ECONOMÍA CHILENA

Diciembre 2016 volumen 19 N.° 3

El objetivo de ECONOMÍA CHILENA es ayudar a la divulgación de resultados de investigación sobre la economía chilena o temas de importancia para ella, con significativo contenido empírico y/o de relevancia para la conducción de la política económica. Las áreas de mayor interés incluyen macroeconomía, finanzas y desarrollo económico. La revista se edita en la Gerencia de División Estudios del Banco Central de Chile y cuenta con un comité editorial independiente. Todos los artículos son revisados por árbitros anónimos. La revista se publica tres veces al año, en los meses de abril, agosto y diciembre.

ISNN 0717-3830

* El Comité Editorial de ECONOMÍA CHILENA lamenta profundamente el deceso del profesor Rosende el pasado agosto. Nuestras sentidas condolencias a su familia y cercanos.

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RESÚMENES

PROPAGACIÓN DE *SHOCKS* INFLACIONARIOS EN CHILE

Michael Pedersen

Cuando un *shock* golpea a un determinado precio, puede extenderse a otros precios y por tanto mover la inflación total en más que el efecto inicial. Este fenómeno se conoce como propagación de *shock* inflacionario y es el tema del presente artículo. Se argumenta que los modelos VAR bidimensionales que utilizan la descomposición de Cholesky, son apropiados para analizar la propagación cuando el vector de datos incluye el componente afectado por el *shock* inicial y el resto de la canasta del IPC. El análisis empírico con datos de la inflación anual en Chile sugiere que la duración de la propagación ha disminuido en general desde septiembre de 1999, a pesar de que el impacto es mayor para algunas categorías. La propagación es estadísticamente significativa para la mayoría de las categorías incluidas en la canasta de consumo, pero sus efectos son bastante dispersos, lo que convendría tener en cuenta al evaluar opciones de política para responder a procesos de inflación creciente.

UNA NUEVA MEDIDA DE RIESGO DE LIQUIDEZ PARA EL SECTOR BANCARIO CHILENO

Sebastián Becerra / Gregory Claeys / Juan Francisco Martínez

El objetivo de este trabajo es construir una medida apropiada del riesgo de liquidez para los bancos chilenos. Ya existen varias medidas de riesgo de liquidez en la literatura, la mayoría basada en supuestos específicos y en opiniones de expertos. Con el fin de superar los posibles problemas de hacer supuestos discrecionales, y para aprovechar bien la información disponible, proponemos una métrica basada en el comportamiento de los bancos en las operaciones de compra en el mercado abierto chileno. Debido a las particularidades de la implementación de la política monetaria de Chile, se introduce una adaptación de la métrica original. Calculamos el indicador de liquidez a nivel agregado y para una muestra de bancos en un período que incluye la reciente crisis *subprime*. Luego comparamos este indicador con una variedad de medidas estándares propuestas en la literatura. Encontramos que nuestra medida captura razonablemente episodios de crisis de liquidez y, por lo tanto, puede utilizarse como herramienta complementaria para evaluar riesgos sistémicos.

DISPARIDADES REGIONALES DE LA BANCARIZACIÓN EN CHILE. PERÍODO 2001-2012

Virginia Isabel Montaña A. / Luz María Ferrada B.

Si bien Chile el país de América Latina con mayor acceso a servicios financieros, es muy dispar en términos espaciales. Nuestro objetivo es medir niveles de bancarización regional en el período 2001-2012 y evaluar diferencias territoriales. Se considera que la bancarización es un fenómeno multivariado que tiene distintas dimensiones, y se evalúa mediante análisis de varianza y de componentes principales. Los resultados indican brechas regionales relevantes, concentrándose en la Región Metropolitana de Santiago. Pese a ello, se evidencia que las regiones extremas presentan mejor comportamiento, y se perciben regiones con cierta homogeneidad, lo que podría ser útil para el diseño de políticas públicas diferenciadas.

ABSTRACTS

PROPAGATION OF INFLATIONARY SHOCKS IN CHILE

Michael Pedersen

When a specific price is affected by a shock, this may spread to other prices and thus affect the overall inflation rate by more than the initial effect. This phenomenon is known as propagation of inflationary shocks and is the subject investigated in the present paper. It is argued that two-dimensional VAR models, with an imposed Cholesky decomposition, are suitable for the propagation analysis when the data vector includes the component affected by the initial shock and the rest of the CPI basket. The empirical analysis with annual Chilean inflation rates suggests that the duration of propagation has generally diminished after September 1999, even though the impact is higher for a couple of divisions. Propagation is statistically significant for most of the divisions included in the consumer basket, but the effects of propagation are quite disperse, which should be taken into account when evaluating policy options in response to increasing inflation rates.

A NEW LIQUIDITY RISK MEASURE FOR THE CHILEAN BANKING SECTOR

Sebastián Becerra / Gregory Claeys / Juan Francisco Martínez

The objective of this work is to construct an appropriate measure of liquidity risk for Chilean banks. There are already several measures of liquidity risk in the literature. Most of these metrics are based on specific assumptions and expert opinion. In order to overcome the potential problems associated with discretionary assumptions, and to exploit the information available, we propose a metric based on the behavior of banks in the procurement operations Chilean open market. Due to the particularities of the implementation of monetary policy of the Chilean economy, we introduce an adaptation of the original metric. We calculate the liquidity indicator at an aggregate level and for a sample of banks in a period that includes the recent crisis in the sub-prime. After that, we compare this indicator with a variety of standard metrics proposed in the literature. We find that our metric reasonably captures episodes of liquidity crises and therefore can be used as a complementary tool in the assessment of systemic risks.

REGIONAL BANKING USAGE DISPARITIES IN CHILE. PERIOD 2001-2012

Virginia Isabel Montaña A. / Luz María Ferrada B.

Although Chile is the Latin American country where access to financial services is greatest, it is spatially disparate. This study aims to measure regional banking service accessibility over the period 2001-2012 and evaluate territorial differences. Access to banking services is considered a multivariate phenomenon with different dimensions and is evaluated using variance analysis and Principal Component Analysis. Results reveal considerable regional gaps, with access mainly concentrated in the Santiago Metropolitan region. Nevertheless, the extreme regions fare better and a degree of homogeneity is identified in some regions. This information could prove useful for the design of differentiated public policies.

PROPAGATION OF INFLATIONARY SHOCKS IN CHILE

Michael Pedersen*

1. INTRODUCTION

Whenever a shock hits the price of a specific service or good, it may spread to other prices and thus affect the overall inflation rate by more than the initial effect. This phenomenon is referred to as propagation of inflationary shocks. A general analysis of the propagation mechanism improves the understanding of how individual price changes influence the overall consumer price index (CPI) inflation, which is the relevant measure for several inflation targeting central banks, such as the Central Bank of Chile. While the inflationary effect of mainly oil price shocks and, to a lesser extent, food price shocks has been studied at length in the economic literature, central banks should also know possible propagation effects of shocks to other prices, which may be affected by e.g. tax changes or exchange rate shocks. The present study provides a general analysis of the effect of inflationary shocks in Chile and supplies results of how these effects have changed after September 1999, when an inflation targeting regime was implemented with fully flexible exchange rates.

No theoretical models exist on the propagation of inflationary shocks, which seems to be more an empirical issue. In the present study, it is argued that vector autoregressive (VAR) models are useful for studying propagation of inflationary shocks when the shocks are identified by imposing a Cholesky decomposition such that the shock to a specific price has a contemporaneous effect on the rest of the prices in the basket, whereas the opposite is not the case. In the present context, these models are referred to as propagation models. Chilean price data are utilized for impulse response analyses of a period prior to the implementation of inflation targeting and fully flexible exchange rate, and another containing data from the subsequent period. The results suggest that, in general, the duration of the propagation is shorter after September 1999, but the impact is higher for a couple of divisions. While the shocks to the prices of most of the divisions included in the consumer basket are statistically significant, the effects are quite disperse among divisions. Particularly, propagation is negative after 1999 for two divisions, meaning that the demand effect is dominating.

* *Economic Research Department, Central Bank of Chile. E-mail: mpederse@bcentral.cl.* *The views and conclusions presented are my own and do not necessarily those of the Central Bank of Chile. I thank an anonymous referee for useful comments.*

Few papers are directly concerned with the propagation of domestic price shocks. The topic has, however, been briefly discussed in the papers of Levin et al. (2004) and Kim and Park (2006), and a more detailed analysis is supplied by Pedersen (2015), who applies a sample of 46 countries to analyze propagation of shocks to food and energy prices. With data spanning the period 1999-2010, he finds that emerging countries are more affected by propagation than advanced ones and that, in general, food price shocks propagate more strongly than do energy price shocks. This is also true in Chile, where the propagation of food price shocks to core prices is more than twice the size of the propagation of energy price shocks.[1]

Although there are few papers concerned directly with the propagation of price changes, several studies are dedicated to the related issues of inflation persistence and pass-through of shocks to international prices. With respect to inflation persistence, Altissimo et al. (2006) report reduced-form estimates in the range of 0.74 to 1.04 for the Eurozone, estimates which fall significantly when allowing for time-variation in the mean. Eurozone estimates for components of the CPI basket indicate that "Miscellaneous goods and services", "Furnishings, household equipment" and "Education" are the most persistent categories, while "Transportation," "Alcoholic beverages, tobacco and narcotics" and "Recreation and culture" are the least persistent. "Clothing and footwear" has negative persistence. Concerning the Chilean economy, studies related to inflation persistence include Agénor and Bayraktar (2003), Céspedes and Soto (2006), De Gregorio (2007), and Pincheira (2009). The first two estimate neoclassical Phillips curves and they find that, with the specifications applied, the coefficient of the lagged inflation rate is 0.52 and 0.45, respectively. Estimating an AR(1) process for the difference between the inflation rate and the target of the central bank, De Gregorio (2007) finds that the coefficient for the first lag is 0.82. Pincheira (2009) evaluates the dynamic of the inflation persistence estimating AR models for different periods. He finds that the persistence of the Chilean inflation increased importantly in the middle of 2007 but tended to decrease again toward the last part of the sample, which ends in 2008.

There exists a huge amount of literature on the pass-through of international price changes to national inflation rates. In the case of Chile, mainly three types of pass-through have been investigated: exchange rate variations, oil price changes and changes in international food prices. Fuentes (2007) has studied the pass-through of nominal exchange rate movements to import prices for four developing countries (Argentina, Chile, Colombia and Uruguay). He estimates several models and finds that the pass-through is fast in the short run and complete within one year. In contrast with similar studies, for example that of Frankel et al. (2005), he finds no evidence that exchange rate pass-through has declined over time. García and Restrepo (2003) apply quarterly Chilean data to estimate a price equation based on a model with imperfect competition. They

1 According to International Monetary Fund (2011), food price shocks are likely to have larger second-round effects if inflation is above target and there is excess demand-side pressure in the economy. This is also the case if the central bank's credibility is weak and the share of food in total consumption is high.

find that a devaluation has real effects but they vanish in the long run. When wage indexation is incomplete, the long-run pass-through is much smaller. Finally, a negative output cap compensates the effect of the devaluation on inflation such that a part of this is not passed on to prices in the short run.

The paper of Álvarez, Jaramillo and Selaive (2008) studies the exchange rate pass-through into 40 disaggregated import prices using monthly data. The authors find evidence consistent with the idea that the pass-through is complete in the long run and that it has not been declining. Furthermore, they report relatively weak evidence of asymmetric pass-through for aggregate import indices, while there seems to be some evidence of asymmetries for capital goods and agriculture.

Utilizing a micro approach, Álvarez, Leyva and Selaive (2008) examine the pass-through of exchange rate changes to components and subcomponents of the CPI. Their model is estimated with monthly data from February 1998 to April 2007. Evidence from this study suggests that only food and transportation prices are significantly affected by the pass-through, but with a high degree of heterogeneity among the products. In a recent study, Justel and Sansone (2015) estimate VAR models with data from 1987 to 2013 and find that the average exchange rate pass-through to total CPI is between 0.1 and 0.2 in the medium term. They argue that the pass-through has been lower after the adoption of inflation targeting. Bertinatto and Saravia (2015) argue, however, that the pass-through is asymmetric in Chile.

De Gregorio et al. (2007) augment the traditional Phillips curve to include oil prices and structural breaks for a set of 34 countries, industrialized and emerging. They find clear evidence of decreasing pass-though in industrial economies and to a lesser degree for emerging ones. The difference in the pass-though, however, is smaller when controlling for the countries' oil intensity.[2] The authors also estimate rolling VAR models for a subsample of 12 countries, including Chile. Impulse-response analyses indicate that the effect of oil price shocks on inflation has fallen for most of these economies. Pincheira and García (2007) estimate several VAR and Panel VAR (PVAR) models with data from Chile and a set of nine industrialized countries. Their impulse-response analyses are conducted in models estimated with headline inflation as well as measures excluding particular components. They find that the pass-through in Chile is less than what is supposed in other studies, for example Medina and Soto (2005), but the responses are in general significantly higher than the average response of the industrialized countries considered in the study. In a recent study, Pedersen and Ricaurte (2014) apply a sign restriction approach and find that the source of the oil price shock is important for the impact in Chilean inflation, such that only demand shocks have a lasting significant impact on the price level.

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2 Baumeister et al. (2010) argue that second-round effects are different across oil-importing countries contributing significantly to differences in the overall impact of oil price shocks.

With respect to the pass-through of international food prices,[3] Jalil and Zea (2011) estimate VAR models for five Latin American countries with observations from 2000 to 2010. They find that the full effect of an international food price shock on Chilean headline inflation is felt after a year and that, when controlling for the central bank's reaction, the highest long-run elasticity is found for Chile at 0.81. López et al. (2008) analyze the effects on Chilean inflation of wheat and corn price changes. They find that the half-life of a shock in the international wheat price is 5.2 months, and 7.1 months for corn. These estimates increase significantly when applying models that do not include fundamentals, such as the AR(1) model. A permanent 10% shock in the international prices of wheat and corn has an impact of 0.06 percentage point in the monthly CPI, 0.07 in the CPIX and 0.09 in the CPIX1.[4]

While generally the papers cited above do not directly deal with the issue of propagation of inflationary shocks, they are certainly related. Pass-through studies, however, are concerned with the overall effect of external price shocks, whereas propagation is defined here as the impact that the price of one component of the CPI basket has on the rest of the prices, which, among other things, depends on the persistence of both the component and the rest of the prices. This implies that the pass-through of, say, oil price shocks, has a mechanism, which can be exploited in greater detail when exploring the so-called propagation models which will be utilized in this work.

The rest of the paper is organized as follows: the next section discusses the concept of propagation and introduces an empirical model for analyzing propagation of inflationary shocks. The third section supplies a discussion of the data utilized and the empirical analysis, while the last section offers the conclusions.

II. METHODOLOGY AND MEASUREMENT OF PROPAGATION

After a general discussion of inflation propagation, this section presents the model, which is applied in section III for the empirical analysis of inflation propagation in Chile.

1. Propagation

The propagation mechanism employed in the present analysis is illustrated in figure 1. The inflationary shock to component i may have a direct effect on the rest of the prices in the CPI basket. As an example, consider an oil-price shock, which, via the pass-through mechanism, affects energy prices, say, component

3 Multi-country studies of pass-through of general commodity price shocks include those of Rigobon (2010) and Pistelli and Riquelme (2010).

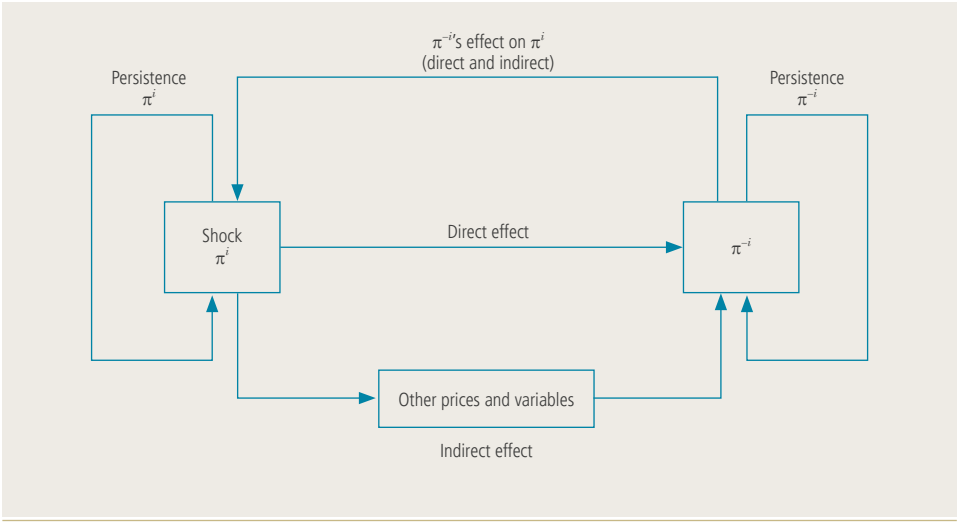
4 CPIX excludes fuels and fresh fruits and vegetables from the CPI, while CPIX1 also excludes fresh meat and fish, regulated utility rates, indexed prices and financial services.

i of the basket. The increased energy prices affect production costs, such that the prices of the final goods increase. This mechanism is referred to as the direct effect in figure 1. On the other hand, increased energy prices may also have an impact on the household budget such that the general demand will decrease putting downward pressure on the prices of goods and services. This mechanism is named the indirect effect in figure 1. The arrow from the inflation of the rest of the basket (π^{-i}) to the inflation of component i (π^{i}) indicates a possible feedback mechanism, which for example could be caused by a cost-push effect. The complete propagation effect is the total effect on π^{-i} of a shock to π^{i} accounting also for the persistence of each of the two components.

Which price shocks could we expect to propagate to other prices? Shocks to prices of items with big weights in the consumer basket are likely to propagate because of their importance in the households' budget. Shocks to low-weight components may, however, also affect other prices if, for example, they are goods or services whose prices are highly visible. For instance, though the item Communication has relatively low weight in the consumer basket, its prices are highly visible to the consumers (e.g. the monthly phone bill) such that a shock to this component could make an impression of general price changes leading to salary increases and, hence, cost-push inflation. In this context, it is important to remember that the analysis in the present paper is made with CPI data, i.e. prices which include amongst other things the salaries paid by firms.

Figure 1

The propagation mechanism



Source: Author's elaboration.

Note: π^{i} refers to the inflation of component i, while π^{-i} is the inflation of the CPI basket excluding component i.

As illustrated in figure 1, in the discussion of propagation it is important to make the distinction from persistence. In the present context, we define persistence as the duration of a shock on the same component that was affected by the shock. On the other hand, propagation is understood as the effect on components other than the one affected by the initial shock. Formally, this can be stated the following ways: Persistence of inflationary shocks: The impact that a shock to price i at time t has on the same price i at time $t+h$ (h=1,2,3,…). Propagation of inflationary shocks: The impact that a shock to price i at time t has on other prices j ($j \neq i$) at time t+h (h=0,1,2,3,…).

The next subsection outlines the propagation model applied in the empirical analysis.

2. The propagation model

To focus the analysis on the propagation, the empirical model includes the two variables of interest, namely inflation of component i and the inflation rate of the remaining of the basket. Hence, the data vector can be summarized as:

$$x_t = \{\pi^{-i}, \pi^i\},$$

where π^i is the inflation rate of component i, and π^{-i} is the rate of inflation of the total CPI excluding component i.

