with the response of monetary policy to both inflationary pressures from the international financial turbulences that were affecting the economy at that moment.

With respect to the explained *ir* dynamics—and particularly at the beginning of August— it is interesting to note that the calendar effects and monetary operations have an active role in the behavior of the *ir*. The variance decomposition indicates that the calendar effects, open market operations, private deposits and other controls account for 40, 56, 4 and 1% of the explained variance during the period under study, respectively. Moreover, the maximum contribution of the open market operations in the August-September episode is 11.1 bps when the difference between *ir* and *mpr* is close to 18 bps – the fifth of September. As for PF, their role is restricted to just a couple of days in mid-August that correspond to the loosening of the restrictions on PF to hold foreign assets.[25] In fact, the estimations indicate that the maximum PF contribution to the *ir* occurred in the August episode, accounting for 2.9 bps of the gap between the *ir* and the *mpr* in the period. This point contrasts with

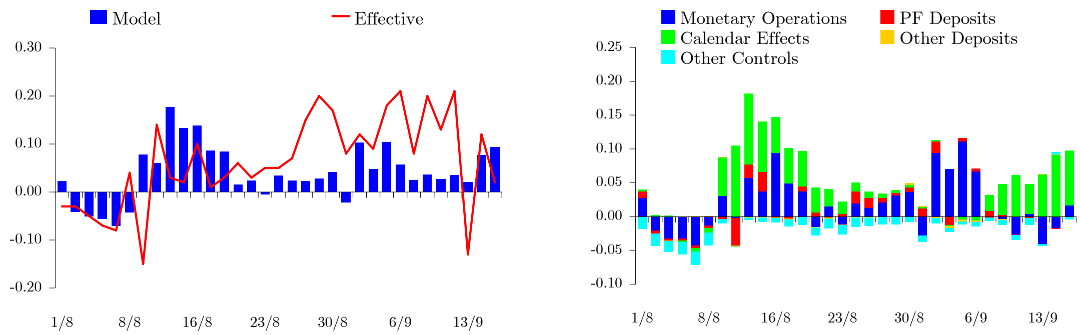
[25] The limit to holding foreign assets was increased from 30% to 35% of total portfolio on August, 9th, 2007.

several opinions by market operators during those days regarding the impact on the market liquidity conditions due to potential PF' portfolio adjustments.[26]

Figure 3

Explaining the *ir* Dynamics: August 2007

Panel (a) **Explained versus Unexplained Share** — **Panel (b)** **Decomposition of Model's Explained Share**



Source: Authors' calculations.

3.2. Panel Data Analysis

This section presents panel data estimates with the purpose of exploring whether bank level differences could be relevant for explaining the dynamics of the *ir*. Due to data availability, the sample period covers a shorter period than in the previous section (from June 2006 to August 2008). The empirical model estimated in this section is similar to the model used in the time series section. In fact, we estimate a panel error correction model with IV to control for endogeneity of some explanatory variables:[27]

$$\Delta ir_{it} = \alpha_0 \left(ir_{it-1} - mpr_{t-1} \right) + \delta' X_{i,t} + \upsilon_i + \eta_t + \varepsilon_{it} \qquad (2)$$

where the dependent variable is defined as the change in the interbank asking rate defined in section 2.1, and where υ_ι and η_τ correspond to fixed and time effects, respectively,[28] while the index i denotes each of the 29 banks in our sample. Vector X contains the same controls used for time series estimations with the only difference that they are disaggregated at the bank level. In general, the notation for the other variables remains the same as before.

[26] See section 2.

[27] A quite similar econometric approach is performed by Cocco et al. (2009)

[28] We consider time effect with a weekly frequency. The reason behind this decision lies in the fact that the time dimension (539) of our dataset is significantly higher than the number of individuals (29).

Similarly to time series estimations, we apply the Hausman (1978) test to each covariate. The test supports the statistical exogeneity assumption for all the variables except for net permanent facilities. For this variable, we consider as external instruments the contemporaneous and lagged values of derivative contracts. The logic behind the use of derivatives as instruments is that they reduce the availability of banks to lend and borrow in the interbank market because they employ part of pre-determined credit lines between banks to operate between them, but the use of derivatives is not directly related to the *ir* dynamics. Therefore, the use of derivatives is related to the endogenous explanatory variable and, simultaneously, not to the error term.

3.2.1. *Baseline Estimations*

Table 7 presents the benchmark regressions. The main difference with respect to time series estimations is the magnitude of the coefficients, which tend to be higher in the panel dimension. Concretely, the speed of convergence of the *ir* of each bank to the *mpr* is practically twice the speed at the aggregated level, roughly 0.50 (Table 7) versus 0.29 (Table 4). On the other hand, and perhaps more interestingly, the contemporaneous effect of injections fluctuates around 0.58, while in the time series estimates are close to 0.05 (however, this coefficient has low statistical significance).

Similarly, the magnitude of the drainage effect is 10 times the effect estimated in the time series: 0.7 in panel estimations while in the time series it is approximately 0.06. A similar situation occurs with the estimated effect of injections, which is approximately three times higher than the estimated effect in the time series dimension. With respect to calendar effects, they have similar magnitudes compared to the time series estimates. The only difference is the estimated effect for the monetary policy meeting dummy variable, which turns out to be negative and significant, and the value-added payoff day dummy, which turns out to be non-significant. The set of calendar effects also include a dummy that takes the value one for those banks that are net lenders in each trading day. We do this in order to capture the fact that lender banks have probably more liquidity at hand and, therefore, should face a lower asking *ir*. Our belief is confirmed by the finding of an *ir* 0.7 bps lower for those banks.