It is assumed that $x_t \sim I(0)$ and that it can be described by a VAR with k lags. To simplify notation, in what follows it is assumed that $k = 1$ and constant terms are omitted. Pre-multiplying the two dimensional VAR in standard form with the matrix B, the following system is obtained:

$$\underbrace{\begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix}}_{B} \underbrace{\begin{bmatrix} \pi_t^{-i} \\ \pi_t^{i} \end{bmatrix}}_{\pi_t} = \underbrace{\begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}}_{\alpha} \underbrace{\begin{bmatrix} \pi_{t-1}^{-i} \\ \pi_{t-1}^{i} \end{bmatrix}}_{\pi_{t-1}} + \underbrace{\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}}_{\varepsilon_t},$$

where α's and β's denote the parameters to be estimated, $\varepsilon_{it} \sim i.i.d(0,\sigma_i^2)$ and $\text{cov}(\varepsilon_1,\varepsilon_2) = 0$. With this notation the errors of the VAR in standard form are:

$$\underbrace{\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}}_{e_t} = \underbrace{\frac{1}{(1-\beta_{12}\beta_{21})}\begin{bmatrix} 1 & -\beta_{12} \\ -\beta_{21} & 1 \end{bmatrix}}_{B^{-1}} \underbrace{\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}}_{\varepsilon_t}.$$

In the interest of measuring the impact that inflation of component i has on the rest of the CPI basket, it is assumed that π^i contemporaneously affects π^{-i} but not vice-versa, i.e. imposing the restriction $\beta_{21} = 0$, which implies that the VAR becomes

$$\begin{bmatrix} \pi_t^{-i} \\ \pi_t^{i} \end{bmatrix} = \underbrace{\begin{bmatrix} \alpha_{11} - \beta_{12}\alpha_{21} & \alpha_{12} - \beta_{12}\alpha_{22} \\ \alpha_{21} & \alpha_{22} \end{bmatrix}}_{A=\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}} \begin{bmatrix} \pi_{t-1}^{-i} \\ \pi_{t-1}^{i} \end{bmatrix} + \underbrace{\begin{bmatrix} \varepsilon_{1t} - \beta_{12}\varepsilon_{2t} \\ \varepsilon_{2t} \end{bmatrix}}_{v_t=\begin{bmatrix} v_{1t} \\ v_{2t} \end{bmatrix}}. \quad (1)$$

From (1) it is evident that an inflationary shock to component i has a contemporaneous effect on the rest of the basket, whereas the opposite is not true. This identification scheme makes the model suitable for analyzing the propagation of inflationary shocks where the object is exactly to evaluate the effect on the rest of the prices from a shock in a particular component.[5]

The covariance of the error terms in (1) is

$$\text{cov}(v_{1t}, v_{2t}) = \text{cov}(\varepsilon_{1t} - \beta_{12}\varepsilon_{2t}, \varepsilon_{2t}) = E[\varepsilon_{1t}\varepsilon_{2t} - \beta_{12}\varepsilon_{2t}\varepsilon_{2t}] = -\beta_{12}\sigma_2^2,$$

such that the initial effect on π^{-i} of a unit shock in π^{i} is equal to the correlation of the residuals in the restricted VAR multiplied by the ratio of the standard deviations of the residuals:

$$\kappa = \left.\frac{\partial \pi_t^{-i}}{\partial \pi_t^{i}}\right|_{t=0} = \text{corr}(v_{1t}, v_{2t})\frac{\sigma_1}{\sigma_2},$$

whereas the impulse-response coefficients are complex nonlinear functions of the underlying model parameters. In the empirical analysis, the coefficient κ is reported as the initial impact of the propagation, i.e. the initial impact of a unit shock.

III. PROPAGATION OF INFLATIONARY SHOCKS IN CHILE

This section analyzes the propagation of inflationary shocks in Chile by applying the propagation model described in the previous section. The focus is on how shocks to the divisions of the consumer price basket affect the rest of the prices. The following subsection contains a description of the data utilized, while the second subsection presents the empirical analysis.

1. Description of data

The analysis is made with data covering the period from April 1989 to July 2015. From 1989 to 2008, the source of the data is Pedersen et al. (2009).[6] The observations and weights in the consumer baskets utilized from January 2009 to July 2015 are extracted from the web page of the Central Bank of Chile.[7]

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5 The empirical results presented in section III are, however, robust to changing the order of the variables and applying the generalized impulse-response approach of Pesaran and Shin (1998).

6 The authors show that, in the overlapping period, there are only small differences between their division's data and those published by Chile's National Statistics Institute (INE).

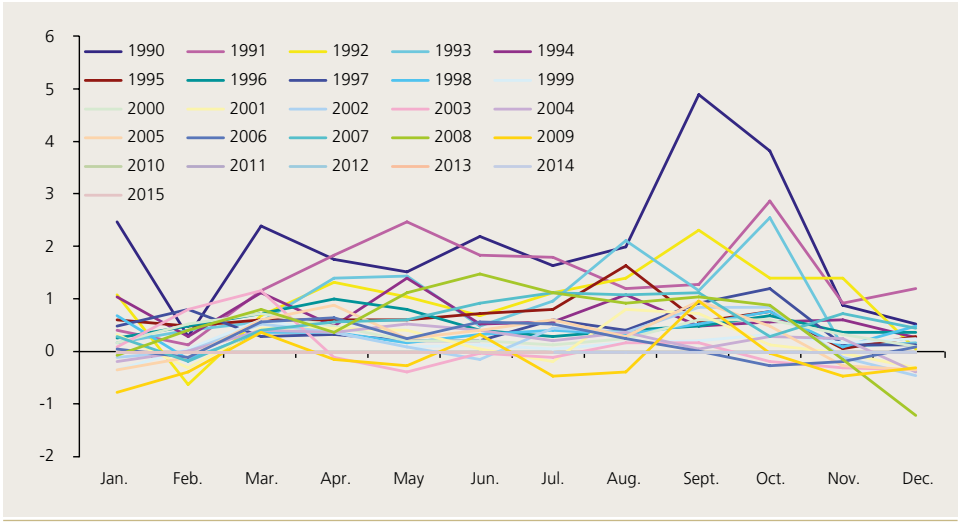
7 Until 2009, the data cover the greater Santiago area and, from January 2010 onwards, the index is compiled with nationwide coverage.

As discussed in the previous section, the analysis of propagation is made by applying impulse-response analyses in models of inflation rates. A natural question, the answer to which is not obvious, is at what frequency these rates should be calculated. One option is to use monthly or quarterly rates, in which case they will most surely be affected by seasonality. Corrections can be made by either using seasonally-adjusted data or including seasonal dummies in the specification. With respect to the first possibility, Maravall (1993) argues that VAR models are not appropriate for modeling seasonally-adjusted series, while Canova (1995) adds that the empirical relevance of this has yet to be demonstrated.

Lütkepohl (2005) notes that using seasonally-adjusted data may lead to impulse-responses quite different from those estimated with unadjusted data. In the present context of analyzing propagation of inflationary shocks, an impulse-response analysis with seasonally-adjusted data may distort the interpretation of the results. This is so because procedures for seasonal adjustment, such as X12-ARIMA, apply two-sided moving averages in the filtering process, implying that the seasonally-adjusted observation for a given month implicitly incorporates information of previous and subsequent months, casting doubts about the interpretation of the error terms as unanticipated shocks.[8]

Figure 2

Monthly CPI inflation rates



Source: National Statistics Institute (INE).

8 Callen and Reynolds (1997) have also employed this argument.

With respect to including seasonal dummies in the model, this relies on the assumption that the seasonal pattern is constant over time. In the period considered in this work, Chile's National Statistics Institute has updated the methodology, and, in particular, the 2008 updating entailed significant changes in the methodology for the compilation of some of the components.[9] For this reason, it is most unlikely that the seasonal patterns have been constant during the period considered in the present work, which is also confirmed by visual inspection of the CPI in figure 2.[10] A pronounced example of the apparent change in seasonality is the October inflation rate, which before 1999 was lower than the September rate only twice, while after 2000 it was lower in 12 of the 15 years examined.

Given the preceding discussion, it was chosen to apply annual inflation rates in the present study, in line with the choice of other authors; for example Pincheira and García (2007). This has also been the choice of studies conducted for other countries, such as that of Lindé (2003). With quarterly Swedish data, he estimates a VAR model and argues that it may be crucial for the empirical analysis to apply annual—rather than quarterly—inflation rates, and as long as inflation is positively autocorrelated, the effects of this choice are small.[11]

The present analysis focuses on the impact of a shock to one component on the rest of the prices in the basket. The inflation rates for the "rest," i.e. the complete basket excluding component i, is calculated as

$$\pi_t^{-i} = 100 * \left(\frac{P_t^{-i}}{P_{t-12}^{-i}} - 1 \right), \quad P_t^{-i} = \frac{P_t - w_{i,t} P_t^i}{1 - w_{i,t}},$$

where P is the aggregate price index, P^i is the price index for component i, P^{-i} is the aggregate index which excludes component i, while $w_{i,t}$ is the weight of component i in the CPI basket.[12]

During the period analyzed, the CPI basket has been changed on four occasions, as shown in table 1, where it can be appreciated that, while the weight of "Food and non-alcoholic beverages" has diminished since 1989, it is still the most important item in the household's budget, followed by "Transport" and "Lodging facilities, electricity, gas and other fuels."

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9 An example is wearing apparel. The compilation of this item included a smoothing parameter up until January 2008, where it was abandoned.

10 Estimations of simple AR(1) models with seasonal dummies reveal substantial changes in the coefficients of the dummies, even when relatively short-time samples are analyzed.

11 The Chilean inflation rates are indeed positively autocorrelated.

12 Pedersen (2009) shows that Chilean inflation rates should be calculated with disaggregated indices, rather than inflation rates, in order to obtain the total CPI.

Table 1

Weights in the total CPI basket

(percentage)

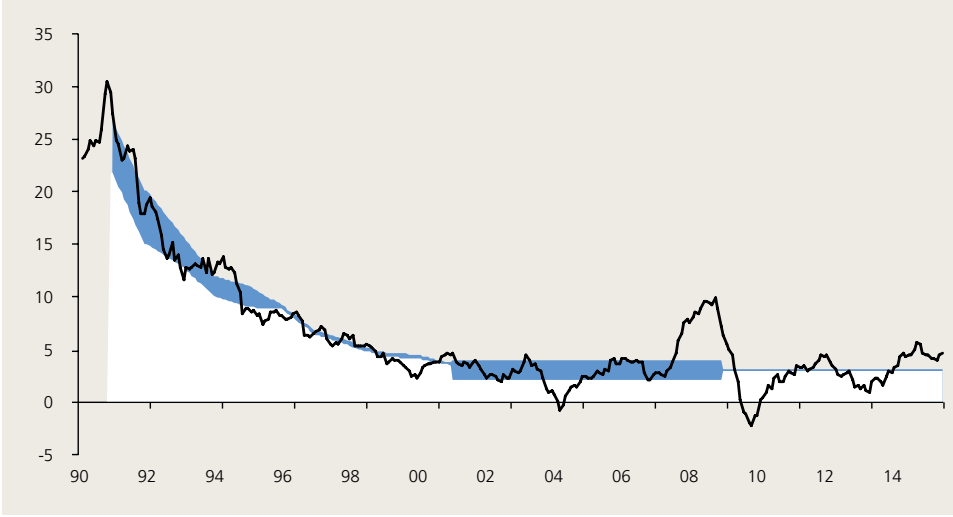
Div.	Name of division	1989	1998	2008	2009	2013
D1	Food and non-alcoholic beverages	28.4	22.2	17.9	18.9	19.1
D2	Alcoholic beverages and tobacco	2.5	2.1	2.1	2	3.3
D3	Clothing and footwear	8.1	7.3	5.1	5.2	4.5
D4	Lodging facilities, electricity, gas and other fuels	16.2	13.7	12.7	13.3	13.8
D5	Furniture, household and household maintenance	7.6	9.5	7.2	7.5	7
D6	Health-care	3.9	6	5.5	5.4	6.4
D7	Transport	15.1	11.7	18.7	19.3	14.5
D8	Communications	1.4	3.1	4	4.7	5
D9	Recreation and culture	5	6.9	9.2	7.5	6.8
D10	Education	3.3	6	6.2	6	8.1
D11	Restaurants and hotels	4.7	4.2	5.9	4.4	4.4
D12	Sundry goods and services	3.8	7.3	5.4	5.8	7.2

Sources: Pedersen et al. (2009) and Central Bank of Chile.
Note: The columns refer to the CPIs with bases April 1989 = 100, December 1998 = 100, December 2008 = 100, average 2009=100, and average 2013 = 100. Names of divisions have changed over time and the ones utilized in the table are current ones.

Figure 3

Annual CPI inflation rates

(percentage)

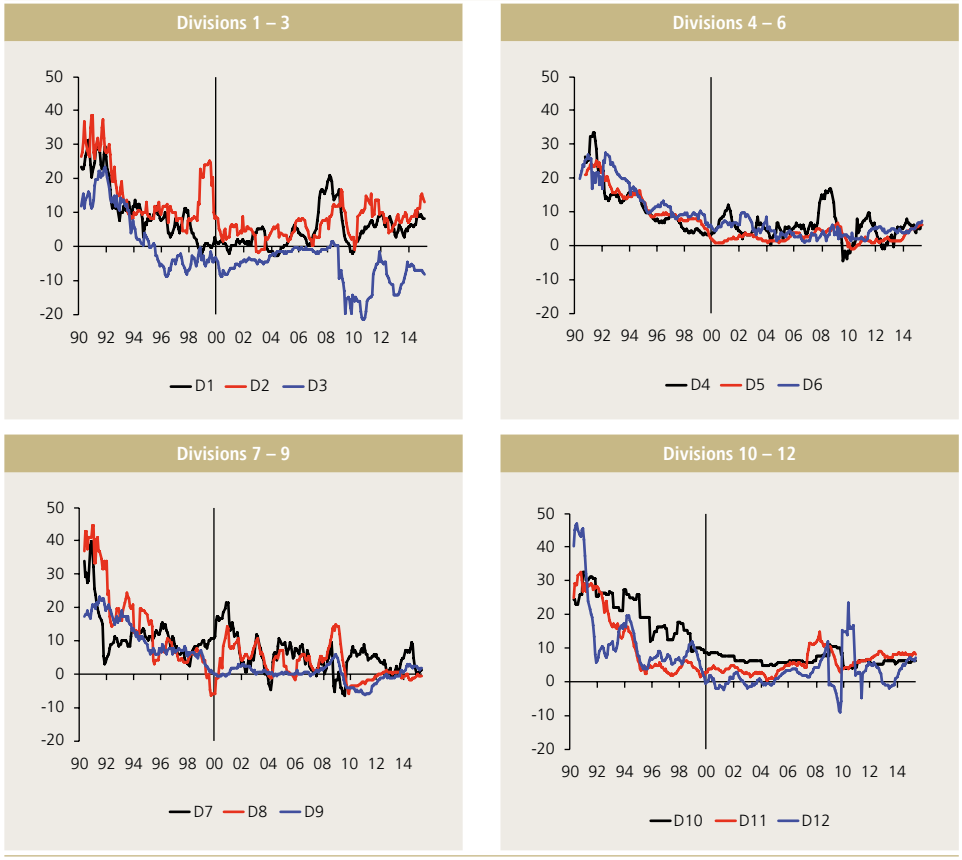


Source: Central Bank of Chile.
Note: Shadows show the inflation target at a given point in time.

Figure 3 presents the aggregate inflation rate, while figure 4 displays the rates of the twelve divisions. In the period analyzed, the Chilean inflation has decreased from an average of close to 11.5% in the 1990s to 3.3% after 2000. This decrease has been generalized across all divisions, but in particular, "Alcoholic beverages and tobacco," "Transport," "Communications" and "Sundry goods and services" posted high inflation rates in the early 1990s. Figure 3 also shows the targets of inflation applied by the Central Bank of Chile during the period under consideration. In the beginning of the period the monetary policy was conducted with a decreasing target, but this has been fixed to 3% in the latter part of the period.

Figure 4

Annual inflation rates by division (percentage)



Sources: Pedersen et al. (2009) and Central Bank of Chile.
Note: The vertical lines indicate September 1999.

Descriptive statistics of the overall inflation rate and those of the divisions are reported in table 2 for the full sample and the two subsamples analyzed in the next subsection. While headline inflation in the period under consideration has oscillated between -2% and 30%, the volatility of the individual divisions was higher with the most volatile ones being "Communications" and "Sundry goods and services." In general, the inflation rate was higher and more volatile during the period before September 1999, where all divisions except "Clothing and footwear" showed two-digit average inflation rates.

The methodology described in section II relies on the fact that the time series are stationary. Unit root tests reveal mixed results with respect to this assumption but, as stated by Pedersen (2015), an assumption of non-stationarity would imply that the propagation of a specific price shock is permanent, which is very unlikely. Hence, the study is conducted under the assumption that inflation rates are stationary, but in some cases very persistent, which turns out to be the case for some divisions in the early part of the period. The assumption of stationary inflation rates in Chile has been employed by several other authors, e.g. Pincheira and García (2007).[13]

Table 2

Descriptive statistics

(percentage)

	Full sample				Apr.90 – Aug.99				Sept.99 – Jul.15			
	μ	σ	Min	Max	μ	σ	Min	Max	μ	σ	Min	Max
CPI	6.4	6.2	-2.3	30.4	11.8	7	3.2	30.4	3.3	2.1	-2.3	9.9
D1	7.2	7.3	-3	31.3	11.5	8.5	-2.6	31.3	4.7	5.1	-3	20.8
D2	10.5	8	-1.8	38.9	16.4	9.2	4.1	38.9	7	4.4	-1.8	24.7
D3	-2.3	8.9	-21.5	23.3	4.3	9.6	-8.9	23.3	-6.2	5.4	-21.5	1.8
D4	7.2	6.5	-5.4	33.5	11.5	7.7	2.3	33.5	4.7	3.9	-5.4	16.4
D5	5.7	6.4	-1.8	24.8	12.4	5.9	2	24.8	1.8	1.6	-1.8	5.8
D6	7.9	6.8	0.2	27	14.9	6.3	5.8	27	3.7	1.9	0.2	9.3
D7	7.2	7	-7.5	39.6	11.4	7.5	1.5	39.6	4.7	5.3	-7.5	20.8
D8	6.9	10.7	-7.4	44.3	15.3	12.4	-2.3	44.3	1.9	4.8	-7.4	14.1
D9	3.5	7	-7.2	22.3	10.9	6.1	0.3	22.3	-0.8	2.4	-7.2	5.1
D10	11	8	3.2	32	20	6.4	8.6	32	5.7	1.5	3.2	10.2
D11	7.6	7.5	-0.3	31.8	12.1	10.2	0.7	31.8	4.9	3	-0.3	14
D12	5.8	9.4	-9.8	46.4	12.7	11.2	3	46.4	1.7	4.6	-9.8	22.5

Source: Author's calculations.

Note: The columns "μ" report the mean, "σ" the standard deviation, and "Min" and "Max" the minimum and maximum values, respectively.

13 The assumption of stationary inflation rates is in accordance with the inflation targeting regime effective in Chile during the period analyzed.

2. Empirical results

In this subsection, Chilean data are applied to evaluate propagation effects in the CPI. The analysis is conducted with data for the full sample (April 1990 to July 2015) as well as subsamples ending and starting, respectively, with the implementation of the inflation target as the monetary policy anchor and fully flexible exchange rates in September 1999. It is important to emphasize that, while changes in propagation to some extent may be attributed to the monetary policy, it is not postulated that this is the only reason since Chile during the last couple of decades has experienced several structural economic changes emphasizing the implementation of the fiscal rule.[14]

For the propagation analysis, twelve VAR models are estimated for each of the samples under consideration. Since the dynamic properties of impulse-responses may depend critically on the chosen lag length (k), the same k is chosen for all the models, $k = 4$, in order to make the results comparable.[15] To eliminate the effect of outliers on the estimated impulse-response functions, blip-dummies were introduced in the models with the purpose of obtaining residuals which are not skewed compared to the Gaussian distribution[16] and are not affected by serial correlation and heteroscedasticity (table A1 in appendix A).

Table 3 reports the main results of the analysis of propagation of inflationary shocks in the twelve divisions of the Chilean CPI, while graphs comparing the responses in the two subsamples are included in appendix B. The first thing to note is that shocks to prices of three of the twelve divisions do not propagate statistically significantly to the rest of the prices in the consumer basket in any of the subsamples. These are "Alcoholic beverages and tobacco" (D2), "Health-care" (D6) and "Sundry goods and services" (D12). "Education" (D10) propagates significantly only in the second subsample, and the effect is only instantaneous in this case.

"Food and non-alcoholic beverages" (D1), the division with the highest weight, propagates positively, and while the effect is higher in the second subsample, the duration of the propagation is longer in the first subsample. When interpreting these results, it should be remembered that the second subsample includes the boom-bust period of commodity prices. The fact that the duration of the effect is shorter in the second period may be attributed to faster monetary policy reactions, though it should be noted that when taking into account the simulated confidence bands, the effect is statistically significantly in only one month, namely 35 months after the shock to the prices of D1. A similar situation

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14 See, for example, Pedersen (2008) for a description.

15 The Bayesian information criteria suggest between one and four lags for models estimated. Kilian (2001) argues that including more lags than suggested by this relatively conservative criterion may result in more accurate impulse response estimates. Estimations of robustness show that the results presented do not change significantly when including up to six lags.

16 Juselius (2006) states that the estimated coefficients of VAR models are more sensitive to non-normality due to skewness than to excess kurtosis.

is observed for D11 "Restaurants and hotels," which to some extent is affected by commodity price swings too. In this case, the effect of propagation is higher than for D1 even though the weight in the consumer basket is substantially lower. A possible explanation is that an important part of the costs of inputs in D11 is wages and, hence, a cost-push shock to the prices in this division may have an impact that is more general to all prices. For D1 the difference in the impacts in the two subsamples is not statistically significantly.

The two divisions that are most affected by changes in international oil prices are "Lodging facilities, electricity, gas and other fuels" (D4) and "Transport" (D7). The duration of the propagation of the shock to D4 is longer in the first subsample and the impact is higher, statistically significantly so 25 to 45 months after the initial shock. On the other hand, a shock to the prices of D7 does not propagate statistically significantly the first period, while the impact in the second sample is positive. A possible explanation may be the increasing weight of this division in the consumer basket, even though it decreased with the latest revision. In any case, the simulated confidence intervals indicate that the effects in the two subsamples are not statistically significantly different.

"Clothing and footwear" (D3) and "Furniture, household and household maintenance" (D5) include imported goods and are to some degree affected by exchange rate movements, D3 more than D5. For both divisions the propagation was positive in the first period and non-significant in the second, except for a negative instantaneous impact for D3, the only moment where the impact is significantly different in the two subsamples. The fact that the propagation is not statistically significant in the second subsample may be ascribed to the change of the monetary policy and for D5 the difference is significant in months 2-3 and 22-43 after the shock.

Finally, two divisions have positive propagation the first period and negative the second; "Communication" (D8) and "Recreation and culture" (D9), i.e. the demand effect dominates the second period. The importance of these two divisions increased considerably during the period analyzed from a total consumption weight of 6.4% to 11.8%, which may be part of the explanation for this phenomenon.

Why do some shocks propagate more than others do? The fact that the three divisions with weights higher than ten percent experience positive propagation and the four divisions for which propagation is not statistically significant have relatively small weights in the CPI basket could suggest a relation between the CPI weight and propagation. On the other hand, the divisions with the highest degree of propagation (D5 and D11) have relatively small weights suggesting that this is not the case. This is supported by regressions of the weights on the maximum impact yielding non-statistically significant slopes. Hence, CPI weights may be part of the explication, but other factors such as visibility of prices and labor insensitivity in the production process may play a role as well. The important issue of determining which factors explain the propagation of an inflationary shock would probably require an analysis with more disaggregated data than those applied in the present analysis. This topic is left to future research.

Table 3

Propagation of unit shocks to D1 - D12

	Effect in the months indicated (percentage points)					Months with significant effect		
	0	3	6	12	24	Max	First	Last
				D1				
Full sample	**0.06**	**0.15**	**0.18**	**0.18**	**0.16**	**0.18** (8)	0	36
90:4 – 99:8	**0.09**	0.09	**0.13**	**0.16**	**0.14**	**0.16** (11)	4[a]	53
99:9 – 15:7	0.03	**0.24**	**0.33**	0.19	-0.04	**0.34** (5)	3	11
				D2				
Full sample	0.00	0.04	0.01	-0.02	-0.05	-0.06 (35)		
90:4 – 99:8	0.01	0.03	-0.01	-0.04	-0.10	-0.43 (120)		
99:9 – 15:7	-0.01	0.05	0.05	0.00	-0.03	0.05 (4)		
				D3				
Full sample	0.06	**0.15**	**0.16**	**0.15**	**0.13**	**0.16** (6)	1	54
90:4 – 99:8	**0.14**	**0.16**	**0.16**	**0.15**	**0.12**	**0.16** (4)	3[a]	37
99:9 – 15:7	**-0.05**	0.03	0.07	0.06	0.01	0.08 (7)	0	0
				D4				
Full sample	**0.14**	**0.22**	**0.32**	**0.41**	**0.36**	**0.42** (14)	0	72
90:4 – 99:8	**0.17**	0.13	**0.32**	**0.55**	**0.49**	**0.55** (12)	4	49
99:9 – 15:7	**0.10**	**0.23**	**0.33**	**0.33**	0.05	**0.36** (9)	0	18
				D5				
Full sample	0.03	**0.74**	**0.93**	**0.81**	**0.59**	**0.93** (6)	2	61
90:4 – 99:8	0.13	**1.10**	**1.05**	**0.82**	**0.66**	**1.16** (4)	1	50
99:9 – 15:7	-0.14	0.10	0.41	0.29	-0.32	0.50 (7)		
				D6				
Full sample	0.03	-0.04	-0.06	-0.08	-0.08	-0.08 (19)		
90:4 – 99:8	0.05	0.02	-0.06	-0.16	-0.22	-0.22 (25)		
99:9 – 15:7	0.00	-0.07	-0.12	-0.14	-0.08	-0.14 (11)		
				D7				
Full sample	**0.05**	**0.08**	**0.08**	0.11	0.12	0.12 (20)	0	3
90:4 – 99:8	0.02	-0.01	-0.01	**0.08**	0.12	0.12 (23)		
99:9 – 15:7	**0.05**	**0.13**	**0.13**	0.04	-0.05	**0.14** (4)	0	6
				D8				
Full sample	0.02	0.02	-0.02	-0.07	-0.09	-0.09 (20)		
90:4 – 99:8	-0.04	0.03	0.10	**0.12**	**0.11**	**0.12** (11)	7	25
99:9 – 15:7	**0.06**	0.01	-0.12	**-0.27**	-0.10	**-0.27** (13)	8[a]	21
				D9				
Full sample	-0.08	-0.08	-0.04	-0.02	-0.01	-0.20 (2)		
90:4 – 99:8	-0.11	0.07	0.19	**0.32**	**0.41**	0.45 (120)	8	51
99:9 – 15:7	-0.04	-0.13	-0.27	-0.48	**-0.44**	**-0.52** (16)	15	30
				D10				
Full sample	-0.05	-0.04	-0.03	-0.01	0.02	-0.05 (4)		
90:4 – 99:8	-0.06	-0.04	-0.05	-0.04	-0.03	-0.06 (0)		
99:9 – 15:7	**0.15**	0.08	0.00	-0.13	-0.07	**0.15** (0)	0	0
				D11				
Full sample	**0.16**	**0.61**	**0.61**	**0.57**	**0.39**	**0.67** (5)	0	35
90:4 – 99:8	**0.13**	**0.58**	**0.49**	**0.41**	**0.30**	**0.59** (4)	0	34
99:9 – 15:7	**0.21**	**0.72**	**0.80**	**0.52**	0.02	**0.80** (5)	0	15
				D12				
Full sample	-0.01	-0.06	-0.01	0.05	0.09	0.09 (26)		
90:4 – 99:8	0.18	-0.05	0.04	0.10	0.11	0.18 (0)		
99:9 – 15:7	-0.07	-0.03	-0.01	-0.02	-0.04	-0.07 (0)		

Source: Author's elaboration.

Note: Bold numbers indicate statistically significant values. The columns "0" to "24" report the responses after 0, 3, etc. months. "Max" is the maximum response in absolute value with the month in parentheses. "First" and "Last" are the first and last months of the longest period with significant responses.
(a) Also significant subsamples before the period indicated.

IV. CONCLUSIONS

The analysis in this paper is concerned with the propagation of inflationary shocks. So far, little research has been concerned with this important issue, while many studies have focused on the related topics of inflation persistence and pass-through effects. It was argued that VAR models of dimension two are suitable for a general analysis of propagation of inflationary shocks. The data vector consists of the component that is affected by the shock (*i*) and the rest of the CPI basket. The shocks are identified by a Cholesky decomposition such that the "rest" component is affected contemporaneously by a shock to component *i*, but not vice-versa.

The empirical analysis was conducted with annual Chilean inflation rates such that seasonal adjustment filters would not affect the results. The results suggest that when analyzing propagation of inflationary shocks, it is important to consider shocks to several prices of the consumer basket and not merely those that are affected by the commodity price shock, which has been the principal focus in the literature on inflationary effects. Furthermore, propagation of shocks is not always positive, since the demand effect dominates when the shock hits prices of some components of the consumer basket. This should be taken into account when evaluating policy options to respond to price shocks.

In general, the results suggest that the duration of inflationary shocks is shorter after 1999, but it is higher for the two divisions that to some extent are affected by shocks to food prices. On the other hand, the propagation impact is lower in the second subsample for the prices mostly affected by oil price shocks. Shocks of prices of divisions containing a great deal of imported goods, and hence are affected by exchange rate shocks, propagate positively to other prices in the first subsample, but not significantly so in the second. Finally, shocks to prices of two divisions, where an important part is services, propagate positively in the first subsample and negatively in the second. The results advocate that appropriate policy actions, as a response to increasing inflation rates, have to begin with a thorough analysis of the origin of the shock in order to evaluate, firstly, which are the prices affected by the original shock and, secondly, given the results of this analysis, what can be expected with respect to possible second-round effects.

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APPENDIX A

CHARACTERISTICS OF THE PROPAGATION MODELS

Table A1

Model specification

	Dummies	Autocorrelation		ARCH(12)		Skewness	
		LM(1)	LM(4)	Eq.1	Eq.2	Eq.1	Eq.2
D1	6, 10, 12, 18, 23, 32, 33, 34, 42, 43, 44, 53, 55, 83, 91, 119, 221, 238, 239.	0.05	0.14	0.06	0.12	0.31	0.06
D2	6, 10, 14, 18, 27, 30, 42, 43, 44, 55, 93, 94, 103, 105, 117, 142, 154, 239, 243.	0.22	0.11	0.06	0.05	0.06	0.3
D3	6, 7, 10, 14, 18, 26, 30, 43, 44, 226, 231, 232, 251, 256, 262.	0.14	0.17	0.05	0.19	0.89	0.14
D4	6, 9, 10, 18, 22, 23, 26, 30, 32 35, 43, 44, 55, 56, 169, 217, 224, 233, 234, 245, 246, 255.	0.54	0.27	0.12	0.05	0.07	0.17
D5	6, 18, 22, 31, 33, 42, 43, 44, 232, 239.	0.37	0.33	0.11	0.08	0.78	0.19
D6	6, 10, 12, 14, 18, 22, 30, 43, 44, 46, 229, 232, 284.	0.05	0.34	0.14	0.11	0.99	0.07
D7	6, 10, 14, 17, 18, 20, 22, 23, 26, 30, 33, 42, 43, 44, 56, 163, 225, 236.	0.74	0.38	0.05	0.06	0.5	0.93
D8	6, 9, 10, 14, 18, 22, 24, 32, 35, 42, 43, 51, 63, 77, 114, 170, 223, 237, 239.	0.09	0.85	0.51	0.07	0.2	0.21
D9	6, 18, 19, 22, 24, 26, 27, 29, 30, 31, 44, 63, 73, 75, 105, 109, 232, 235, 238, 250.	0.83	0.62	0.1	0.06	0.36	0.41
D10	6, 10, 14, 17, 18, 30, 33, 42, 43, 44, 56, 57, 69.	0.73	0.79	0.15	0.06	0.7	0.24
D11	6, 18, 23, 26, 29, 30, 31, 32, 33, 40, 43, 49, 57, 208, 210, 220, 222, 237, 238, 250.	0.82	0.2	0.07	0.06	0.15	0.36
D12	6, 10, 18, 19, 25, 30, 41, 43, 44, 100, 103, 127, 227, 228, 238, 239, 240, 244, 245, 246, 250, 256, 257.	0.07	0.26	0.06	0.13	0.21	0.08

Source: Author´s elaboration.

Note: Di (i = 1,2,…,12) refers to the propagation model for division i. The column "Dummies" reports the dummies included in the model such that the number denotes observations after March 1990. LM(1) and LM(4) are p-values for the multivariate tests of no autocorrelation. ARCH(12) and Skewness report p-values for the univariate tests of no ARCH of order 12 and no skewness in the distribution of the residuals, where Eq. (1) refers to the division reported in column 1 and Eq. (2) to the rest of the consumer basket.

APPENDIX B

IMPULSE-RESPONSES FOR THE TWO SUBSAMPLES WITH THE RESPECTIVE 95% CONFIDENCE BANDS

Figure B1

Responses of CPI- from a unit shock to D1 – D12

(percentage points)

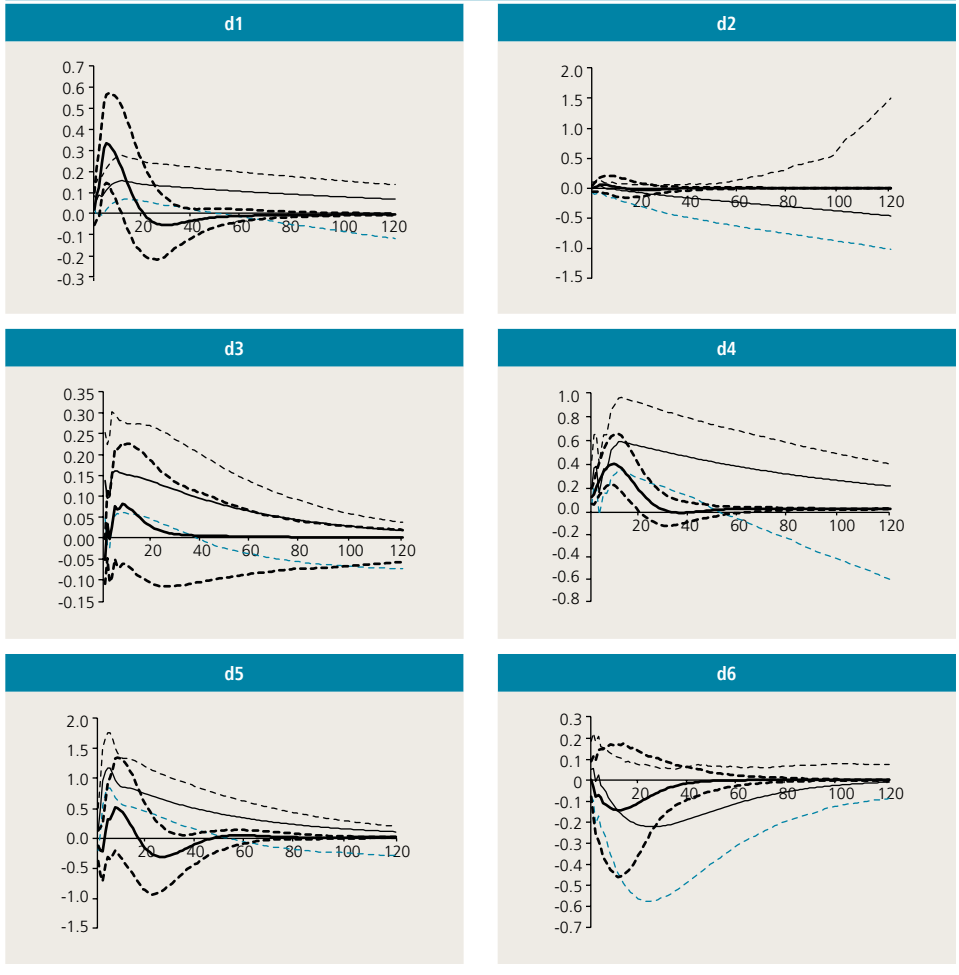
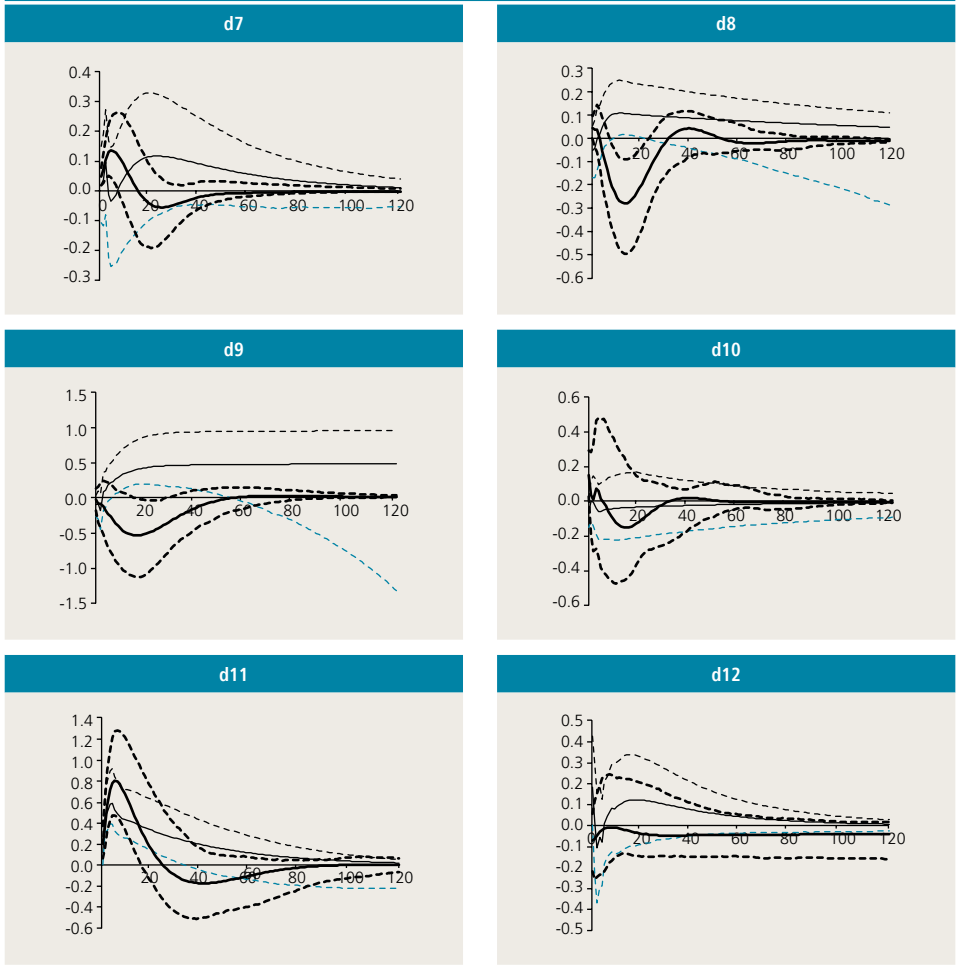


Figure B1 (cont'd)



Source: Author's elaboration.

Note: Thin lines are from the first subsample (April 1990 – August 1999), while thick lines are from the second subsample (September 1999 – July 2015). Dashed lines indicate 95% confidence bands bootstrapped with 2000 replications as described by Hall (1992).

A NEW LIQUIDITY RISK MEASURE FOR THE CHILEAN BANKING SECTOR*

Sebastián Becerra**
Gregory Claeys***
Juan Francisco Martínez****

I. INTRODUCTION

Liquidity risk is inherent to banking activity because of maturity transformation. Long-term assets co-exist with short-term liabilities.

During the last decade, banks all over the world have been heavily reliant on short-term wholesale funding, more on the commercial papers market and less on retail. However, during 2007, in advanced economies, those markets froze when doubt over the quality of their asset/solvency emerged (Schmieder et al., 2012). This reliance on the deep and broad unsecured money market resulted in liquidity challenges for many banks. In spite of the lack of attention to liquidity risks in recent decades (Goodhart, 2008), it has attracted renewed concern since the last turmoil (2007-2008). Before the crisis, international regulatory standards were predominantly focused on credit risk (BIS, 2010).