The existence of higher impacts at individual than aggregated level reflects the high heterogeneity across banks in terms of the use of instruments and liquidity positions at each moment.[29] In this sense, this result highlights the importance of a monetary planning that takes into account the liquidity position of each bank in order to maximize the efficiency of its instruments.

To illustrate the implications of the magnitude of the individual elasticities, if the Central Bank reduces liquidity by $ 700 billion through liquidity deposits in 9 commercial banks,[30] the *ir* of the banks using such instrument will go up by 5.3 bps. In contrast, time series estimates indicate that the aggregated *ir* will decrease by only 3.7 bps. In contrast, a liquidity injection of 300 billion through *repo* operations in 5.1 commercial banks reduce the *ir* of those banks in a similar amount than the estimated response in the time series section.[31]

Table 7

Panel IV Estimation. Dependent Variable: Δir_{it}

Sample Period: June 2006 to August 2008

	[1]	[2]	[3]
ir (t-1) - *mpr* (t-1)	-0.542 ***	-0.481 ***	-0.479 ***
Δ *mpr*	0.228 ***	0.436 ***	0.437 ***
Δ *ir* (t-1)	-0.058 ***	-0.058 **	-0.059 **
Δ *mpr* (t-1)	0.161 ***	0.417 ***	0.417 ***
Calendar Effects			
MP Meeting day	-0.010 *	-0.018 ***	-0.017 ***
VAT Payoff day	-0.004	-0.001	-0.001
Pre- End of Maintenance Period	-0.009 ***	-0.007 *	-0.007 *
Post- End of Maintenance Period	0.026 ***	0.027 ***	0.027 ***
Dummy Lender Bank	-0.006 **	-0.007 **	-0.007 **
Central Bank's Open Market Operations			
Δ Injections		-0.184 **	-0.181 **
Δ Injections (t-1)		0.13	0.135
Δ Drainage		0.725 **	0.702 **
Δ Drainage (t-1)		0.679	0.649
Δ Net Permanent Facilities		-0.541	-0.529
Δ Net Permanent Facilities (t-1)		0.151	0.219
Private Investors Depositors			
Δ Overall PFs Deposits			-0.095
Δ Overall PFs Deposits (t-1)			-0.294
Δ Other Deposits			0.005
Δ Other Deposits (t-1)			0.059
Observations	3804	3085	3085
Groups	22	20	20

Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects.

Source: Authors' calculations.

[29] If banks were not heterogeneous, the aggregate elasticity will collapse to the individual estimates.

[30] The average liquidity deposit implies that 9.5 banks use this facility, each one requesting 73.1 billions pesos.

[31] The average repo operations implies that 5.1 banks use this facility, each one requesting 61.7 billions pesos.

3.2.2. *Asymmetric Response*

In this section we explore whether the asymmetric effects of monetary operations and deposits on the *ir* dynamics found in time series analysis are also valid on the *ir* of individual banks. Table 8 reports the coefficients for these variables depending on the sign of the *ir* – *mpr* spread of each bank—i.e., liquid and illiquid market. The results are similar to the aggregated estimates, but they also add some new pieces of information with respect to the interbank market dynamics.

Table 8

Testing Asymmetry

Dependent Variable: Δir_{it}

Sample Period: June 2006 to August 2008

	[1]	[2]	[3]
	Illiquid Market	**Liquid Market**	
	ir* > *mpr	***ir* < *mpr***	**Chi2**
ir (t-1) - *mpr* (t-1)	-0.547 ***	-0.450 ***	[207.4] ***
Δ *mpr*	0.982 ***	0.074 *	[127.1] ***
Δ *ir* (t-1)	0.001	-0.106 ***	[4.90] **
Δ *mpr* (t-1)	0.083	0.163 *	[4.52] **
Central Bank's Open Market Operations			
Δ Injections	-0.096	0.000	[0.19]
Δ Injections (t-1)	0.125	-0.119	[0.00]
Δ Drainage	0.088	0.765 ***	[2.97] *
Δ Drainage (t-1)	0.065	1.709 ***	[4.93] **
Private Investors Depositors			
Δ Overall PFs Deposits	0.039	0.400	[0.62]
Δ Overall PFs Deposits (t-1)	-0.442	-0.380	[1.55]
Δ Other Deposits	0.067	-0.267	[0.91]
Δ Other Deposits (t-1)	0.120 **	-0.139	[0.01]
Observations		3059	
Groups		20	

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects. The equations include the same controls used in the time series IV estimation

Source: Authors' calculations.

First, the speed of convergence is statistically higher when the banks are illiquid or, equivalently, the banks' capacity to bring down the *ir* is higher when its *ir* is above the *mpr*. Moreover, and in line with time series estimations, the *ir* adjustment to changes in the *mpr* is statistically higher when the *ir* is above than below the *mpr*. In some sense, these results can be summarized as a higher bank capacity to adjust to an illiquid status—i.e., *ir*>*mpr*—and/or, complementary, the *mpr* tends to be the relevant marginal rate for illiquid banks, which is consistent with an *ir* higher than *mpr*, and vice versa.