Liquidity risk metrics are based on different sources of information. Some of them use *balance-sheet* data of banks. This information can be used to measure liquidity risk at bank—and systemic—level as in Federico (2012). For example, within the balance sheet (or other data collected by supervisors) based indicators we can find the liquidity coverage ratio (LCR), the net stable funding ratio (NSFR)—both introduced by Basel III—and the liquidity mismatch index (LMI), by Brunnermeier and Pedersen (2009). Other measures are *market based*, such as the ones proposed by the ECB (2007) and the BoE (2007). These ones are built as a composition of liquidity measures such as bid-ask spreads, return-to-volume ratio and liquidity premia. Finally, in the main interest of our paper, some indicators depend on banks' behavior in the context of monetary policy operations, i.e. how commercial banks' bid schedules behave in open market operations conducted by central banks. In this line, our reference work will be that of Drehmann and Nikolaou (2012). These authors construct a funding

* *We thank Pablo Carvajal Álvarez and Matías Ortiz de Zárate for superb research assistance. We are indebted to Rodrigo Cifuentes, Kevin Cowan and Alejandro Jara for valuable advice. We also thank participants at the Latin-American Financial Network meeting at México City (2013), Jornadas de Economía at the Central Bank of Uruguay (2013) and Central Bank of Chile internal seminar (2014), especially to Andrew Powell, Claudio Raddatz, Matías Bernier, Felipe Musa, Claudia Sotz and an anonymous referee. All errors are ours.*
** *Financial Policy Division, Central Bank of Chile. E-mail: jbecerra@bcentral.cl*
*** *Research on European Macroeconomics, Monetary and Fiscal Policy, Bruegel E-mail: gregory.claeys@bruegel.org*
**** *Financial Policy Division, Central Bank of Chile. E-mail: jmartinez@bcentral.cl*

liquidity risk indicator from banks' asked bid rates and volumes in the main refinancing operations performed by the European Central Bank. Basically, the more liquidity constrained an institution, the higher the spread between a benchmark and their asked rate.

To contribute to growing research on liquidity risk measures, in this paper we adapt a metric for funding liquidity risk—proposed by Drehmann and Nikolaou (2012)—and apply it to the Chilean banking industry. In order to address this task it would be necessary to underline our assessment on the concept of liquidity. As described in Drehmann and Nikolaou (2012), funding liquidity is defined as the ability to settle obligations with immediacy. It is interesting to distinguish it from market liquidity; Brunnermeier and Pedersen (2009) note that market liquidity refers to the ease to sell an asset (therefore asset-specific), and funding liquidity to the ease to access funding (therefore agent-specific). In the previous definition, funding liquidity risk is driven by the probability that over a specific horizon the bank will become unable to settle its obligation with immediacy; therefore, it is forward looking.

We revise different liquidity risk measures —funding and market based— in order to check the ones that better fit the Chilean banking sector given the available information. Looking at their benefits and drawbacks we will build a selection of metrics of liquidity risk.

To replicate some of the measures of liquidity risk for Chile, it is necessary to understand the context and the objective of open market operations (OMOs) conducted by the Central Bank of Chile (CBC).

The CBC's liquidity policy is conducted differently from most of the international central bank policies (in particular the Fed and the European Central Bank, ECB). Unlike the ECB, which injects liquidity every week, the CBC mainly drains liquidity through the sale of short-term notes (PDBC of different maturities) and of long-term bonds (BCP and BCU). This is due to the excess of inflows that is typical of emerging economies. Thus, we need to alter the Drehmann and Nikolaou's *Liquidity Risk Premium* (LRP) indicator. The idea behind this measure is that banks reveal their liquidity risks through their bidding behavior in the OMOs conducted by the monetary authority.

We construct a unique (confidential) database using the OMOs of the CBC. From September 2002 to November 2012, our data contains all the OMO auctions for every bond and note offered by the CBC, including the volumes and asked bid rates by every authorized bank operating in Chile. Using this information, we introduce an adapted LRP indicator for an emerging market liquidity policy, such as that of Chile: the CALRP, or Chilean averaged liquidity risk premium. We show that our metric manages to capture reasonably well the main episodes of liquidity stress of the last decade, especially during the recent financial crisis. Once computed this metric, we test some features about the OMO's bidding behavior of local banks and describe the modified LRP dynamics. Finally, we compare our version of LRP metric (CALRP) against other

—local and international—liquidity risk indicators proposed by the literature, highlighting periods of local policy intervention or changes in regulation. As a robustness check, we also test the relationship between void processes on our CALRP indicator.

The paper is structured as follows. Section II provides a survey of existing measures of liquidity risk. Section III describes the OMO auctions and liquidity facilities performed by the CBC. Section IV presents the liquidity risk premium indicator adapted to the Chilean context. Section V describes the data. Section VI presents the results. Section VII explicates the relation between liquidity and credit. Section VIII presents a comparative analysis and, finally, section IX concludes.

II. A BRIEF SURVEY OF EXISTING MEASURES OF LIQUIDITY RISK

In this section we present different ways of modelling a liquidity risk measure. These alternatives use balance-sheet information (at bank and banking system level), market information, or bank behavior, revealed in the biding behavior in open market operation auctions conducted by central banks. Table 1 describes the liquidity metrics covered in this work.

We concentrate this investigation on a set of liquidity metrics that have been recently issued or applied by advanced and developing economies' financial authorities. In the next section we describe the rationale, construction, strengths and weaknesses of these metrics. Most of them are replicated using Chilean banking system information. However, in the cases of CLF and CALRP we make an effort to adapt these metrics to the Chilean financial system's idiosyncrasies. Additionally, in the analysis section (section VIII), we relate and compare the computed liquidity metrics.

Table 1

Metrics of liquidity

Metric	Sources	Liquidity dimension
Liquidity coverage ratio: LCR	Balance sheet constraints	Funding
LIBOR-OIS spread: LOIS	Global funding markets prices	Funding
Global Financial Liquidity: GFL	Equity and other market spreads	Market
Prime swap spread: PS	Local wholesale funding market prices	Funding
Chilean liquidity financial indicator: CLF	Equity and other market spreads	Market
Chilean averaged liquidity risk premium: CALRP	Monetary policy behavior	Funding

Source: Central Bank of Chile.

1. Balance sheet based indices

At bank level

After the recent global financial crisis (2007-2009), the BIS introduced two liquidity requirements. Based on balance sheet data, these measures provide information at bank level, and then aggregate, for the whole banking sector or cluster. These measures are the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). Both metrics intend to measure the fragility of each bank and of the system to a shock using a stress test based approach.[1]

Another measure is the Liquidity Mismatch Index (LMI) proposed by Brunnermeier et al. (2011). It is based on a weight earmarked to the assets and liabilities depending on their liquidity characteristics, for different stress scenarios. The LMI can give individual and aggregated information, can identify SIFIs and, also, takes into account market and funding liquidity information (similar to the balance sheet indices above).

One of the benefits of this kind of measures is that these can be presented at the bank and aggregate level. Another advantage is that these metrics take into account both market and funding liquidity, where the funding dimension is calculated as a function of the market liquidity of the assets on the balance sheet of each agent. On the other hand, the main drawback of these measures is that they depend on the stress scenario in place, and it is always difficult to assess the severity of shocks with only a few crises in the past.[2] Additionally, balance-sheet based measures are sensitive to the weight and categorization of assets and liabilities; besides the fact that banks' balance-sheet information is hard to read, it changes quickly, and is subject to changes in regulation, accounting standards and window dressing. In conclusion, these indices help to understand the fragility of a bank and the banking industry as whole, but there are reasons to explore other alternatives based on mark-to-market information.

At system level

To capture the banking systemic exposure to liquidity risk, Federico (2012), following a similar methodology to the one introduced by Basel III for the NSFR, constructs a set of indices that measure how vulnerable a banking system is to a sudden drying-up of liquidity in emerging markets. By assigning weights to assets and liabilities according to their liquidity characteristics, a "Cash Shortage" index for every bank in every country used in the sample is built. This is used to build two aggregate metrics, namely the "Coverage of New Lending" and "Impaired New Lending". The author claims that these are valid indicators

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1 In general, CBC instruments constitute an important portion of banks' liquid assets (see tables A4 and A5 in appendix A). There are only a few banks where these represent less than 10% of the volume. For the NSFR and LCR definitions and constructions, see BCBS (2010) and (2013).

2 Nevertheless, we acknowledge that in order to calibrate the parameters it is possible to use international data of similar economies.

since they are robust in explaining output contractions across Latin America's and other developing countries' markets after the Lehman event.

The metric elaborated by Federico (2012) has similar benefits and drawbacks as the previously described balance-sheet based indicator. Additionally, for its construction, as the author points out, depending on the source of information, the metrics need to be corrected for a breakdown of liabilities by currency.

Although this type of indicators are feasible using the Chilean banking system information, we do not generate them, since the supporting literature is still in a preliminary stage of development.

2. Market based indices

Market spreads

Numerous market based liquidity risk measures in the literature are mainly rate spreads. These metrics mainly measure the funding dimension of liquidity. The most commonly used are spreads between overnight interbank market rates and central bank policy rates, such as the Libor-OIS spread (LOIS). These measures are easy to understand and compute, and since daily measures can be obtained, liquidity stress episodes can be quickly revealed. However they are not bank-specific, and it is difficult to disentangle liquidity risk from other risks —like solvency risk—, and they are less easy to build when markets are shallow or in a development phase.

The local Chilean version of the Libor-OIS is the *prime-swap spread* (PS), proposed by Ahumada and Álvarez (2011), which is available for different maturities (90, 180 and 360 days). The information used to build this indicator comes from a survey and a marketed overnight SWAP rate, similar to the Libor-OIS.

Composite indices

Other types of market liquidity metrics use more aggregated data. The ECB (2007) and the BoE (2007) derive, build and propose global financial liquidity (GFL) indicators based on bid-ask spreads, exchange rates, stock returns, return-to-volume ratios, liquidity premia of corporate bonds and interest rate swaps, among others. These indicators are constructed by normalizing the series and adding them up into a composite metric.

In this paper, we replicate the composite metrics GFL and CFL. Although the complete set of market data needed for constructing the indicator could be difficult to obtain for Chile due to shallow markets (compared to the developed economies), we are able to build a local version: the Chilean financial liquidity indicator (CLF). We make some assumptions and use all the information available, to the best of our knowledge.

$$CLF_t = \sum_{i=1}^{n} \frac{C_t^i}{\sigma_T^{Ci}} \tag{1}$$

It can be noticed in the formula that the main assumption is that the components of the index are independently, identically and normally distributed; thus, they are comparable and the resulting liquidity indicator should be also normally distributed. In this case, C_t^i defines the indicator's i^{th} value at time t and T is the number of periods considered to calculate the standard deviation. The number of series considered for the CLF analysis (n) is equal to four, for the GLF is six, and the time period is set to seven years.[3]

The Libor-OIS, PS and the CLF are compared to other proposed liquidity metrics in section (8).

3. Bank behavior based index - Monetary based index

The liquidity risk premium (LRP) indicator introduced by Drehmann and Nikolaou (2012) measures funding liquidity risk using banks' biding behavior in the weekly open market operations of the ECB. As it is difficult to estimate the liquidity risk of a bank, the authors assume that banks have an idea about it and reveal their balance sheet liquidity situation and preferences their transactional behavior during OMOs.

The intuition behind the LRP indicator is that there is a cost in obtaining liquidity from a central bank, and that this cost reflects banks' funding liquidity risk. Accordingly, banks with bigger liquidity problems will be more willing to incur a higher cost of getting liquidity. Along this line of thought, Nyborg and Strebulaev (2004) show that illiquid banks bid more aggressively than liquid ones. In Chile this means that banks would ask for lower prices on the CBC papers and notes.[4]

We also find that the mechanics behind the relationship between banks' liquidity and their bidding behavior at monetary auctions is rather intuitive. Furthermore, as Drehmann and Nikolaou (2012) indicate—apart from mere instinct—that it has been shown theoretically that this relationship exists (Nyborg and Strebulaev, 2004; Valimaki, 2006).

Using data from 175 main refinancing operations (MROs) conducted by the ECB from 2005 to 2008 with information on 1055 banks, Drehmann and Nikolaou (2012) measure the LRP, interpreted as the average insurance premium banks are willing to pay in the OMOs to insure themselves against funding liquidity risk.

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3 For details about the series included, please refer to table 2.

4 It should be noted that the main source of financing for commercial banks in Chile are deposits (over 50%). Thus, metrics that use information from the deposits market —such as the PS spread— would be a direct approach. However, the focus of the present work is the analysis of a source of information that has not yet been explored in the literature for the Chilean case: the demand for CBC papers through the auctions data of the open market operations.

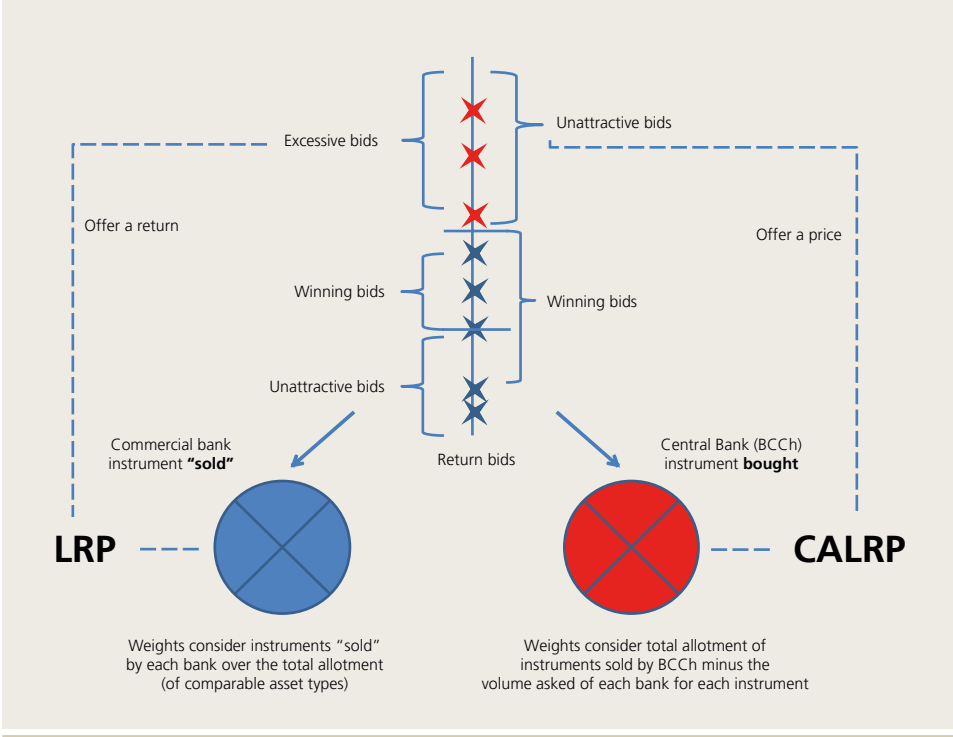
In order to build a Chilean version of the LRP index, we need to use information from the OMOs performed by the CBC. However, its definition must be adapted, since the ECB injects liquidity and the CBC mainly drains it through an auction process managed by the respective central banks.

In figure 1, we can observe the differences between both auction processes and the interpretation of liquidity risk in each of them. In Drehmann and Nikolaou (2012) we observe a direct mechanism. If a commercial bank needs liquidity, this bank will pay a higher return than others in order to get liquidity. On the other hand, in the Chilean case the liquidity risk also is represented by a high spread, but here it means that the liquidity constrained commercial banks are willing to participate in the auctions if and only if they obtain a sufficiently attractive return from the CBC and the offer to buy a lower volume.

Finally, for completeness, in the next section we describe the details about the CBC's liquidity management and how the described CBC instruments' auction processes frame.

Figure 1

Comparison between auction processes



Source: Central Bank of Chile.

III. OPEN MARKET OPERATIONS AND LIQUIDITY FACILITIES OF THE CBC

Open market operations (OMO) are a valuable tool in the implementation of monetary policy, due to their high degree of effectiveness and flexibility. Open market operations generally include, among others, purchase and sale of securities, repurchase (Repo), liquidity deposits (which replaced the anti-repo) and currency swaps. These operations, which act in conjunction with standing facilities, are intended to absorb or provide overnight liquidity at interest rates (which are dependent on the MPR), establishing a price channel where interbank market transactions are performed overnight.

OMOs can be classified into "adjustment" and "structural" operations, depending on the extent and duration of their impact on the monetary base. The CBC conducts adjustment operations in order to neutralize transitory liquidity fluctuations in the financial system, which might drive the interbank rate (IBR) away from the monetary policy rate (MPR). These operations are performed at the monetary policy rate, both to supply and absorb liquidity. As to terms, they are generally performed on an overnight basis.

The CBC, through its Open Market Operations Department (DOMA), keeps monitoring of the liquidity status of the financial system, considering its global conditions as well as the financial microstructure of the agents involved in the interbank market, for which purpose it establishes permanent communication with those responsible for managing the liquidity of the banking corporations. The CBC's instruments for doing these adjustments to the liquidity of the system are used by taking into account—among other variables—the circumstances the banking system is going through, the availability of collaterals of participating agents and the term of each operation. These operations are informed at market pre-opening times so as not to create information inconsistencies regarding trades taking place on the market that day. The regular communications channel is through direct telephone conferences and the website.

Structural operations are those conducted through changes in promissory note (PDBC) and bond (BCP, BCU and BCD) stocks. The first ones, with issuance terms ranging from 28 to 360 days, allow to manage and regulate the liquidity level of the financial system within a month or from one month to another. Bonds which have maturity periods equal to or longer than one year, are used to regulate liquidity in more permanent time periods (from one year to another) and, usually, their schedule is not altered as they respond to structural factors and are also intended for the development of the capital market. Planning of these promissory notes takes place every year and the monthly schedule of operations of the Bank is informed to the public in advance. This schedule contemplates liquidity demand expectations, maturity of previous period issuances, required reserve fulfillment strategies and seasonal effects affecting liquidity in the period. In turn, the scheduling of bonds is executed according to an annual schedule, usually announced to the market during the first days of the year. This schedule states instruments to be issued, with a description of terms, adjustments and total amounts to be bid.

The planning of these operations takes into account the main flows known for the year and demand and growth prospects of the monetary base consistent with the available economic scenario and the monetary policy course. Although the conduct of these operations has the primary goal of affecting the monetary base for extensive periods of time, the resulting rates of the bidding process have a direct bearing on the interest rates of the secondary market at different terms, reflecting and consolidating the economic expectations and the course of the monetary policy on the part of the agents at longer time horizons. That is why these operations are an important means of transmission and orientation of the monetary policy. Daily, and at the end of the day, the CBC offers standing overnight liquidity facilities (SLF) and deposit facilities (SDF) to authorized financial institutions, which are used by banking corporations to handle the deficits or surpluses that are not directly managed through the interbank market. With this mechanism, the CBC at all times sets a floating band with a ceiling and a floor of ±0.25 bp of the MPR and permits a fluctuation of the IBR around the MPR without CBC intervention. The Bank compensates the SDF at MPR –25 basis points and charge the SLF at MPR +25 basis points.

Additionally, and with a view to facilitating the liquidation of operations carried out through the real time gross settlement system (RTGS), the CBC offers an intraday liquidity facility (ILF), which corresponds to a loan that must be repaid on the same day without cost of interest to the bank. All these facilities are always open to banking corporations. While the ILF is available for a large part of the day, liquidity and deposit facilities are only open at the end of the day. In case of operations injecting money into the system (bank loans), such as the SLF and the ILF, they must be implemented as securities repurchase operations.[5]

1. Term structure management

The CBC's monetary operations manage not only the MPR, but the whole term structure. In this section we analyze these actions and the effects on the yield curve, providing a classification in terms of maturity and availability of the instruments: permanent or transitory.

The SDF, SLF and Repo are permanent operations for the monetary policy management and implementation. On the other hand, the fine tuning of the term structure is performed by the CBC instrument auctions in the primary market —that are less frequent— and some occasional and unconventional operations, such that of the FLAP. In this sense, the CBC instruments auctions contribute in the margin to the shape of the term structure (slope and curvature) and reflect the banking sector immediate liquidity conditions. The amount associated to the permanent operations is considerably higher than those associated with the CBC instruments (over a million times higher). However, the CBC auctions are comparable in volume to the unconventional policies, such as the FLAP. To

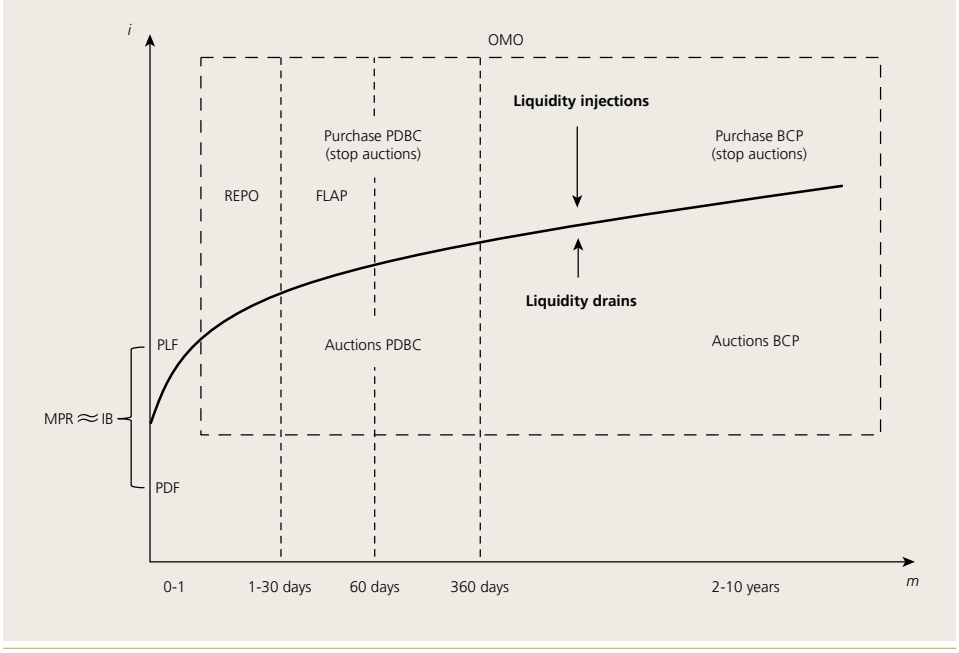
5 For more information about the CBC's liquidity management, see Central Bank of Chile (2011).

give a context, the FLAP was implemented between 2009 and 2010 and their total amount for each year accounted for 22.5% and 4.4% of all papers tendered by the CBC, respectively.

Figure 2 describes the implementation of monetary policy in the CBC. There are various instruments in its toolkit to drive market liquidity (affecting bank's funding liquidity). On the permanent type of operations we have the Standing Deposit Facility (SDF) and Standing Liquidity Facility (SLF), which operate overnight. These instruments allow commercial banks to manage liquidity shortages and surpluses that are not resolved in the interbank market during the day. Since the CBC charges MPR+25bp by SLF and MPR-25bp by SDF it ensures that the interbank interest rate (IB) is aligned with the monetary policy rate (MPR). Other short maturity—frequently traded—instruments are those with a repurchase agreement (Repos). With a lower frequency and longer maturity (more than 30 days), we have the CBC assets auctions. These are scheduled in advance every year. Finally, the CBC also has implemented unconventional policies facing temporary liquidity shortages, such as the term liquidity facility (FLAP) during the last financial crisis (2009-2010).

Figure 2

Monetary policy implementation



Source: Central Bank of Chile.

As shown in figure 2, Repos are considered liquidity injections. They would pull the yield curve down, making it flatter. This is because in the Repo, the CBC buys financial assets in exchange for an amount in pesos and simultaneously agrees to sell them within a specified period (1-30 days). These operations generate incentives to hold CBC instruments because these (and other safe assets) are required as collateral. The FLAP works similarly to the Repo, but with longer periods (60 days).

In case of longer maturities (2, 5 and 10 years), the CBC instrument auctions are less frequent, and drain liquidity from the market. The CBC sells fixed income assets of its own issue, in exchange for an amount in pesos. This would push the yield curve upwards making it steeper. The opposite occurs when the CBC decides to stop the auctions program, perceived as a liquidity relief, pulling the yield curve down, making it flatter.

IV. THE CALRP INDICATOR

We elaborate our local version of the LRP (the CLRP) by following the structure of the previously described local OMO mechanism. In contrast to the original LRP, the idea behind our measure is that given the Chilean financial sectors particularities—due to the OMO structure—banks are less willing to use their cash to *purchase* notes and bonds from the central bank in case of increased illiquidity. Intuitively, banks with tighter liquidity either submit higher bid rates—equivalently a lower price—for the notes, submit lower bid volumes, or do not participate at all in the auction.[6]

The original Drehmann and Nikolaou LRP definition appears in (2). It is the aggregate difference between the bid and a *marginal* rate[7] for each bank at each auction, weighted by the volume of each bank's allotment.

$$LRP_t = \frac{\sum_{i=1}^{N}\sum_{b=1}^{B}\left(max\left\{0, BidRate_{b,i,t} - E_t(MarginalRate)\right\}\cdot Volume_{b,i,t}\right)}{E_t(allotment)}\cdot 100 \qquad (2)$$

where $BidRate_{b,i,t}$ and $Volume_{b,i,t}$ are the rate and the volume of bank i (from 1 to N), which submits b bids (from 1 to B) at time (auction) t. $E_t(MarginalRate)$ is the expected marginal rate. These are instruments auctioned by the commercial banks that the central bank buys. It is calculated as the aggregate difference

6 It has to be mentioned that a possible drawback of the LRP type of liquidity metrics is that we cannot extract from the data the exact reasons motivating the agents to participate. We can just infer (and test) that is due to illiquidity. However, for small banks (investment banks in the Chilean case)- since their balance sheets are more volatile - their liquidity decisions could greatly variate over time and would make the auction participation decisions less informative for liquidity management purposes.

7 That is, the closest expected financial alternative or benchmark rate, which is calculated using a combination of swaps.

between the bid and the corresponding *marginal* rate, where the marginal rate is the closest expected financial alternative or benchmark rate. The LRP indicator is calculated for each bank at each auction, weighted by the volume of each bank's allotment. In this case, the higher the spread, the lower the liquidity.

As previously mentioned, in the case of the CBC's OMO mechanism, the buyer and the seller switch places. Thus, we need to alter the original definition of the LRP by adapting the weights and benchmark rates for every asset sold by the CBC.[8]

In (3) we show the local version of the LRP (i.e. the CLRP). The transformed weights are calculated as the portion of the central bank's total allotment of the specific asset acquired by the specific commercial bank. Thus, the weights take into consideration the differences in spread but regarding the volume that the agents are offering to buy in each auction. Notice also the absence of the expectations operator on the denominator. Given that all the CBC auctions are programmed in advance, there is certainty about the total volume of assets to be allocated at every auction.

$$CALRP_t = \sum_{i=1}^{N_t}\sum_{b=1}^{B_t} \frac{\left(max\left\{0, BidRate_{b,i,t} - E_t\left(MarginalRate\right)\right\}\right)}{\left(N_t \cdot B_t - 1\right)} \cdot \frac{\left(TotalBidVolume_j - BidVolume_{b,i,t}\right)}{TotalBidVolume_t} \cdot 100 \qquad (3)^9$$

where $BidRate_{b,i,t}$ and $BidVolume_{b,i,t}$ are the rate and volume of bank i (from to N), which submits b bids (from to B) at time (auction) t. E_t ($MarginalRate$) is the expected marginal rate and $TotalBidVolume_t$ is the total volume of the auctioned CBC instrument. These are instruments auctioned by the central bank that the commercial banks buy in the primary market: PDBC30, PDBC90, PDBC180, PDBC360, BCP2, BCP5, BCP10, BCU2, BCU5, BCU10 and BCU20. The CLRP is computed as the aggregate difference between the bid and the corresponding *marginal* rate, where the marginal rate is the closest expected financial alternative or benchmark rate, which in the Chilean case is calculated using a combination of swaps. As for the weights, these are calculated as the portion of the central bank's total allotment of the specific asset acquired by the specific commercial bank. Thus, these weights take into consideration the

8 The CLRP metric is constructed for a variety of CBC assets traded in the OMOs' primary market, covering maturities of 30 days to 20 years: PDBC30, PDBC90, PDBC180, PDBC360, BCP2, BCP5, BCP10, BCU2, BCU5, BCU10 and BCU20.

9 Banks with few transactions of CBC instruments have greater weight in the CALRP. The rationale behind this characterization is that if banks trade a low volume it means that they are less willing to give up their liquidity. We acknowledge that this definition woul make the CALRP outweigh some longer maturity CBC instruments due to infrequent trading. However, we have checked that in most of the instruments we have sufficient trading information to overcome this issue.

volume that the agents are offering to buy at each auction. If the volume is high we assume that the particular commercial bank is less liquidity constrained.

In some cases, due to the infrequent participation of any specific bank, the CLRP indicator becomes too sensitive to volume acquisition at a specific auction. In order to overcome this issue, we compute another version of the weights. In (4), we depict the more robust version of the Chilean liquidity indicator, the CALRP,[10] where we average the weights of a set of auctions (i.e. 10) in which the bank participates.[11] This modification allows the liquidity metric to become less dependent in the current operation and thus more structural.

$$CALRP_t = \sum_{i=1}^{N_t}\sum_{b=1}^{B_t}\sum_{j=k-9}^{k} \frac{\left(max\left\{0, BidRate_{b,i,t} - E_t\left(MarginalRate\right)\right\}\right)}{(N_t \cdot B_t - 1)} \cdot \frac{\left(TotalBidVolume_j - BidVolume_{b,i,j}\right)}{TotalBidVolume_j} \cdot 100 \quad (4)$$

As shown in (3) and (4), the CLRP and CALRP formulas depend —apart from bid rates and volumes— on a reference rate (i.e. the *MarginalRate*), which is the expected future comparable rate for each instrument. Consequently, this rate relies upon the CBC asset that is auctioned. In the case of PDBC30 instrument auctions, as the comparable swap instrument does not exist, we compute the benchmark as a composite of swap rates of different maturities (90d, 180d and 1y). In this case we have that

$$\text{SWAP30}_t = \frac{7 \cdot \text{SWAP90}_t - 5 \cdot \text{SWAP180}_t + \text{SWAP360}_t}{3}$$

In all the other assets auctioned, the comparable maturity instrument is available.

In the same spirit of the original LRP, and in contrast to other liquidity metrics, the Chilean version (CALRP) has the advantage of being calculated at bank level. However, the CALRP results can be also aggregated at other levels. In this work, in order to protect the anonymity of the CBC auction participants, we present the results at a cluster or system level.[12]

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10 CALRP stands for the Chilean averaged liquidity risk premium.

11 In this case we need to add an aggregation term. That is a sum operator for 10 auctions. This operation goes between k –9 and k, where k represents the auction that is occurring at time t.

12 For the long-term instrument auctions, it should be noted that there are institutional investors with greater participation. It is observed that these institutions absorb a high percentage of CBC instruments. For the case of 5-year bonds, over the last 10 years they have a 38% average participation; whereas in the 10-year bonds they have a 44% share. Of course this makes our indicator less accurate for these instruments, especially in the definition of weights, because the preferences of institutional investors could contaminate our results. However, the banking sector is still an important player even in these long-term assets.

V. THE DATA

Our CALRP data set comes from the transactional information of all the instruments auctioned by the CBC. Those instruments are the PDBC, BCP and BCU but only nominal instruments are considered to make the analysis consistent with the monetary policy interest rate.[13]

The auctions considered were conducted from September 2000 to November 2012. This data allows us to follow the bidding behavior of the 21 major banks in the Chilean financial system. The information includes the submitted bid schedule—bid rate and bid volume—of each bank, and the allotted volume earmarked by the authority. These data is not publicly available. However, information of benchmark marginal rates is obtainable through the CBC web site. The rest of the data sources are described in table 2.

Table 2

Data and sources

Data series	Frequency	Source	Metric	Comments
Bids for CBC PDBC notes (30d, 90d, 180d, 1y; in CLP)	weekly	CBC	CALRP	private
Bids for CBC BCP bonds (2y, 5y, 10y, 20y; in UF)	weekly	CBC	CALRP	private
Swap rates (30d, 90d, 180d, 1y, 2y, 5y, 10y, 20y)	weekly	CBC	CALRP/PS/CLF	public
Banks' balance sheet data (C08 file)	monthly	SBIF	LCR	private
Prime deposit rate (90d)	daily	LVA indices	PS	private
Bid-Ask spread (Stock Mkt Index IPSA, SWAP CLP Rates 3y)	daily	Santiago SE/ Blomberg	CLF	private
Return to volume ratio (IPSA, Central bank bonds (secondary market))	daily	Santiago SE/ CBC	CLF	private
Bid-Ask spread (FTSE 100)	daily	Bloomberg	GFL	public
Return to volume ratio (FTSE 100, SP500)	daily	Bloomberg	GFL	public
Libor – Gov't bond spread (US, EUR, GBP)	daily	Bloomberg	GFL	public
Libor - OIS spread	daily	Bloomberg	LOIS	public

Source: Central Bank of Chile.

13 The objective of this research is to relate the preference for CBC instruments in the context of the implementation of monetary policy, leaving out the implications of fiscal policy related to BTP. Hence, these instruments are not included in the analysis.

Now we turn to the descriptive statistics. As shown in tables 3 and 4, the peaks of void auctions are distributed along the financial crisis and at the end of 2009, 2010 and 2011. For the short maturity instruments, the percentage of void auctions increased during the financial crisis, but peaked in 2011 and 2012.

In the case of long-term instruments, as presented in table 5, the evidence is somewhat mixed. On one hand, the 2-year bonds in pesos (BCP2) void auctions peak in 2009, right after the crisis. On the other hand, longer maturity instruments' void auctions represent a greater percentage between 2007 and 2010.

Table 3

Descriptive statistics: auctions and effectiveness - short-term papers

	PDBC30				PDBC90			
Year	Auctions	Amount	Banks (%)	Void (%)	Auctions	Amount	Banks (%)	Void (%)
2005	54	12,524	99.8	0	54	7,348	100	0
2006	100	15,376	99.9	3	97	8,036	100	1
2007	86	13,708	100.0	1	84	4,533	100	0
2008	95	12,633	100.0	3	60	2,585	99.3	5
2009	102	21,691	100.0	1	96	7,922	100	9
2010	115	47,676	87.1	1	64	6,054	97.5	11
2011	95	54,224	94.4	7	91	7,266	96	21
2012	74	53,118	94.7	4	37	4,597	95	32
Total	721	230,951	94.9	3	583	48,341	98.7	9

Source: Central Bank of Chile.

Table 4

Descriptive statistics: auctions and effectiveness - short-term papers

	PDBC180				PDBC360			
Year	Auctions	Amount	Banks (%)	Void (%)	Auctions	Amount	Banks (%)	Void (%)
2005	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	-	-	-
2007	2	77	100	0	2	77	100	0
2008	22	700	100	27	22	782	99	23
2009	54	985	100	44	15	432	100	0
2010	31	719	86	23	36	911	92	22
2011	15	331	97	73	-	-	-	-
2012	10	189	98	60	-	-	-	-
Total	134	3000	96	40	75	2202	97	18

Source: Central Bank of Chile.

Table 5

Descriptive statistics: auctions and effectiveness - long-term papers

	BCP2				BCP5				BCP10			
Year	Auctions	Amount	Banks (%)	Void (%)	Auctions	Amount	Banks (%)	Void (%)	Auctions	Amount	Banks (%)	Void (%)
2005	24	702	82	4	33	377	95	3	33	318	98	6
2006	9	339	87	0	13	336	76	0	5	155	78	0
2007	13	530	92	23	14	420	91	21	1	19	35	100
2008	25	773	95	20	23	657	89	9	11	160	68	18
2009	18	242	87	33	12	198	70	17	-	-	-	-
2010	37	829	98	16	40	1119	72	28	-	-	-	-
2011	13	476	99	15	30	1421	56	7	20	972	56	5
2012	17	514	91	6	24	719	76	17	17	719	40	12
Total	156	4405	92	15	189	5247	74	13	87	2344	60	9

Source: Central Bank of Chile.

We are interested in the auctions' effectiveness. The intuition tells us that there is a relation between void auctions and liquidity. The rationale is that when liquidity conditions are more stringent, commercial banks are more constrained to acquire CBC papers. Thus, the auctions are more prone to be declared ineffective. In section (VI.2), we will test this hypothesis.

Marginal rates are a key element in the construction of our CALRP indicator, since the results depend on the choice of this variable. That is how these interest rates are constructed using the relevant swap rates, in order to account for expectations. In table 6 we present the relevant benchmark (or marginal) rates moments across different time windows. We can see that all marginal rates (i.e. the benchmark rate for equivalent alternative investments) peak in 2008, during the financial crisis period. The standard deviations of the different marginal rates are shown in parentheses. These tables show that during the financial crisis there was an increase in the time-series volatility that remained high for two more years, after it stabilized to pre-crisis levels in 2011.

Another element of the CALRP indicator we are constructing is the bidding behavior. Table 7 shows the bidding behavior of banking institutions when operating at the OMO of the Central Bank. It can be observed that—similar to the marginal rates—the peaks in all the instruments are reached during the crisis period in 2008. In the case of volatility, we see that the time-series variability (i.e. volatility of the average bids) and its cross-section counterpart (average of bids' volatility) increased in 2008 and remained high until 2010, but decreased to pre-crisis levels in the following years.

Table 6

Descriptive statistics: marginal rates

(percentage)

Year	PDBC30	PDBC90	PDBC180	PDBC360	BCP2	BCP5	BCP10
2005	3.83[1]	4.19	4.04	4.32	5.05	5.95	6.63
	(0.45) [2]	(0.43)	(0.74)	(0.67)	(0.74)	(0.56)	(0.38)
	3.38 [3]	3.78	3.69	3.90	4.59	5.62	6.36
	3.93 [3]	4.18	4.01	4.17	4.81	5.82	6.49
	4.21 [3]	4.62	4.52	4.69	5.41	6.27	6.69
2006	4.93	5.09	5.25	5.43	5.99	6.47	6.85
	(0.26)	(0.16)	(0.11)	(0.12)	(0.23)	(0.33)	(0.39)
	4.79	4.92	5.17	5.35	5.81	6.19	6.59
	5.02	5.18	5.23	5.41	6.05	6.57	6.98
	5.12	5.22	5.35	5.51	6.16	6.71	7.16
2007	5.33	5.41	5.47	5.48	5.77	6.10	6.35
	(0.34)	(0.39)	(0.44)	(0.46)	(0.49)	(0.42)	(0.36)
	5.03	5.00	4.99	4.95	5.19	5.60	5.97
	5.21	5.30	5.41	5.52	5.93	6.28	6.46
	5.74	5.83	5.88	5.91	6.21	6.45	6.61
2008	7.10	7.18	7.20	7.05	7.07	6.96	6.95
	(0.86)	(0.83)	(0.83)	(0.77)	(0.73)	(0.64)	(0.56)
	6.27	6.33	6.38	6.33	6.46	6.44	6.48
	6.84	7.18	7.12	6.89	6.81	6.83	6.86
	8.12	7.96	7.95	7.65	7.80	7.59	7.47
2009	1.96	1.69	1.57	1.86	2.91	4.64	5.35
	(2.22)	(1.89)	(1.56)	(1.19)	(0.76)	(0.56)	(0.58)
	0.54	0.51	0.63	1.24	2.41	4.29	4.92
	0.76	0.66	0.76	1.39	2.64	4.70	5.45
	2.19	1.96	1.77	1.78	3.11	5.13	5.73
2010	1.53	1.76	2.09	2.72	3.72	5.11	5.86
	(1.01)	(1.11)	(1.17)	(1.03)	(0.63)	(0.19)	(0.22)
	0.57	0.59	0.78	1.53	3.16	4.97	5.71
	1.17	1.62	2.14	2.87	3.79	5.07	5.92
	2.62	2.96	3.25	3.68	4.26	5.19	6.05
2011	4.76	4.78	4.82	4.88	5.19	5.56	5.83
	(0.77)	(0.60)	(0.50)	(0.50)	(0.61)	(0.57)	(0.54)
	4.13	4.54	4.53	4.46	4.58	4.92	5.22
	5.26	5.02	4.89	4.73	5.46	5.86	6.02
	5.32	5.22	5.30	5.45	5.75	6.07	6.29
2012	5.00	4.93	4.87	4.80	4.96	5.21	5.45
	(0.07)	(0.07)	(0.13)	(0.23)	(0.31)	(0.28)	(0.23)
	4.98	4.89	4.78	4.62	4.72	5.04	5.29
	5.00	4.95	4.88	4.81	4.95	5.16	5.45
	5.02	4.99	4.99	5.01	5.23	5.44	5.57

Source: Central Bank of Chile.
(1) Mean. (2) Standard deviations. (3) Quartiles 1,2,3.