Regarding monetary operations, we find that discretionary drainages are more effective when the market is liquid. In fact, the magnitude of the sum of both contemporaneous and lagged draining coefficients when the market is liquid is almost ten times the coefficients when the market is illiquid. On the other hand, injections are not statistical significant. The same is true for PFs overall deposits, and for the contemporaneous value of depostis by other investors.

3.2.3 Large and Medium Banks

In this subsection we evaluate if the responsiveness of the *ir* depends on the bank's scale. For such purposes, and following the bank classification proposed by Jara and Oda (2007), we run a different regression for the large-, medium-, and small-banks. These authors make a cluster analysis for the Chilean banking industry, defining each cluster according to the Euclidean distance of each bank with respect to others which is dependent of a set of characteristics.[32]

Results in Table 8 reveal that large-scale banks are able to adjust faster to misalignments of the *ir* from the *mpr.* In addition, large-scale banks are less responsive to variations of the *mpr.* These results are consistent with the fact that large-sized banks have a bigger quantity of funding sources as well as greater assets. On the other extreme, small-scale banks shows the smaller coefficient of convergence and are more responsive to changes in the *mpr.*

The main result, however, corresponds to the strong asymmetry observed in the monetary operations depending on bank type. Open market operations are non-significant for large- and medium-scale banks. This finding is consistent

[32] Jara and Oda (2007) consider the following characteristics: market share, leverage, degree of portfolio diversification and target market.

with a higher degree of autonomy in the funding of this type of banks (see section 2.3). On the contrary, small-scale banks are the most responsive classification to open market operations. Actually, they are the only group responding significantly to both liquidity and draining operations.

Table 9

Panel IV Estimation by Type of Bank

Dependent Variable: Δir_{it}

Sample Period: June 2006 to August 2008

	Large Banks [1]	Medium Banks [2]	Small Banks [3]
ir (t-1) - *mpr* (t-1)	-0.649 ***	-0.55 ***	-0.486 ***
Δ *mpr*	0.134	0.197 ***	0.299 ***
Δ *ir* (t-1)	0.002	-0.047	-0.083 ***
Δ *mpr* (t-1)	0.185	0.08	0.21 **
Central Bank's Open Market Operations			
Δ Injections	-0.025	-0.163	-0.266 *
Δ Injections (t-1)	0.074	0.139	0.212 *
Δ Drainage	0.294	0.687	1.36 ***
Δ Drainage (t-1)	-0.439	0.239	0.986
Private Investors Depositors			
Δ Overall PFs Deposits	-0.224	0.338	0.932
Δ Overall PFs Deposits (t-1)	-0.347	-0.233	-0.189
Δ Other Deposits	-0.053	0.042	0.173
Δ Other Deposits (t-1)	0.049	0.012	0.047
Observations	497	1650	1395
Groups	4	9	7

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects. The equations include the same controls used in the time series IV estimation

Source: Authors` calculations.

4. Conclusions

In this paper we make use of three detailed micro-datasets to understand the determinants of the dynamics of the *ir* in Chile, which allows us to evaluate in detail the role of open market operations and private deposits. Regarding monetary policy, we consider discretionary operations that provide liquidity (repos) and those that reduce it (liquidity deposits), and non-discretionary instruments (permanent credit facilities). Also, the estimations control for calendar effects, which are quite relevant in explaining the dynamics of the *ir*.

In general terms, the main findings show the effectiveness of open market operations in terms to get the *ir* closer to the *mpr*. This is especially valid to discretionary operations. In fact, the point estimates of the coefficients related to drainages and injections are statistically and economically significant. Indeed, the average draining operation increases the *ir* approximately 3.4 bps, while the opposite operation reduces the *ir* around 1.7 bps. The asymmetries detected suggest that such effectiveness depends on the liquidity status at market level. Specifically, open market operations seem to be more effective when the market is illiquid –i.e., *ir*>*mpr*. Moreover, in this line of results, the estimates suggest that the pass trough from *mpr* to *ir* is close to 1 when the *ir* is above the *mpr*. Conversely, if the *ir* is below the *mpr*, the coefficient of pass trough is near to 0.15.

The role of asymmetries of monetary operations is reinforced by the panel estimates. In general, the panel's point estimates of open market operations are significant higher than the time series estimates –for instance, the magnitude of the drainage effect is also 10 times the effect estimated in the time series– which indicates that the effectiveness and access to central bank's instruments is quite heterogeneous across banks. The estimates by category of bank -large and medium- show that part of this heterogeneity is captured trough this classification, where the open market operations are less relevant to large banks (the more liquid ones), and more relevant for small-sized banks.

The results on PF deposits indicate that they are statistically significant with a relative high coefficient –specially, long-run deposits- but if we consider the behavior of this variable during the sample period, their economic relevance is limited. In fact, the statistical tests oriented to evaluate the relevance of potential explanatory variables suggest that bank's deposits do not significantly help to improve the econometric specifications of the *ir*. Traditional information criteria statistics tilt towards a specification based on calendar effects and open market operations as controls. Nonetheless, from a financial stability perspective, the PF deposits could be quite relevant on the dynamics of the *ir*, because PF accounts for approximately 20% of total bank deposits. In other words, even though the PF's deposits did not play an important role on the dynamics of the *ir* during the sample period, if these investors rebalance their portfolios abruptly against banks' deposits, the effects on the interbank market could have a systemic impact.

Finally, the calendar effects are both statistical and economic significant. For instance, the day of payment of the value-added-tax is associated with an increase of the *ir* equal to 2 bps. This kind of result is relatively standard in the literature, and even though market practitioners could be habituated to them, they are puzzling. On one hand, these calendar effects are totally predictable -for instance, they are not doubts about when the taxes are paid- and, if we assume perfect markets, the *ir* should internalize such effects on its pricing. This line of reasoning opens important questions about the frictions that could be behind the calendar effects' incidence.

References

Allen, F. and D. Gale (2000). "Asset Price Bubbles and Monetary Policy." Working Papers 01-26, Center for Financial Institutions, Wharton School Center for Financial Institutions, University of Pennsylvania.

Angenili, P. (2002). "Liquidity Announcement Effects in the Euro Area." Paper 451, Banca D`Italia.

Balduzzi, P., G. Bertola, and S. Foresi (1997). "A Model of Target Changes and the Term Structure of Interest Rates." *Journal of Monetary Economics* 39, 223-49.

Bartolini, L., B. Giusepe, and A. Prati (2002). "Day-to-Day Monetary Policy and the Volatility of the Federal Funds Interest Rate." *Journal of Money, Credit and Banking* 34, 137-159.

Balduzzi, P., G. Bertola, S. Foresi, and L. Klapper (1998). "Interest Rate Targeting and the Dynamics of Short-term Rates." *Journal of Money, Credit, and Banking* 30, 26-50.

Cocco J., F. Gomes, and N. Martins (2009). "Lending Relationships in the Interbank Market." *Journal of Financial Intermediation* 18, 24-48.

Cowan, K. D. Rappaport and J. Selaive (2006). "High Frequency Dynamics of the Nominal Exchange Rate in Chile." Working Paper 433, Central Bank of Chile.

Elliott, G., T. Rothenberg, and J. Stock (1996). "Efficient tests for an autoregressive unit root." *Econometrica* 64, 813-836.

Freixas, X. B. Parigi and J-C. Rochet (2000). "Systematic Risk, Interbank Relations, and Liquidity Provisions by The Central Bank." *Journal of Money, Credit and Banking* 32(3), 611-638

Gaspar, V. G. Quiroz and H. Medizabal (2004). "Interest Rate Determination in the Interbank Market." Working Paper 351. European Central Bank.

Hamilton J. (1996). "The Daily Market for Fed Funds". *Journal of Political Economy*, 26-56.

Hamilton, J. and O. Jorda (2002). "A Model For The Federal Fund Target" Department of Economics 99-07, California Davis - Department of Economics.

Hausmann, J. A. (1978). "Specification Tests in Econometrics." Econometrica 46, 1251 - 1271

Ho, T. and A. Saunders (1985). "A Micro Model of the Federal Funds Market." *The Journal of Finance* 3, 977-988.

Jara A. and D. Oda (2007). "¿Cómo Agrupar Las Instituciones Bancarias?: Un Aplicación de Análisis de Clusters." Informe de Estabilidad Financiera, Primer Semestre 2007, Banco Central de Chile.

King, T. (2004). "Discipline and Liquidity in the Market for Federal Funds." Working Paper 2003-02, Federal Reserve Bank of St. Louis.

Linzert and Schmidt (2008). "What Explains the Spread Between the Euro Overnight Spread and the ECB´s Policy Rate?". Working Paper 983, European Central Bank.

Nautz D. and C. Offermanns (2006). "The Dynamics Relationship between the Euro Overnight Rate, the ECB's Policy Rate and the Term Spread." Discussion Paper, Series 1: Economic Studies, 01/2006. Deutsche Bundesbank.

Prati A., L. Bartolini and G. Bertola (2003). "The Overnight Interbank Market: Evidence from G-7 and the Euro Zone." *Journal of Banking and Finance*, 27, 2045-2083.

Raddatz, C. and S. Schmukler (2008). "Pension Funds and Capital Market Development: How Much Bang for the Buck?" Manuscript, World Bank.

Sarno L. and D. Thornton (2002). "The Dynamics relationship Between the Federal Funds Rate and the Treasury Bill Rate: An Empirical Investigation." Working Paper, 2000-032C. Federal Reserve Bank of St. Louis.

Spindt, P., and R. J. Hofmeister (1988). "The Micromechanics of the Federal Funds Market: Implications for Day-of-the-Week Effects in Funds Rate Variability." *Journal of Financial and Quantitative Analysis* 23(4), 401-416.

Taylor, J. and J. Williams (2008). "A Black Swan in the Money Market." Manuscript.

Appendix 1: Managing the *ir* in Chile

The Central Bank applies its monetary policy through the definition of a target level for the interbank rate (*ir*) known as the monetary policy rate (*mpr*). To ensure that the *ir* remains close to the *mpr*, the Central Bank must regulate the financial system's liquidity (or reserves) through the use of several instruments: open market transactions, buying and selling of short-term promissory notes, lines of credit and liquidity deposits.

Open market transactions are essentially carried out through regular auctions of promissory notes issued by the Central Bank: short-term nominal discount promissory notes (PDBC), and nominal and indexed promissory notes (BCP and BCU). Banks, financial institutions administering PF, insurance companies and mutual funds can participate in these tenders' auctions. The bidding of promissory notes is carried out using the single price per auction method, that is, a cut-off rate is applied to all participants in the auction placing winning bids, in what is known as the "Dutch method". This encourages competition among auction participants and tends to reflect current market conditions more accurately.