Table 7

Descriptive statistics: bids' average rates

(percentage)

Year	PDBC30	PDBC90	PDBC180	PDBC360	BCP2	BCP5	BCP10
2005	3.74(1)	3.96			4.61	5.56	6.04
	(0.68)(2)	(0.71)			(0.29)	(0.45)	(0.30)
	[0.65](3)	[0.68]			[0.28]	[0.44]	[0.3]
	3.04(4)	3.17			4.52	5.26	5.85
	3.96(4)	4.19			4.66	5.47	5.96
	4.28(4)	4.51			4.75	5.68	6.15
2006	4.71	4.84			5.90	6.08	6.25
	(0.37)	(0.34)			(0.26)	(0.24)	(0.59)
	[0.3]	[0.27]			[0.3]	[0.27]	[0.36]
	4.40	4.58			5.75	6.01	6.11
	4.73	4.80			5.97	6.11	6.25
	5.01	5.11			6.07	6.19	6.40
2007	5.00	5.14	6.18	6.23	5.86	5.98	5.45
	(0.47)	(0.50)	(0.16)	(0.18)	(0.42)	(0.52)	(0.05)
	0.39	[0.44]	[0.12]	[0.19]	[0.45]	[0.42]	n.a.
	4.60	4.79	6.20	6.05	5.65	5.60	5.40
	4.95	5.07	6.24	6.29	6.00	6.20	5.45
	5.25	5.50	6.25	6.36	6.20	6.32	5.50
2008	7.58	6.98	7.32	7.19	7.31	7.12	7.75
	(1.22)	(0.85)	(0.69)	(0.61)	(0.70)	(0.78)	(0.44)
	[1.15]	[0.72]	[0.65]	[0.59]	[0.72]	[0.74]	[0.41]
	6.60	6.55	6.69	6.69	6.65	6.48	7.36
	7.50	6.65	7.16	6.95	7.15	7.10	7.65
	8.30	7.50	8.00	7.66	7.95	7.77	7.99
2009	1.79	2.11	1.49	2.99	3.25	4.71	
	(2.15)	(2.17)	(1.58)	(1.74)	(0.92)	(0.45)	
	[2.10]	[2.00]	[1.37]	[1.37]	[0.86]	[0.42]	
	0.44	0.48	0.60	1.80	2.67	4.48	
	0.58	1.10	0.80	1.99	2.89	4.76	
	2.25	3.13	1.57	3.60	3.60	4.96	
2010	1.27	1.82	2.69	3.16	4.26	5.67	
	(1.05)	(1.12)	(0.94)	(1.08)	(0.70)	(0.20)	
	[1.05]	[1.14]	[0.94]	[0.94]	[0.66]	[0.15]	
	0.40	0.50	1.80	2.20	3.69	5.56	
	0.60	1.79	3.02	3.31	4.36	5.68	
	2.43	2.92	3.49	4.15	4.87	5.79	
2011	4.65	4.97	5.43		5.49	5.71	5.99
	(0.79)	(0.67)	(0.48)		(0.58)	(0.67)	(0.63)
	[0.76]	[0.66]	[0.49]		[0.56]	[0.65]	[0.64]
	3.99	4.70	5.12		4.93	5.06	5.45
	5.10	5.22	5.49		5.69	5.95	6.15
	5.25	5.43	5.79		6.02	6.30	6.49
2012	4.93	4.99	5.02		5.24	5.39	5.56
	(0.19)	(0.20)	(0.27)		(0.26)	(0.26)	(0.24)
	[0.12]	[0.17]	[0.21]		[0.26]	[0.24]	[0.24]
	4.80	4.84	4.80		5.03	5.20	5.38
	4.91	4.98	5.00		5.27	5.36	5.46
	5.04	5.15	5.24		5.41	5.62	5.76

Source: Central Bank of Chile.
(1) Mean from banks by date. (2) Standard deviations from banks by date. (3) Deviations from system by date. (4) Quartiles 1,2,3.
(5) n.a.=not available.

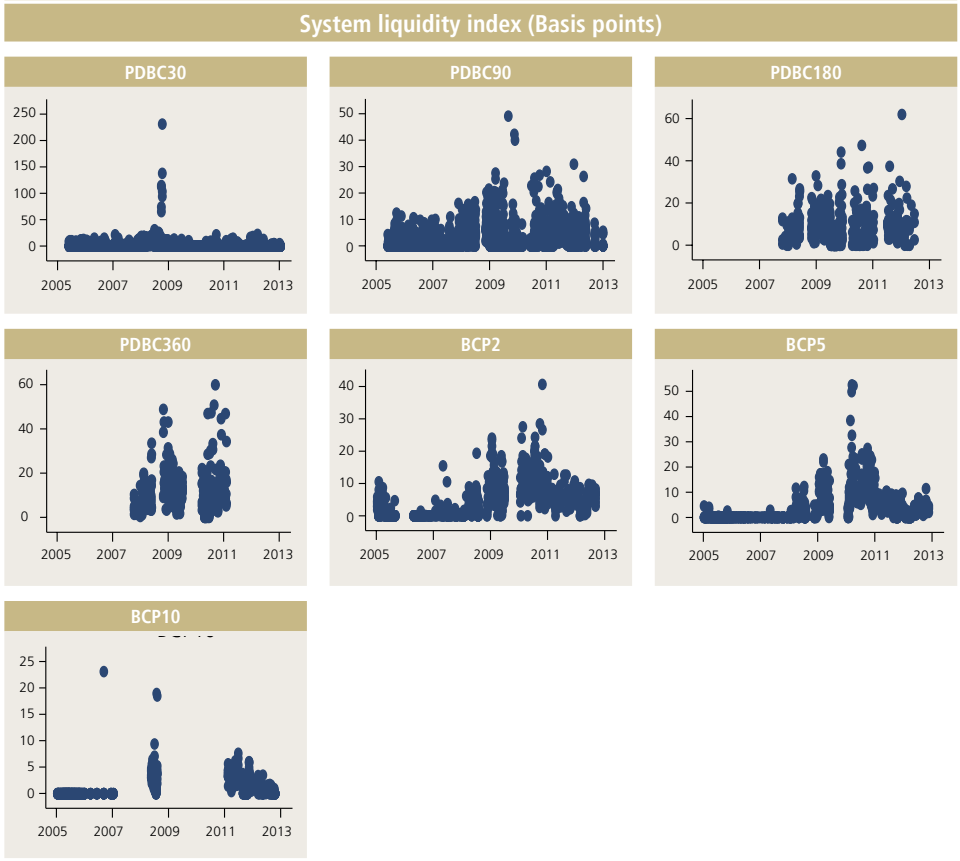
Now we have described the data; in the next section we present our results for the CALRP indicator.

VI. CALRP RESULTS[14]

In this section we present the results of our major contribution: the CALRP. As we previously mentioned, this indicator can be built at bank level. However, we must avoid the presentation of individual data because of confidentiality concerns, so we aggregate the results. Figure 3 shows the Chilean banking systems aggregate results (by CBC instrument). We can observe that for the shortest maturity assets (PDBC30), the CALRP indicates that this part of the yield had an approximate increase of 100bp of risk premium at the end of 2009, coinciding with shortages in international financial markets funding.

Figure 3

Agregated results by instrument



Source: Central Bank of Chile.

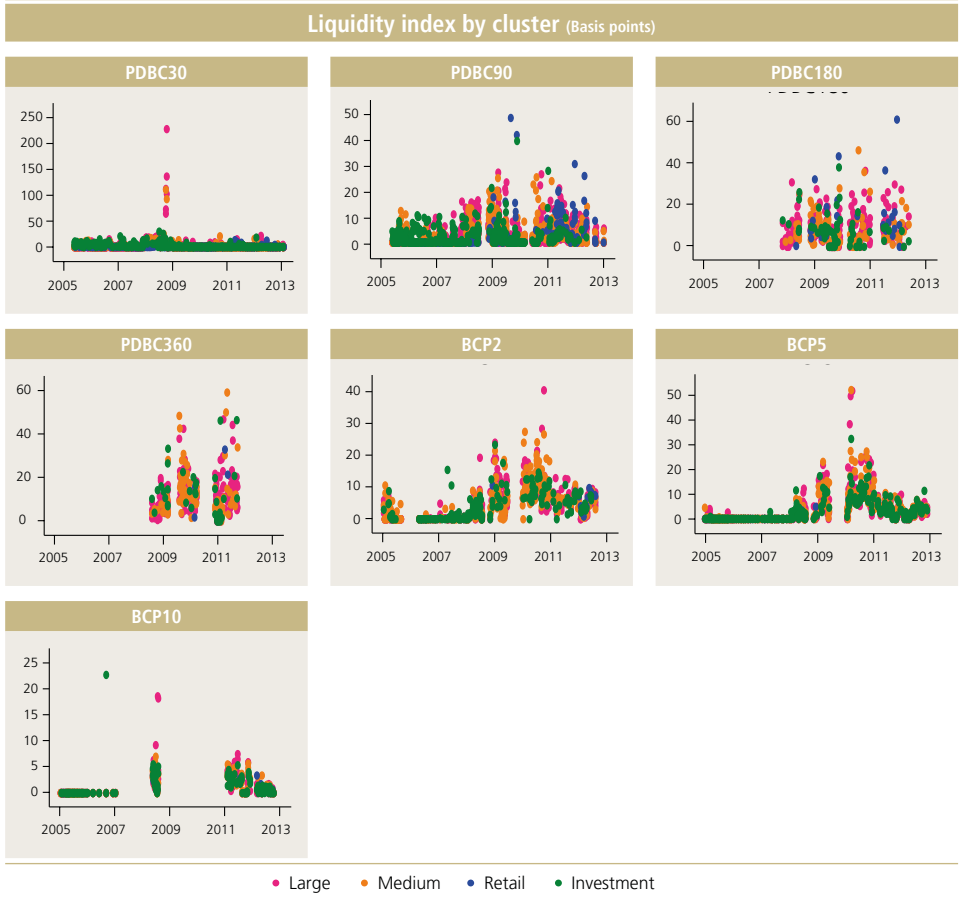
14 The participation of pension funds and other institutional investors is highly relevant in the Chilean economy. Thus, their impact in the final adjudication rates should be a matter of further analysis. As a robustness check of our results, we have revised that their influence on final rates is only binary (see figures 10 and 11 in appendix A). When they participate, the adjudicated rates are lower and their interval of variation is shorter. However, in the auctions where institutional investors are not present, we observe higher levels and a wider range of settled rates.

On the other hand, we see that the longer maturity instruments show an increase in the CALRP in 2010 and 2011.

At a more detailed level, in figure 4, we present the results of CALRP aggregated at cluster level. These cluster's groupings are defined by size and are described in Central Bank of Chile (2007). In cluster 1 appear the biggest banks of the Chilean banking system, the rest of the groups are medium-sized banks (1 and 2) and small banks. The plot shows that large and medium banks present a similar liquidity behavior, as measured by the CALRP. However, investment and retail banks follow different patterns. This would be explained by the fact that the latter banks' businesses are of a different nature. Investment banks have excess liquidity with virtually no consumer deposit or external financing, that is used mainly for trading purposes. On the other hand, retail banks—as opposed to commercial banks—do not use external financing, and mainly provide low volume and high revenue consumer-type of credit. Thus, they have relatively lower liquidity needs [15].

Figure 4

Aggregate results by instrument and cluster (size)



Source: Central Bank of Chile.

15 *For details about the annual averages, please see tables A1, A2, and A3 in appendix A.*

Table 8

CALRP Liquidity indicator by instrument and year

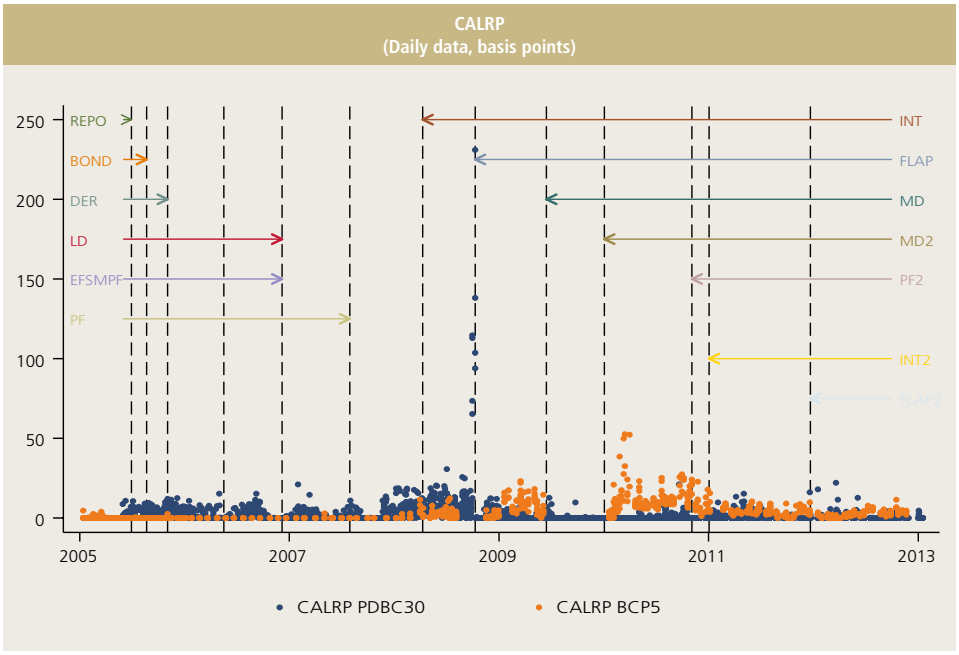
(basis points)

Year	PDBC30	PDBC90	PDBC180	PDBC360	BCP2	BCP5	BCP10
2005	2.1 (1)	1.1	0	0	1.3	0.1	0
	(2.7) (2)	(1.9)	(0)	(0)	(2.2)	(0.6)	(0)
	0 (3)	0	0	0	0	0	0
	0.8 (3)	0	0	0	0	0	0
	3.4 (3)	1.7	0	0	1.9	0	0
2006	1.1	0.5	0	0	0	0	0.6
	(2.4)	(1.7)	(0)	(0)	(0.2)	(0)	(3.8)
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0.5	0	0	0	0	0	0
2007	0.9	0.8	4.2	4.3	0.8	0	0
	(2.3)	(1.9)	(4.7)	(2.6)	(2.3)	(0.3)	(0)
	0	0	1.1	3	0	0	0
	0	0	2.4	3.8	0	0	0
	0.3	0.4	4.2	5	0.6	0	0
2008	7.2	5.9	9.3	11.4	3	1.8	3.1
	(15.7)	(4.2)	(5.8)	(8.2)	(3.1)	(2)	(2.9)
	1.8	3.3	5.3	5.6	0.6	0.1	1.4
	4.7	5.4	8.2	9.1	2.3	1.4	3
	7.9	7.9	11.1	14.6	4.4	2.7	4
2009	0.4	2.9	6.1	13.6	7.7	9.7	0
	(1.4)	(5.2)	(7.3)	(6.9)	(5.3)	(5.2)	(0)
	0	0	0	8.8	4.4	5	0
	0	0.9	4	12	6.2	10	0
	0	3.9	9.4	17.2	10.2	13.1	0
2010	0.2	2.1	8	13.3	10.8	11	0
	(1.2)	(4.3)	(8.9)	(12.2)	(5.3)	(7.8)	(0)
	0	0	1.2	5.4	7.2	6.9	0
	0	0	5.5	10.6	10	9.1	0
	0	2.6	11.5	17.1	12.8	12.7	0
2011	0.9	4.6	12.1	18.9	6.3	3.9	2.4
	(1.9)	(4.5)	(10.2)	(14.2)	(3.1)	(2.6)	(1.7)
	0	1.4	5.4	6.4	4.1	2.1	1.6
	0	3.4	9.9	16	6	3.6	2.4
	0.8	6.2	14.3	34.4	8	5.3	3.5
2012	0.7	2.7	8.3	0	4.4	2.4	0.7
	(1.8)	(3.8)	(7.6)	(0)	(2.6)	(2)	(0.7)
	0	0	1.6	0	2	0.6	0
	0	1.2	7.6	0	4.1	2.2	0.7
	0.9	4.4	11.4	0	6.6	3.6	1
2013	0.4	1.2	0	0	0	0	0
	(1.1)	(2.1)	(0)	(0)	(0)	(0)	(0)
	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
	0	0.6	0	0	0	0	0
Total	1.6	2.4	7.8	12.4	4.9	3.7	1.2
	(6.2)	(4)	(7.9)	(9.6)	(5.2)	(5.5)	(2.1)
	0	0	1.4	6.2	0.3	0	0
	0	0.2	6.5	10.5	3.8	1.8	0
	1.3	3.5	10.9	15.9	7.6	5.3	2.1

Source: Central Bank of Chile.
(1) Mean by date. (2) Standard deviation from banks by date. (3) Quartiles 1,2,3.

Figure 5

CALRP and economically significant events



Source: Central Bank of Chile.

Table 8 contains the CALRP yearly average, calculated by CBC instrument. We can observe that all instruments evidence a liquidity spike in 2008, during the crisis. We can also see that the peaks—describing lower banks' funding liquidity—of short-maturity instruments were achieved in the same year. However, for the higher-maturity instruments, peaks were achieved in 2010 and 2011.

Additionally, figure 5 depicts different time events that could coincide with or be related to developments in the banking system's liquidity. On one hand, short-term liquidity—as measured by the CALRP of PDBC30—is associated to regulations events affecting the short-term market. Whereas CALRP calculated using longer-maturity instruments is naturally more correlated to regulations affecting the long-term market operations.

First, we present examples of short-term financial market regulations and their influence on the short-maturity instruments'—PDBC30—CALRP. In June 2005, the CBC authorized the purchase of credit securities through Repos with the CBC. This coincided with the increase of the liquidity premium of short-maturity CBC instruments, mainly because the Repos constitute an alternative source of short-term financing/investment. Another short-term measure was introduced in May 2006, namely an electronic deposit facility of the CBC, for monetary operations purposes. This new system introduced a liquidity friction that lasted

for one quarter, until the institutions adapted their operations. We also observe an increase in the short-maturity CALRP after the CBC authorized to raise the pension fund (PF) limits on foreign investment. This imposed a constraint in local financing of commercial banks operating in Chile. Finally, the peak was achieved right after the Lehman event in 2008 and it decreased following the CBC's announcement of its flexible liquidity policy program (FLAP).[16]

Second, we present events that coincide with longer maturity CALRP—BCP5—fluctuations. In the case of the long term CALRP indicator, we see that there is some increase after the FLAP in 2008, because these instruments were competing against short-term CBC securities with relatively better pricing conditions. In June 2009 the BCP5 instruments were suspended, coinciding with a Chilean government bond issuance. The instruments were allowed back in 2010 showing an increased CALRP premium and volatility across banks, mainly due to rebalancing of the commercial banks' investment portfolios, after the measure.

1. CALRP term structure

As we have shown previously, the CALRP indicator reasonably captures episodes of commercial banks' liquidity contraction at different maturities or horizons. However, to get a better view of the CALRP term structure and put our metric in historical/maturity context, we analyze the liquidity risk premium yield over time (figure 6).