In the case of the (average) *ir* deviates from the policy rate due, for instance as a result of liquidity levels below demand from the banking system, liquidity is injected to lower the *ir* rate and bring it closer to the *mpr*. This liquidity injection is generally achieved by overnight purchases of notes with repurchase clauses (repos). When the opposite occurs, and there is excess liquidity and the *ir* tends to be below the *mpr*, the excess is withdrawn by selling short term promissory notes.

Additionally, starting on January 2005, the Central Bank implemented permanent credit (deposit) facilities which are intended to avoid the *ir* surpasses (be below) the *mpr* by more (less) than 25 basis points. In this context, the implementation of open market operations followed common practices of developed economies' central banks (US, Canada, Europe, among many others).

The Central Bank uses permanent liquidity credit lines to provide financial institutions with overnight loans. This account requires collateral, instruments authorized in the Compendium of Financial Norms. It does not have quantitative limits, except for the availability of collateral of the applicant. Currently, the received interest rate is set at 25 basis points above the *mpr*.

Similarly, permanent liquidity deposits allow financial institutions to deposit temporary excess liquidity overnight with the Central Bank and receive a minimum return. Currently, this rate is set at 25 basis points below the *mpr* and in practice this constitutes the floor of the *ir*.

In order to regulate adequately financial system liquidity, the Central Bank develops a cash flow program around the reserve requirement time period, that is, from day nine of each month though day eight of the following month. To encourage less volatility in the banks' reserve requirement compliance and thus the *ir*, there is also an intermediate reserve requirement on day 23 of each month, the deadline by which the banks must have complied with at least 90% of the required reserve.

To program cash flow, projections are made for both supply and demand of bank reserves that is bills and coins in the power of banks and balances in banks' current accounts in the Central Bank. Demand is of a derived nature that basically depends on reserve requirement rates and trends forecast for demand and term deposits, along with the behavior of currency in the public's hands. The supply of bank reserves depends on the behavior of currency in the public's hands and from the main sources of emission, particularly the maturities of previously auctioned promissory notes and other, more autonomous sources of monetary expansion for which projections are required. These operations include eventual purchases or sales of dollars within the financial system by the Central Bank and State financial operations having monetary effects.

Once the supply and demand for bank reserves have been determined, the amount of notes to be tendered by the Central Bank is established. The calendar of auctions is published the day before each new reserve period begins. The liquidity projection for the next four weeks is monitored daily to permit fine tuning operations on bank reserves, as needed, using the repo operations already mentioned or special sales of short-term promissory notes. Worth to mention that the mechanism to provide and dried out liquidity from banks described above is quite similar -with particularities in the implementation that may be crucial in the modeling strategy- in other economies.

Appendix 2: Unit Root Test

Table A1

Persistence, Unit Root and Co-integration Tests

	Target rate		**Interbank Rate**		**Residual**	
Half-Life	Not Defined		345.2		1.3	
Unit-Root-tests						
Augmented Dickey - Fuller	-0.314		-0.409		-4.733	***
Phillips - Perron (Z_t)	-0.379		-0.863		-11.306	***
DF - GLS	1.675		0.31		-3.993	***
KPSS	7.95	***	8.15	***	0.884	***

Note: Except for KPSS, all the tests have as null hypothesis the non-stationarity of the series. * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix 3: OLS Estimation (Baseline Time-Series Model)

Table A2

OLS Estimations

Dependent Variable: Δir_t

May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
ir (t-1)	-0.343 ***	-0.285 ***	-0.281 ***	-0.272 ***
	[0.040]	[0.044]	[0.044]	[0.040]
mpr (t-1)	0.343 ***	0.285 ***	0.281 ***	0.271 **
	[0.041]	[0.045]	[0.044]	[0.040]
Δ *mpr*	0.217 **	0.158	0.154	0.134
	[0.099]	[0.107]	[0.109]	[0.115]
Δ *ir* (t-1)	-0.094 ***	-0.066 *	-0.065 *	-0.084 *
	[0.035]	[0.037]	[0.037]	[0.036]
Δ *mpr* (t-1)	0.232 *	0.268 *	0.277 *	0.233
	[0.129]	[0.142]	[0.146]	[0.149]
Calendar Effects				
MP Meeting day	0.021	0.031 **	0.032 **	0.033 **
	[0.014]	[0.014]	[0.014]	[0.014]
VAT Payoff day	0.025 **	0.025 **	0.023 **	0.021 *
	[0.011]	[0.011]	[0.011]	[0.012]
Pre- End of Maintenance Period	-0.007	-0.007	-0.005	-0.005
	[0.006]	[0.006]	[0.006]	[0.006]
Post- End of Maintenance Period	0.027 ***	0.015 *	0.012	0.013
	[0.009]	[0.008]	[0.009]	[0.009]
Central Bank's Open Market Operations				
Δ Injections		-0.054 ***	-0.058 ***	-0.057 ***
		[0.015]	[0.015]	[0.015]
Δ Injections (t-1)		-0.005	-0.010	-0.011
		[0.014]	[0.014]	[0.014]
Δ Draining		0.017	0.014	0.013
		[0.014]	[0.014]	[0.014]
Δ Draininng (t-1)		0.006	0.006	0.005
		[0.013]	[0.012]	[0.012]
Δ Mandatory Reserve Requirement		0.014	0.017	0.018
		[0.020]	[0.019]	[0.019]
Δ Mandatory Reserve Requirement (t-1)		0.063 ***	0.067 ***	0.067 ***
		[0.019]	[0.019]	[0.019]
Δ Net Permanent Facilities		0.110 ***	0.112 ***	0.113 ***
		[0.018]	[0.018]	[0.017]
Δ Net Permanent Facilities (t-1)		0.033 *	0.033 *	0.036 **
		[0.018]	[0.018]	[0.017]

Table A2 (cont.)