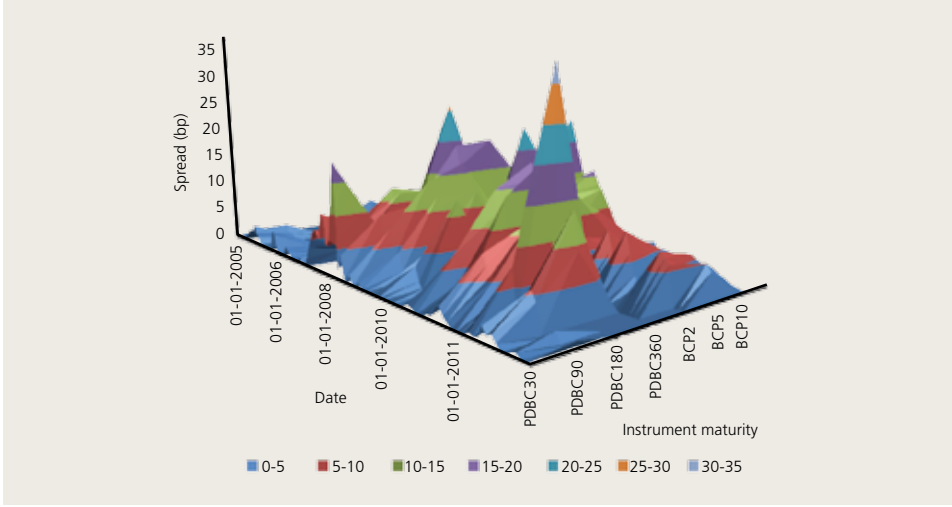
On one hand, we have that, for the short-maturity instruments, the 2008-2009 period was particularly problematic in terms of liquidity. On the other hand, in contrast to the short maturity instruments, the longer maturity ones observed other peaks occurred more recently.

The sources of different timing structures of CALRP are explained by large scale adjustments in commercial banks' balance sheets for the longer instruments' maturity case. However, in the case of short-term maturity CALRP, we observe that liquidity is more sensitive to events of global or local financial fragility. Additionally, we observe reversions in the CALRP term structure curves, especially in 2008. This would be in favor of Borio and Zhu (2008) and others that describe this phenomenon as one indicator of financial vulnerability, due to non-anticipation of monetary policy.

16 For more details, please refer to appendix B.

Figure 6

CALRP term structure



Source: Central Bank of Chile.

2. Void auctions analysis

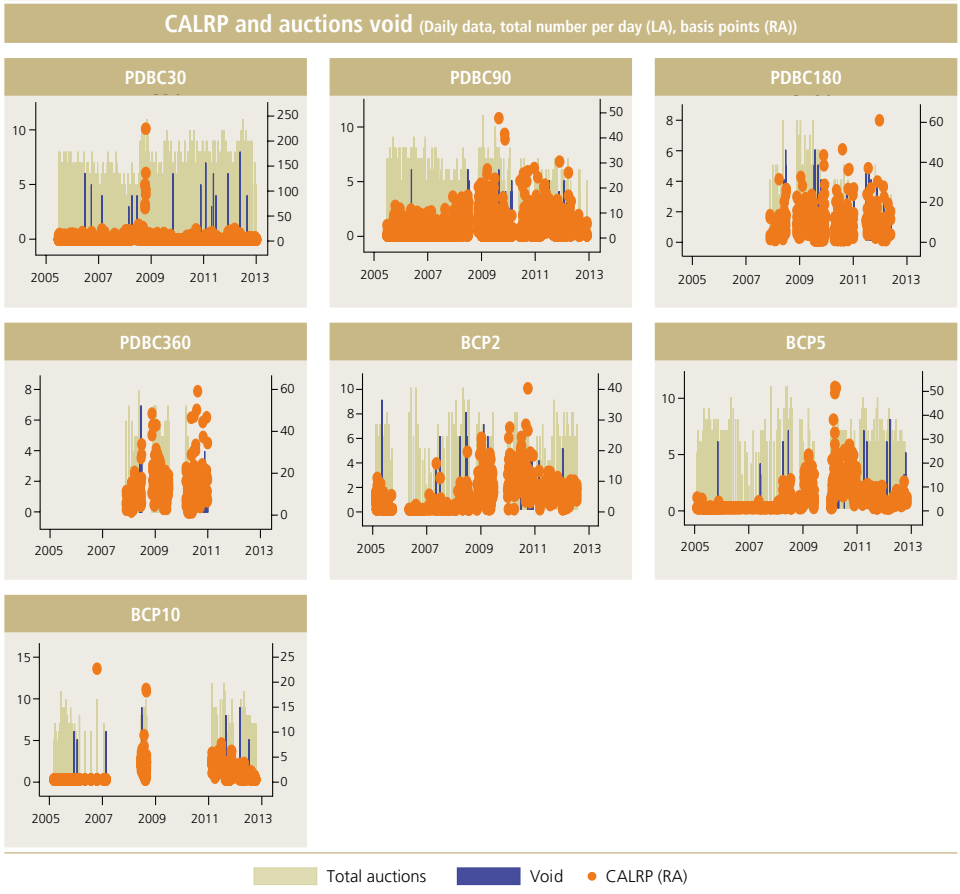
There is an outcome to which every auction is exposed: a void process. This occurs when the seller does not accept any of the bids. In this case, the CBC determines that an auction is void by using expert criteria. These criteria are based on different pieces of market information: surveys, the banking system and the auction history data. The CBC staff basically draws an implicit price threshold for every auction. When the bids are not attractive enough, the CBC declares the auction void.

We are interested in understanding the reasons behind a void auction. This would serve as robustness check for our proposed liquidity indicator. Figure 7 shows certain correlation between the level of the CALRP indicator and the frequency of void auctions. To confirm this relationship, we perform a statistical analysis. Specifically, we test the hypothesis indicating that when liquidity is scarce, commercial banks will be *excessively* unwilling to participate in a CBC auction. Thus, we can check the correlation of our metric of liquidity (the CALRP) with the appearance of a void auction process. Equation (5) shows our model specification for each CBC asset j and auction occurred at time t^*.

$$P\left(\text{Voidauction}=1\right)_{j,t^*}=\text{P}\left(\varepsilon_{j,t^*}>-\left[\alpha+\beta\cdot\text{CALRP}_{j,t^*}\right]\right)=\Phi\left(\alpha+\beta\cdot CALRP_{j,t^*}\right) \quad (5)$$

FIGURE 7

CALRP and void auctions



Source: Central Bank of Chile.

Tables 9 and 10 show the results of our probit regressions of a void auction dummy as independent variable, and the associated CALRP indicator as explanatory variable. These tables refer to long- and short-maturity CBC papers, respectively.

Table 9

Probit void auctions: BCP

	(1)	M.E.	(2)	M.E.	(3)	M.E.
CALRP BCP2	-0.028	-0.002				
	(0.052)	(0.003)				
CALRP BCP5			0.006	0.000		
			(0.031)	(0.002)		
CALRP BCP10					0.202	0.009
					(0.166)	(0.007)
Constant	-1.813***		-2.059		-2.342	
	(0.313)		(0.262)***		(0.473)***	
Observations	156		188		87	
Pseudo *R* squared	0.009		0.001		0.076	

Source: Author's elaboration.
Coefficients and standard errors of individual univariate regression between *Void auction* ∈ {0,1} and the corresponding CALRP for each instrument maturity. Monthly data, 2005-2013. Standard errors in parentheses. Marginal effects (M.E.) reportedM.E. ***p<0.01, **p<0.05, *p<0.1.

Table 10

Probit void auctions: PDBC

	(1)	M.E.	(2)	M.E.	(3)	M.E.	(4)	M.E.
CALRP PDBC30	0.008	0						
	(0.015)	(0)						
CALRP PDBC90			0.152***	0.001***				
			(0.039)	(0.001)				
CALRP PDBC180					0.052***	0.007 ***		
					(0.023)	(0.003)		
CALRP PDBC360							0.017	0.002
							(0.034)	(0.004)
Constant	-2.356***		-3.269***		-1.940***		-1.833***	
	(0.146)		(0.389)		(0.291)		(0.538)	
Observations	723		580		131		73	
Pseudo R-squared	0.003		0.300		0.077		0.008	

Source: Author's elaboration.
Coefficients and standard errors of individual univariate regression between *Void auction* ∈ {0,1} and the corresponding CALRP for each instrument maturity. Monthly data, 2005-2013. Standard errors in parentheses. Marginal effects (M.E.) reported. ***p<0.01, **p<0.05, *p<0.1.

As shown in tables 9 and 10, there is a positive and statistically significant relation between a void auction and our liquidity indicator. This means that the greater the spread between the proposed and the marginal rate—or lower

liquidity—, the higher the probability of observing a void action. The regularity is more pronounced in the cases where the regression has a high R-squared. Those regressions coincide with a high number of observations, or instruments' trading frequency. That is the case of PDBC instruments at 90 days.

Clearly, the results in this section need to be read carefully. This is because the higher value of our indicator often coincides with the exact date where an auction is declared null. Thus, the results cannot be directly interpreted as a predictor of void auctions.[17] Nevertheless, the CALRP metric allows us to understand one important determinant of CBC null auctions: banking system liquidity.

VII. LIQUIDITY AND CREDIT

As Cornett et al. (2011) suggest, one of the most regarded—and potentially dangerous—consequences of a considerable liquidity shortage is the possibility that this financial tension is translated into a credit contraction. The problem is worse in case two elements are present. The first element is creditworthiness. If credit quality does not considerably change through the liquidity crisis period, the banking deleveraging process causes a—potentially inefficient—financial contraction. There are no apparent reasons to consider that there is a relationship between credit quality and banks liquidity. The second element to be considered is financial dependence. The higher the financial dependence on banking credit, the worse the outcome for households and firms.

Table 11 indicates that there is a statistically significant correlation between liquidity shortages and credit supply. This evidence is consistent with that of Alfaro et. al. (2003), where the authors find that monetary policy (i.e. aggregate funding liquidity) is transmitted to credit supply.

We observe that shorter-maturity liquidity is more correlated with consumer credit and is not correlated with longer-maturity types of credit (i.e. mortgage and commercial loans). We also observe that the relationship between banks' funding liquidity and credit supply is economically higher for consumer credit. This suggests that shorter-maturity credits are more sensitive to liquidity fluctuations, whereas longer-maturity loans are more "irreversible," so banks cannot adjust them in times of financial turmoil.

Finally, we also tested the same regression by using PS spread as dependent variable. The results are similar but weaker than when using CALRP.[18]

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17 Additionally, there is a potential selection bias since the participation of a bank in a particular auction determines the level of both the probability of a void auction and the CALRP indicator (although it has to be noticed that there are no auctions with zero bids). Since the bias does not change the direction and objective of our results, we deal with this issue in appendix D.

18 These results are presented in the appendix D.

Table 11

Liquidity (CALRP) and credit growth

	Consumer	Commercial	Housing	Total
PDBC30	-1.17***	-0.77***	-0.44*	-1.00***
	(0.26)	(0.22)	(0.20)	(0.23)
	[0.20]	[0.13]	[0.05]	[0.18]
PDBC90	-1.58***	-0.94***	-1.38***	-1.42***
	(0.31)	(0.26)	(0.21)	(0.26)
	[0.25]	[0.14]	[0.37]	[0.28]
BCP2	-0.32	-0.63***	-0.83***	-0.62***
	(0.21)	(0.14)	(0.11)	(0.16)
	[0.02]	[0.23]	[0.45]	[0.17]
BCP5	-0.32	-0.54***	-0.63***	-0.48**
	(0.19)	(0.12)	(0.11)	(0.14)
	[0.03]	[0.22]	[0.32]	[0.12]
BCP10	-4.00***	-1.11*	-2.17***	-2.04***
	(0.65)	(0.42)	(0.36)	(0.45)
	[0.54]	[0.16]	[0.52]	[0.38]

Source: Author's elaboration.
This table shows the coefficients, standard errors and *R*-squared of individual univariate regression between the CALRP (grouped by instrument) and credit growth (by type of credit). Monthly data, 2005-2013. Constants not reported. Standard errors in parentheses. In brackets, adjusted *R*-squared. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

As a robustness check, we have calculated the correlation of non-performing loans and the CALRP in table 12. We observe very low or virtually no correlation,[19] especially in the case of consumer loans. Although this analysis does not imply any direction of causality, we can infer that the effect of liquidity in credit growth is only partially related with agents' creditworthiness. It would correspond more to a supply effect given by banks' financial opportunities.

19 Recall that the standard deviation of the CALRP is greater than 1 bp; thus, the correlation is lower than the reported regression coefficient found in table 13.

Table 12

Liquidity (CALRP) and non-performing loans

	Consumer	Commercial	Housing	Total
PDBC30	0.03***	0.01*	0.015	0.01
	(0.01)	(0.01)	(0.02)	(0.01)
	[0.22]	[0.05]	[-0.00]	[0.03]
PDBC90	0.01	0.03***	0.09***	0.04***
	(0.01)	(0.01)	(0.02)	(0.01)
	[0.01]	[0.22]	[0.18]	[0.23]
BCP2	-0.02***	0.01***	0.07***	0.02***
	(0.00)	(0.00)	(0.01)	(0.00)
	[0.21]	[0.15]	[0.48]	[0.35]
BCP5	-0.01***	0.01***	0.07***	0.02***
	(0.00)	(0.00)	(0.01)	(0.00)
	[0.19]	[0.16]	[0.54]	[0.39]
BCP10	0.03*	0.03*	0.20***	0.07***
	(0.01)	(0.01)	(0.02)	(0.01)
	[0.14]	[0.16]	[0.74]	[0.61]

Source: Author's elaboration.
This table shows the coefficients, standard errors and R-squared of individual univariate regression between the CALRP (grouped by instrument) and non-performing loans (by type of credit). Monthly data, 2005-2013. Constants not reported. Standard errors in parentheses. In brackets, adjusted *R*-squared. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

VIII. COMPARATIVE LIQUIDITY ANALYSIS

In this section, we put all the metric calculation results into context. First, figure 7 suggests that there is covariation among different metrics for liquidity. All the liquidity metrics included in this work experience considerable movements during the crisis period, especially during 2008. Second, table 13 shows that there is a significant and positive correlation amongst all the indicators replicated and/or proposed in this work. Nevertheless, there are some differences to be analyzed.

The Chilean metric for liquidity of the local fixed income market—the PS—is very close with the LOIS and VIX. This suggests that the Chilean economy is highly dependent on global liquidity and/or external financial conditions. The mechanism operating this relationship appears in a recent paper. Bruno and Shin (2013) indicate that the mechanism through which international liquidity is transmitted into the domestic economies is through the leverage cycle.

In the case of market liquidity metrics, we can observe that the Chilean and international composite indices (CLF and GFL) are closely related. This suggests that the transmission channel of market liquidity is also relevant and significant.

Table 13

Correlation between liquidity indices

	CALRP	GFL	CLF	VIX	LOIS	PS
CALRP	1					
GFL	0.22*	1				
CLF	0.06	0.59*	1			
VIX	0.30*	0.65*	0.33*	1		
LOIS	0.34*	0.75*	0.45*	0.88*	1	
PS	0.35*	0.16	-0.12	-0.10	0.05	1

Source: Author's elaboration.
Represents correlation coefficients significance at the 5% level or better. Monthly data, 2005-2013.

In the case of our proposed CALRP, we observe that it captures well local market liquidity conditions, because of its high correlation with the PS indicator. However, we appreciate that it captures more the systemic variations and it does not vary too much in other episodes that are perhaps less relevant for aggregate liquidity risk.

We have shown that our local counterparts of liquidity metrics reasonably capture liquidity stress episodes. With our local version of liquidity metrics, there are certain differences to be highlighted, we find advantages and drawbacks for each measure. In the case of the CLF, although it captures the episodes in a great manner, it has also an excessive variation, this volatility makes the metric less useful as early warning indicator, since it `jumps' too much. As for the PS, it is less volatile than the CLF, which is an advantage. It has also a good relation with historically tight liquidity periods. However, there are some issues. The PS depends partially on a survey, and it has only a system level interpretation. In the case of our CALRP indicator, it has certainly a low variation, except during the global crisis. Thus, it is a good measure for high magnitude events, but it does not capture well minor stress episodes.

IX. CONCLUSION

This paper presents a novel indicator of funding liquidity of the Chilean banking system inspired by the methodology proposed by Drehmann and Nikolaou (2012). It is based on banks' biding behavior, through their bidding schedule (bid rate and volume), on notes and bonds auctions conducted by the CBC.

Compared to other liquidity indices, the CALRP indicator can be constructed at the same time as information about the auctions becomes available, which is easily accessible from within the CBC; it captures well the liquidity crisis episode; is not expert dependent; and we argue that it measures only liquidity risk.

We acknowledge that one of the main drawbacks of our liquidity indicator is that the decision not to participate at all in the auctions is not captured; then, a

more reliable measure of the LRP (or CALRP) indicator should account for this fact. However, as a mitigating factor, we find that there is significant correlation between a void auction process and our liquidity indicator. Additionally, it would be interesting to see how CBC notes and bonds are traded in the interbank (secondary) market. Further research will address these concerns.

One limitation in building the CALRP indicator for instruments of higher maturity is that these instruments are generally auctioned less frequently than instruments of lower maturity (e.g. 30-day notes or PDBC30), and therefore it is harder to build a more reliable version of the CALRP for this kind of instruments.

Like many—if not all—liquidity indicators, our CALRP suffers from the possibility of being contaminated by other effects, such as that of institutional investors' participation (e.g. because of regulatory changes) or other market phenomena that could be happening simultaneously. However, our analysis suggests that this indicator provides a good summary statistic of the banks' reactions when facing monetary policy operations. Moreover, since, as we have pointed out, we observe a high correlation with banking credit. Acknowledging all the statistical caveats, the evidence suggests that our metric reflects the tradeoffs between banking liquidity hoarding and credit supply decisions.

To sum up, we propose this indicator as a complementary metric that would help to explain risk and transmission of funding liquidity in the Chilean financial market, specifically in the commercial banking sector.

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APPENDIX A

Table A1

CALRP annual average by cluster level - short-term papers

(basis points)

	PDBC30				PDBC90			
Year	Large	Medium	Retail	Investment	Large	Medium	Retail	Investment
2005	1.33	2.34	1.21	5.20	0.47	2.36	0.00	1.63
2006	0.75	1.08	0.00	5.01	0.28	0.27	0.03	2.32
2007	0.60	0.42	0.00	3.04	0.74	0.59	0.01	1.59
2008	8.47	6.9	0.98	6.23	6.00	7.84	1.38	5.30
2009	0.47	0.45	0.11	0.34	2.74	2.76	5.42	2.69
2010	0.34	0.22	0.00	0.14	1.87	3.22	2.55	0.78
2011	0.81	0.71	1.92	0.59	4.45	3.54	7.15	3.26
2012	0.96	0.49	0.84	0.72	2.9	1.52	5.98	2.72
2013	0.94	0.03	0.00	0.04	1.47	1.03	0.00	n.a.

Source: Central Bank of Chile.
n.a. = not available.

Table A2

CALRP annual average by cluster level - short-term papers

(basis points)

	PDBC180				PDBC360			
Year	Large	Medium	Retail	Investment	Large	Medium	Retail	Investment
2005								
2006								
2007	3.23	2.42		12.98	3.70	4.23		7.07
2008	9.04	9.25	6.65	13.48	9.74	13.91		16.09
2009	5.32	6.02	12.01	6.96	12.92	14.9	8.85	14.72
2010	9.17	7.14	15.05	4.92	14.52	11.89	27.52	10.03
2011	11.91	8.01	19.22	7.43	11.20	34.36		
2012	8.02	11.11	5.34	3.46				
2013								

Source: Central Bank of Chile.