OLS Estimations

Dependent Variable: Δir_t

May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
Private Investors Depositors				
Δ Other Investors' Deposits			-0.018	-0.014
			[0.019]	[0.019]
Δ Other Investors' Deposits (t-1)			-0.007	-0.005
			[0.015]	[0.015]
Δ Short-Run Pension Funds Deposits			0.089	0.084
			[0.067]	[0.067]
Δ Short-Run Pension Funds Deposits (t-1)			-0.051	-0.057
			[0.051]	[0.051]
Δ Long-Run Pension Funds Deposits			0.107	0.109
			[0.081]	[0.080]
Δ Long-Run Pension Funds Deposits (t-1)			-0.125 **	-0.119 *
			[0.062]	[0.062]
Other External & Domestic Variables				
Forward IR - MPR				-0.016
				[0.052]
Forward IR - MPR (t-1)				-0.067
				[0.056]
Libor-Ois				0.087
				[0.160]
Libor-Ois (t-1)				-0.108
				[0.149]
VIX				0.001
				[0.052]
VIX (t-1)				0.009
				[0.052]
Observations	804	804	804	804
Akaike Information Criterion	-2068.3	**-2184.6**	-2181.6	-2178.5
Bayesian Information Criterion	-2021.4	**-2100.2**	-2069.1	-2037.8
R-squared	0.3	0.41	0.42	0.42

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Appendix 4: Full Tables

Table A3 (Extended Table 4)

IV Estimations; Dependent Variable: Δir_t

Sample Period: May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
ir (t-1)	-0.342 ***	-0.299 ***	-0.295 ***	-0.286 ***
	[0.041]	[0.045]	[0.043]	[0.042]
mpr (t-1)	0.343 ***	0.299 ***	0.295 ***	0.286 ***
	[0.041]	[0.045]	[0.043]	[0.043]
Δ *mpr*	0.215 **	0.179	0.175	0.142
	[0.099]	[0.109]	[0.109]	[0.116]
Δ *ir* (t-1)	-0.092 ***	0.032	0.026	0.031
	[0.035]	[0.065]	[0.067]	[0.069]
Δ *mpr* (t-1)	0.230 *	0.251 **	0.261 **	0.223 *
	[0.129]	[0.119]	[0.123]	[0.127]
Calendar Effects				
MP Meeting day	0.021	0.03 **	0.032 **	0.034 **
	[0.014]	[0.015]	[0.015]	[0.015]
VAT Payoff day	0.026 **	0.02 *	0.018	0.015
	[0.012]	[0.012]	[0.012]	[0.013]
Pre- End of Maintenance Period	-0.006	-0.004	-0.003	-0.003
	[0.006]	[0.006]	[0.006]	[0.006]
Post- End of Maintenance Period	0.028 ***	0.03 ***	0.027 **	0.028 **
	[0.009]	[0.011]	[0.011]	[0.011]
Central Bank's Open Market Operations				
Δ Injections		-0.057 ***	-0.061 ***	-0.062 ***
		[0.017]	[0.017]	[0.017]
Δ Injections (t-1)		-0.003	-0.007	-0.007
		[0.014]	[0.014]	[0.014]
Δ Draining		0.014	0.011	0.007
		[0.030]	[0.031]	[0.031]
Δ Draininng (t-1)		0.056 **	0.054 **	0.059 **
		[0.026]	[0.026]	[0.026]
Δ Mandatory Reserve Requirement		0.011	0.015	0.011
		[0.030]	[0.029]	[0.029]
Δ Mandatory Reserve Requirement (t-1)		0.111 **	0.112 ***	0.116 ***
		[0.028]	[0.028]	[0.028]
Δ Net Permanent Facilities		0.102 *	0.103 *	0.111 **
		[0.058]	[0.057]	[0.056]
Δ Net Permanent Facilities (t-1)		-0.091	-0.083	-0.095
		[0.055]	[0.057]	[0.058]

Table A3 (cont.)

IV Estimations; Dependent Variable: Δir_t

Sample Period: May 2005 – Aug 2008

	[1]	[2]	[3]	[4]
Private Investors Depositors				
Δ Other Investors' Deposits			-0.008	-0.004
			[0.020]	[0.020]
Δ Other Investors' Deposits (t-1)			-0.006	-0.004
			[0.017]	[0.017]
Δ Short-Run Pension Funds Deposits			0.091	0.093
			[0.078]	[0.078]
Δ Short-Run Pension Funds Deposits (t-1)			-0.112 *	-0.123 *
			[0.068]	[0.069]
Δ Long-Run Pension Funds Deposits			0.110	0.118
			[0.088]	[0.089]
Δ Long-Run Pension Funds Deposits (t-1)			-0.142 *	-0.141 *
			[0.079]	[0.080]
Other External & Domestic Variables				
Forward IR - MPR				-0.043
				[0.048]
Forward IR - MPR (t-1)				-0.030
				[0.042]
Libor-Ois				0.027
				[0.058]
Libor-Ois (t-1)				-0.022
				[0.059]
VIX				0.017
				[0.181]
VIX (t-1)				-0.044
				[0.177]
Observations	795	795	795	795
Akaike Information Criterion	-2037.7	**-2069.4**	-2062.9	-2055.6
Bayesian Information Criterion	**-1991.0**	-1985.4	-1950.9	-1915.6
R-squared	0.33	0.37	0.37	0.37

Note: Robust standard error in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%

Table A4 (Extended Table 6)

Testing Asymmetric Coefficients

Dependent Variable: Δir_{it} ; Sample Period: June 2006 to August 2008

	[1]	[2]	[3]
	Illiquid Market	**Liquid Market**	
	$ir > mpr$	$ir < mpr$	**Chi2**
ir (t-1)	0.462 ***	0.324 ***	[2.31]
	[0.074]	[0.063]***	
mpr (t-1)	-0.455 ***	-0.329 ***	[2.80] *
	[0.073]	[0.064]***	
Δ mpr	1.050 ***	0.130	[19.89] ***
	[0.191]	[0.093]	
Δ ir (t-1)	-0.086	-0.067	[0.07]
	[0.075]	[0.083]	
Δ mpr (t-1)	0.488 ***	0.198	[1.43]
	[0.142]	[0.191]	
Central Bank's Open Market Operations			
Δ Injections	-0.041 ***	-0.070 **	[0.66]
	[0.014]	[0.035]**	
Δ Injections (t-1)	-0.017	-0.068	[1.18]
	[0.015]	[0.048]	
Δ Draining	-0.024	0.015	[2.00]
	[0.028]	[0.031]	
Δ Draining (t-1)	-0.006	-0.049	[3.25] *
	[0.026]	[0.032]	
Δ Mandatory Bank Reserve Position	0.027	-0.050	[5.48] **
	[0.028]	[0.034]	
Δ Mandatory Bank Reserve Position (t-1)	0.067 **	-0.023	[8.52] ***
	[0.028]	[0.035]	
Private Investors Depositors			
Δ Other Investors' Deposits	-0.025	-0.078	[1.93]
	[0.019]	[0.034]**	
Δ Other Investors' Deposits (t-1)	-0.022	0.017	[0.76]
	[0.017]	[0.042]	
Δ Short-Run PF Deposits	0.118	0.175	[0.35]
	[0.078]	[0.106]	
Δ Short-Run PF Deposits (t-1)	-0.151 **	0.026	[0.09]
	[0.068]	[0.148]	
Δ Long- Run PF Deposits	0.000	0.068	[0.18]
	[0.068]	[0.102]	
Δ Long- Run PF Deposits (t-1)	0.061	0.023	[1.00]
	[0.065]	[0.119]	
Observations	680		

Note: * significant at 10%; ** significant at 5%; *** significant at 1%

Table A5 (Extended Table 7)

Panel IV Estimation, Dependent Variable: Δir_{it}

Sample Period: June 2006 to August 2008

	[1]	[2]	[3]
ir (t-1) - *mpr* (t-1)	-0.542 ***	-0.481 ***	-0.479 ***
	[0.024]	[0.024]	[0.024]
Δ *mpr*	0.228 ***	0.436 ***	0.437 ***
	[0.041]	[0.069]	[0.069]
Δ *ir* (t-1)	-0.058 ***	-0.058 **	-0.059 **
	[0.016]	[0.027]	[0.027]
Δ *mpr* (t-1)	0.161 ***	0.417 ***	0.417 ***
	[0.060]	[0.056]	[0.056]
Calendar Effects			
MP Meeting day	-0.010 *	-0.018 ***	-0.017 ***
	[0.005]	[0.006]	[0.006]
VAT Payoff day	-0.004	-0.001	-0.001
	[0.004]	[0.005]	[0.006]
Pre- End of Maintenance Period	-0.009 ***	-0.007 *	-0.007 *
	[0.003]	[0.004]	[0.003]
Post- End of Maintenance Period	0.026 ***	0.027 ***	0.027 ***
	[0.004]	[0.003]	[0.004]
Dummy Lender Bank	-0.006 **	-0.007 **	-0.007 **
	[0.003]	[0.003]	[0.003]
Central Bank's Open Market Operations			
Δ Injections		-0.184 **	-0.181 **
		[0.084]	[0.086]
Δ Injections (t-1)		0.13	0.135
		[0.086]	[0.086]
Δ Drainage		0.725 **	0.702 **
		[0.319]	[0.328]
Δ Drainage (t-1)		0.679	0.649
		[0.501]	[0.499]
Δ Net Permanent Facilities		-0.541	-0.529
		[0.627]	[0.630]
Δ Net Permanent Facilities (t-1)		0.151	0.219
		[0.915]	[0.915]
Private Investors Depositors			
Δ Overall PFs Deposits			-0.095
			[0.219]
Δ Overall PFs Deposits (t-1)			-0.294
			[0.301]
Δ Other Deposits			0.005
			[0.045]
Δ Other Deposits (t-1)			0.059
			[0.044]
Observations	3804	3085	3085
Groups	22	20	20

Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects.

Table A6 (Extended Table 8)

Testing Asymmetry; Dependent Variable: Δir_{it}

Sample Period: June 2006 to August 2008

	[1] Illiquid Market $ir > mpr$	[2] Liquid Market $ir < mpr$	[3] Chi2
ir (t-1) - mpr (t-1)	-0.547 ***	-0.450 ***	[207.4] ***
	[0.035]	[0.060]	
Δ mpr	0.982 ***	0.074 *	[127.1] ***
	[0.086]	[0.038]	
Δ ir (t-1)	0.001	-0.106 ***	[4.90] **
	[0.030]	[0.041]	
Δ mpr (t-1)	0.083	0.163 *	[4.52] **
	[0.083]	[0.098]	
Central Bank's Open Market Operations			
Δ Injections	-0.096	0.000	[0.19]
	[0.136]	[0.139]	
Δ Injections (t-1)	0.125	-0.119	[0.00]
	[0.098]	[0.179]	
Δ Drainage	0.088	0.765 ***	[2.97] *
	[0.417]	[0.283]	
Δ Drainage (t-1)	0.065	1.709 ***	[4.93] **
	[0.521]	[0.569]	
Private Investors Depositors			
Δ Overall PFs Deposits	0.039	0.400	[0.62]
	[0.241]	[0.440]	
Δ Overall PFs Deposits (t-1)	-0.442	-0.380	[1.55]
	[0.394]	[0.354]	
Δ Other Deposits	0.067	-0.267	[0.91]
	[0.047]	[0.188]	
Δ Other Deposits (t-1)	0.120 **	-0.139	[0.01]
	[0.057]	[0.192]	
Observations		3059	
Groups		20	

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects. The equations include the same controls used in the time series IV estimation

Table A7 (Extended Table 9)

Panel IV Estimation by Type of Bank; Dependent Variable: Δir_{it} ;

Sample Period: June 2006 to August 2008

	Large Banks [1]	Medium Banks [2]	Small Banks [3]
ir (t-1) - *mpr* (t-1)	-0.649 ***	-0.55 ***	-0.486 ***
	[0.080]	[0.034]	[0.038]
Δ *mpr*	0.134	0.197 ***	0.299 ***
	[0.110]	[0.060]	[0.085]
Δ *ir* (t-1)	0.002	-0.047	-0.083 ***
	[0.104]	[0.034]	[0.031]
Δ *mpr* (t-1)	0.185	0.08	0.21 **
	[0.241]	[0.098]	[0.103]
Central Bank's Open Market Operations			
Δ Injections	-0.025	-0.163	-0.266 *
	[0.182]	[0.178]	[0.150]
Δ Injections (t-1)	0.074	0.139	0.212 *
	[0.132]	[0.128]	[0.119]
Δ Drainage	0.294	0.687	1.36 ***
	[0.287]	[0.445]	[0.378]
Δ Drainage (t-1)	-0.439	0.239	0.986
	[1.129]	[0.368]	[0.935]
Private Investors Depositors			
Δ Overall PFs Deposits	-0.224	0.338	0.932
	[0.543]	[0.238]	[1.099]
Δ Overall PFs Deposits (t-1)	-0.347	-0.233	-0.189
	[0.685]	[0.214]	[1.120]
Δ Other Deposits	-0.053	0.042	0.173
	[0.110]	[0.053]	[0.156]
Δ Other Deposits (t-1)	0.049	0.012	0.047
	[0.111]	[0.086]	[0.145]
Observations	497	1650	1395
Groups	4	9	7

Notes: Robust standard errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%. Estimations include individual and monthly fixed effects. The equations include the same controls used in the time series IV estimation

Documentos de Trabajo Banco Central de Chile	Working Papers Central Bank of Chile
NÚMEROS ANTERIORES	PAST ISSUES

La serie de Documentos de Trabajo en versión PDF puede obtenerse gratis en la dirección electrónica: www.bcentral.cl/esp/estpub/estudios/dtbc. Existe la posibilidad de solicitar una copia impresa con un costo de $500 si es dentro de Chile y US$12 si es para fuera de Chile. Las solicitudes se pueden hacer por fax: (56-2) 6702231 o a través de correo electrónico: bcch@bcentral.cl.

Working Papers in PDF format can be downloaded free of charge from: www.bcentral.cl/eng/stdpub/studies/workingpaper. Printed versions can be ordered individually for US$12 per copy (for orders inside Chile the charge is Ch$500.) Orders can be placed by fax: (56-2) 6702231 or e-mail: bcch@bcentral.cl.

DTBC-515 Abril 2009
Sovereign Defaulters: Do International Capital Markets Punish Them?
Miguel Fuentes y Diego Saravia

DTBC-514 Abril 2009
En Búsqueda de un Buen Benchmark Predictivo para la Inflación
Pablo Pincheira y Álvaro García

DTBC-513 Marzo 2009
From Crisis to IMF-Supported Program: Does Democracy Impede the Speed Required by Financial Markets?
Ashoka Mody y Diego Saravia

DTBC-512 Diciembre 2008
A Systemic Approach to Money Demand Modeling
Mauricio Calani, Rodrigo Fuentes y Klaus Schmidt-Hebbel

DTBC-511 Diciembre 2008
Forecasting Inflation in Difficult Times
Juan Díaz y Gustavo Leyva

DTBC-510 Diciembre 2008
Overoptimism, Boom-Bust Cycles, and Monetary Policy in Small Open Economies
Manuel Marfán, Juan Pablo Medina y Claudio Soto

DTBC-509 Diciembre 2008
Monetary Policy Under Uncertainty and Learning: An Overview
Klaus Schmidt-Hebbel y Carl E. Walsh

DTBC-508 Diciembre 2008
Estimación de Var Bayesianos para la Economía Chilena
Patricio Jaramillo