Table A3

CALRP annual average by cluster level - long-term papers

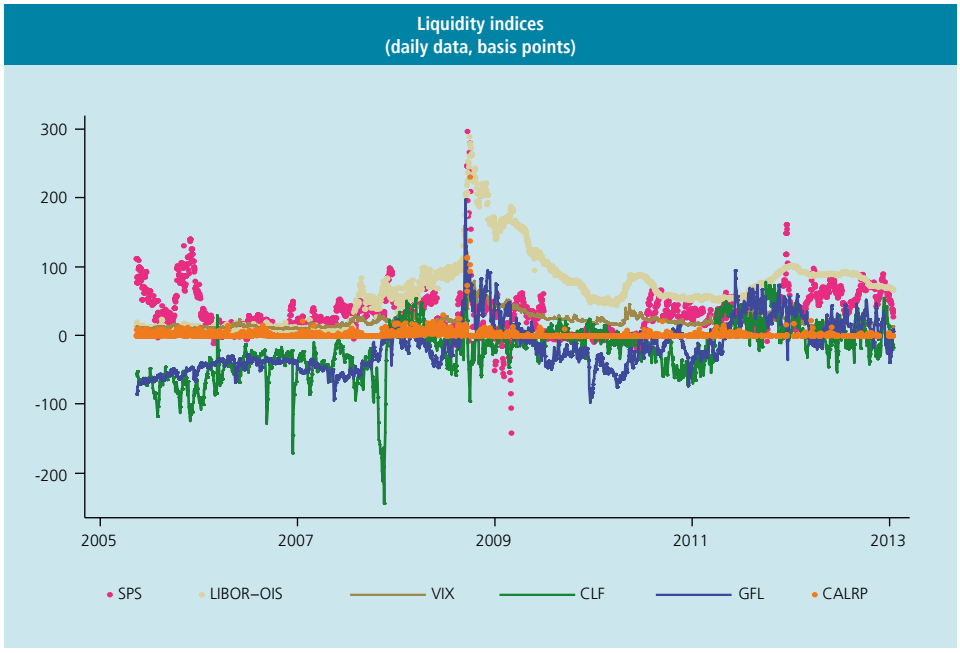
(basis points)

	BCP2				BCP5				BCP10			
Year	Large	Medium	Retail	Investment	Large	Medium	Retail	Investment	Large	Medium	Retail	Investment
2005	1.26	1.26		2.1	0.19	0.09	0	0.01	0	0	0	0
2006	0.01	0.08	0	0	0	0		0	0	0		2.1
2007	0.51	0.48	0	1.5	0	0	0	0.12	0	0		0
2008	3.09	2.96	6.89	2.73	1.83	1.7	3.78	1.8	4.48	2.74	2.73	2.48
2009	8.16	6.77		9.84	10.73	9.28		8.86				
2010	11.2	11.24	6.39	8.68	12	10.81		9.58				
2011	6.71	6.4		5.66	3.96	3.92	6.65	3.69	2.63	2.4	2.3	2.25
2012	4.3	3.96	5.08	5.34	2.33	2.34	1.78	2.67	0.64	0.82	1.92	0.52
2013												

Source: Central Bank of Chile.

Figure 8

Liquidity metrics comparison

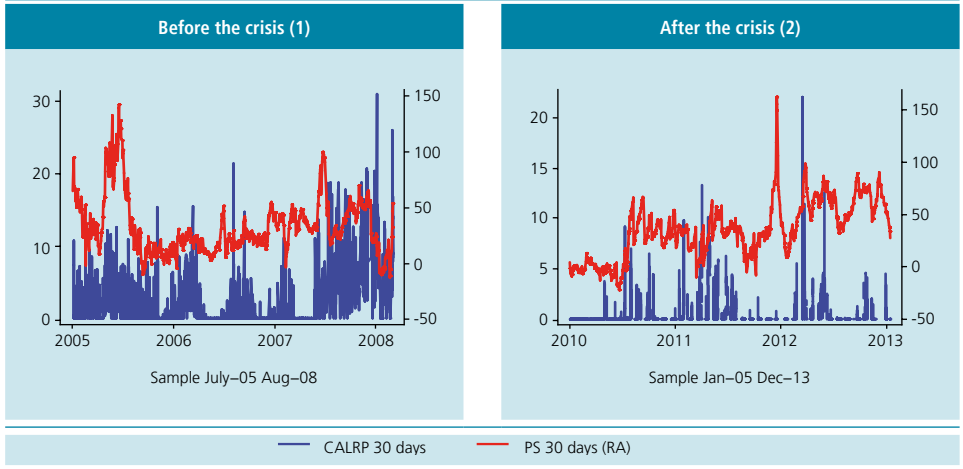


Source: Central Bank of Chile.

Figure 9

CALRP and Prime Swap-Spread before and after the financial crisis

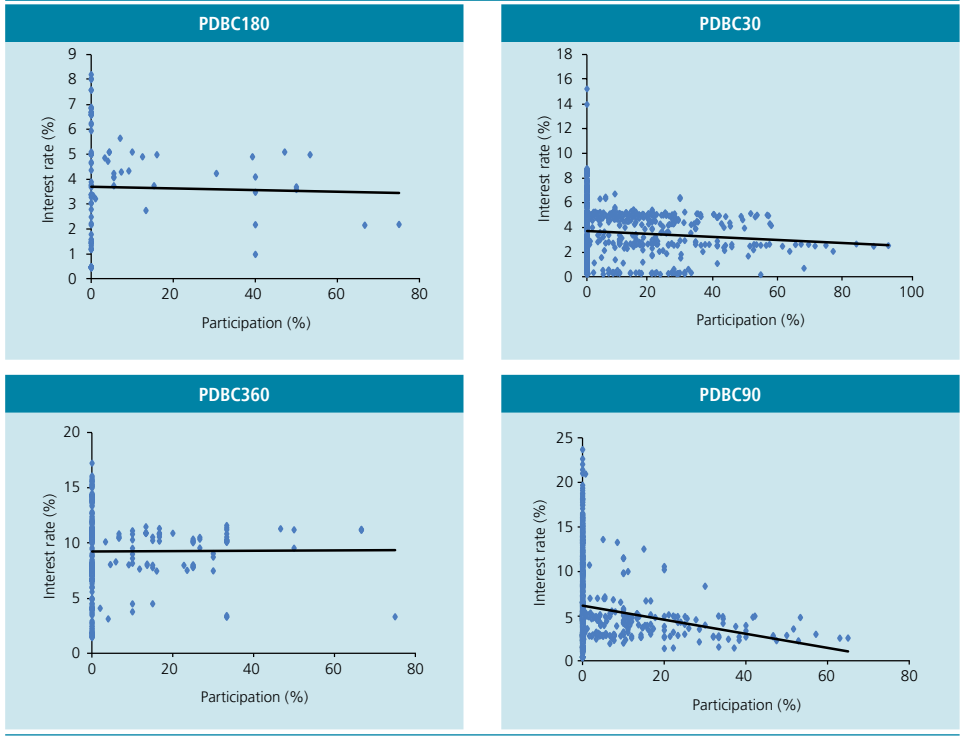
(basis points)



Source: Central Bank of Chile.

Figure 10

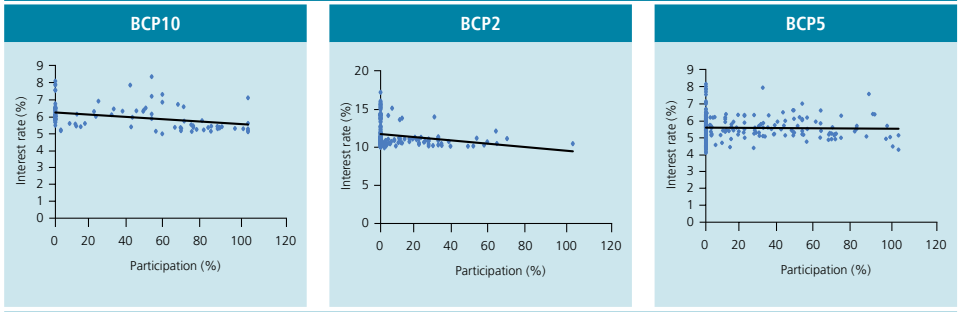
Participation of pension funds and other institutional investors in PDBC auctions



Source: Central Bank of Chile.

Figure 11

Participation of pension funds and other institutional investors in BCP auctions



Source: Central Bank of Chile.

Table A4

Liquid assets' participation in the Chilean bank's balance sheet

	2006	2007	2008	2009	2010	2011	2012	2013
Mean	14.3	13.8	14.4	18.1	18.6	18.0	17.3	15.6
P50	13.8	13.0	13.1	16.2	16.2	15.8	15.2	14.1
P25	10.5	11.7	9.8	12.2	14.0	13.3	13.9	12.0
P75	16.7	15.9	18.7	20.3	20.6	23.1	21.1	18.0
Std. dev.	7.4	5.9	6.7	8.1	7.8	6.5	5.9	5.6

Source: Central Bank of Chile.

Table A5

Central Bank instruments' participation in the liquid assets

	2006	2007	2008	2009	2010	2011	2012	2013
Mean	17.8	23.3	18.0	19.4	17.1	12.4	10.5	8.8
P50	16.6	26.3	18.1	10.2	13.8	9.8	5.5	5.1
P25	4.6	12.2	8.7	7.1	4.6	3.3	2.3	1.6
P75	28.7	31.0	23.8	27.2	24.1	17.1	14.6	13.5
Std. dev.	14.4	14.3	11.3	20.8	16.1	11.5	12.2	9.7

Source: Central Bank of Chile.

APPENDIX B

MAIN FINANCIAL MEASURES TAKEN BY THE CENTRAL BANK OF CHILE: 2005-2011

June 30, 2005: (Repo) The Central Bank authorized the purchase of credit securities using buy-back agreements (Repos) between the Central Bank of Chile and financial institutions at variable interest rates, based on the average value of the MPR during the period the operation is in effect. This measure should deepen the market for these securities.

August 22, 2005: (Bond) The Central Bank announced a change to its policy of issuing its own securities, to offset the monetary effect of bond issues in indexed units of account (Unidades de fomento, UF) maturing in 10 and 20 years (BTU10 and BTU20) from the Treasury as of September.

November 3, 2005: (DER) The Bank empowered financial institutions to operate with local market derivatives based on Chilean Treasury bonds, making the corresponding changes to Chapter III.D.1 in the Compendium of Financial Regulations.

May 18, 2006: (LD) A new way for banks to deposit in the Central Bank was added, called the "Liquidity Deposit in Pesos for Banks and Finance Companies". This type of deposit, which serves the purpose of monetary regulation, operates through electronic communications between commercial banks and the Central Bank, through the open-market operations system, subject to supply and conditions that are set by the Central Bank on each occasion.

December 7, 2006: (EFSMPF) The Central Bank of Chile complemented the definition of the external formal secondary market in which pension funds can trade investment securities internationally, to include securities or other documents issued by foreign firms.

July 31, 2007: (PF1) The Central Bank raised the ceiling on pension fund investment in foreign securities to 35%. Moreover, it increased the ceilings on investment in foreign exchange with no foreign exchange coverage for each type of pension fund, 43% for type A, 28% for type B, 22% for type C and 17% for type D.

April 10, 2008: (INT1) The Central Bank has decided today to intervene in the foreign exchange reinforcing the international liquidity position of the Chilean economy adopting the following measure: increase international reserves by US$8 billion, by purchasing foreign currency, from Monday 14 April and until 12 December 2008. The first reserve purchase program, in force from 14 April to 9 May, will consist of daily purchases for about US$50 million, through competitive auctions.

The monetary effects of this measure will be set off so that the peso liquidity provision in the market is consistent with the monetary policy interest rate. During the period corresponding to the first aforementioned program, this will be implemented through short-term operations.

October 10, 2008: (Flap) The Board of the Central Bank of Chile informs that new measures were adopted today, which are intended to make liquidity management more flexible in the domestic financial system, in response to a further deterioration of international financial markets. These measures, which will be implemented next week, include:

- To extend from one to six months the U.S. dollar swap purchase program. These swaps will be offered at 60 and 90 days, alternately each week for US$500 million at each auction. This measure implies offering a maximum amount of up to US$5 billion.
- As a complement to the aforesaid program, to offer Repo operations aimed at injecting liquidity in pesos at similar terms.
- To offer, every week and during the same six-month term, renewable 7-day Repo operations, which may have bank deposits as collateral. This measure allows expanding the universe of eligible collaterals for financing transactions.

June 15, 2009: (MD) The Central Bank modified its debt schedule by suspending the issue of five year peso bonds (BCP5), five year UF bonds (BCU5), and BCU10 in the primary market. At the same time, the Central Bank announced that it would buy back up to US$1.0 billion of its five and ten-year Central Bank UF bonds. It further communicated that the measures described above are necessary to offset the impact on the fixed income market of the Finance Ministry announcement, on the same day, of a new issue of Treasury bonds for approximately US$1.7 billion and a new program of foreign exchange sales totaling US$4.0 billion, in the form of competitive auctions of US$40 million a day.

January 3, 2010: (MD2) BCP5 are reinstated.

November 4, 2010: (PF2) Chapter III.F.4, Pension fund investments of the Compendium of Financial Regulations was modified to raise the upper limit on total overseas investment by the pension funds from 60% to 80%. At the same time, the upper limit on overseas investment by type of fund was raised to 100% for type A funds, 90% for type B funds, 75% for type C funds, 45% for type D funds, and 35% for type E funds.

January 3, 2011: (INT2) The Central Bank of Chile has decided to initiate a foreign exchange purchase program to strengthen its international liquidity position. The foreign exchange purchase program will be sterilized through the issue of short-term instruments and the use of facilities for a total of US$2.0 billion dollars, together with bond issues in pesos and UFs (unidad de fomento, an inflation-indexed unit of account) for US$10.0 billion. The structure of this plan has been designed to soften the effects of the measure on prices in the debt market.

December 22, 2011: (Flap2) The Central Bank of Chile will implement a temporary program to facilitate the financial system liquidity management in pesos. The Bank will offer a floating rate repo program, for terms of up to 91 days.

APPENDIX C

LIQUIDITY (PS) AND CREDIT GROWTH

Table C1

Liquidity (PS spread) and credit growth

	Consumer	Commercial	Housing	Total
PS30	0.05	0.04	0.02	0.03
	(0.03)	(0.03)	(0.02)	(0.03)
	[0.01]	[0.01]	[0.00]	[0.00]
PS90	-0.04	-0.02	-0.050*	-0.055*
	(0.03)	(0.02)	(0.02)	(0.03)
	[0.01]	[0.00]	[0.06]	[0.04]
PS180	-0.066**	-0.047*	-0.077***	-0.073***
	(0.02)	(0.02)	(0.02)	(0.02)
	[0.07]	[0.06]	[0.23]	[0.13]
PS360	-0.068***	-0.044**	-0.074***	-0.066***
	(0.02)	(0.02)	(0.01)	(0.02)
	[0.12]	[0.09]	[0.31]	[0.16]

Coefficients, standard errors and *R*-squared of individual univariate regression between the PS spread and credit growth (by type of credit). Monthly data, 2005-2013. Standard errors in parentheses. In brackets, adjusted *R*-squared. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

Table C2

Liquidity (PS spread) and NPL

	Consumer	Commercial	Housing	Total
PS30	0.001	0	-0.006**	-0.002*
	(0.001)	(0.001)	(0.002)	(0.001)
	[0.03]	[-0.006]	[0.112]	[0.048]
PS90	0	0.001	0	0.001
	(0.001)	(0.001)	(0.002)	(0.001)
	[-0.011]	[0.023]	[-0.012]	[-0.003]
PS180	0	0.001**	0.004**	0.002**
	(0)	(0)	(0.001)	(0.001)
	[-0.003]	[0.076]	[0.085]	[0.096]
PS360	0	0.001*	0.004***	0.002**
	(0)	(0)	(0.001)	(0)
	[-0.007]	[0.049]	[0.136]	[0.112]

Coefficients, standard errors and *R*-squared of individual univariate regression between the PS spread and credit growth (by type of credit). Monthly data, 2005-2013. Standard errors in parentheses. In brackets, adjusted *R*-squared. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

APPENDIX D

DEALING WITH SELECTION BIAS

To address a potential the selection bias problem in the determination of a void auction, we set the specification in two steps, using a Heckman (1979) probit correction. In the first stage, we estimate the participation of banks in an auction as a function of an alternative liquidity indicator (Spread Prime Swap 30 days, and the Libor-OIS spread, for short- and long-maturity auctioned instruments, respectively). This explanatory variable is used since it reasonably correlates with the participation, and as an aggregated macro variable is available for all instruments' maturities, for all dates. In a second stage we estimate the probability that an auction is declared void, depending on the CALRP indicator, and correcting for the participation already estimated in the first stage.

Tables 21 and 22 show that the correction is necessary. The p value is different from zero and the results of the biased regression differ from the corrected one. However, given the signs of coefficients are not altered, we find that the corrected results do not alter the conclusions of the original specification.

Table D1

Heckman probit (two steps) for PDBC: 30, 90, 180 and 360 days

Probit Void Auctions (,): 2nd step								
	(1)	M.E. (1)	(2)	M.E. (2)	(3)	M.E. (3)	(4)	M.E. (4)
CALRP PDBC30	0.0058	0.0004						
	(0.0034)	(0.0002)						
CALRP PDBC90			0.0516***	0.0062***				
			(0.0099)	(0.0008)				
CALRP PDBC180					0.0125***	0.0132***		
					(0.003)	(0.0029)		
CALRP PDBC360							0.0053	0.0050*
							(0.0033)	(0.0024)
Auction Participation (participation =1,: =0): 1st step								
Prime spread swap 30 days	-0.0010*							
	0.0004							
Prime spread swap 90 days			-0.0022***					
			0.0004					
Prime spread swap 180 days					-0.0024***			
					0.0004			
Prime spread swap 360 days							-0.0011	
							0.0007	
Rho	0.7859		0.6337		-0.9935		-0.9926	

Coefficients and standard errors of individual univariate regression between *Auction participation* ∈ {0,1}and the corresponding CALRP for each instrument maturity. Daily data, 2005-2013. Standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

Table D2

Heckman probit (two steps) for BCP: 2, 5 and 10 years

Probit Void Auctions (,): 2nd step						
	(5)	M.E. (5)	(6)	M.E. (6)	(7)	M.E.(7)
CALRP BCP2	0.0092***	0.0102***				
	(0.0026)	(0.0028)				
CALRP BCP5			0.0197	0.0109***		
			(0.0106)	(0.0022)		
CALRP BCP10					0.0085	0.0023
					(0.0212)	(0.0053)
Prime spread swap 360	-0.0008**		-0.0004		0.0013*	
	(0.0003)		(0.0004)		(0.0006)	
Rho	-1		-0.9855		-0.8678	

Coefficients and standard errors of individual univariate regression between *Auction participation* $\in \{0,1\}$ and the corresponding CALRP for each instrument maturity. Daily data, 2005-2013. Standard errors in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

DISPARIDADES REGIONALES DE LA BANCARIZACIÓN EN CHILE. PERÍODO 2001-2012*

Virginia Isabel Montaña A.**
Luz María Ferrada B.***

I. INTRODUCCIÓN

La literatura especializada (Rojas-Suarez, 2006; Larraín, 2006; Hernández y Parro, 2005; Zahler, 2008; Casilda, 2011) reconoce a Chile como el país con mayor intermediación financiera de América Latina y entre países emergentes, siendo el crédito bancario la fuente más relevante de financiamiento para empresas y personas. Esto se explica por los sostenidos resultados macroeconómicos que se registran en el país desde mediados de la década de los 80, además de una permanente política de protección hacia la banca. Sin embargo, pese al reconocimiento del importante desarrollo del mercado financiero en el país, las mediciones desde la perspectiva crediticia y transaccional muestran que los indicadores de bancarización son bajos respecto de los países desarrollados, lo que se traduce en un importante desafío que es necesario abordar por su relevancia en el logro del crecimiento económico.

Al interior del país, se observa que las cifras en el ámbito bancario están sesgadas por la localización metropolitana de las casas matrices y las mesas de dinero, como asimismo, se presenta una fuerte y creciente centralización financiera en torno a la región Metropolitana de Santiago, confirmando la inconsistencia entre la geografía financiera y la de la producción, expresada en el origen y destino territorial de los recursos (Daher, 1995). Considerando lo anterior y la heterogeneidad espacial en diferentes aspectos (laboral, inversión pública y empleo, entre otras), surge la interrogante de cómo se distribuye la bancarización entre las regiones del país, en sus diferentes dimensiones; así como de cuáles son las magnitudes de las posibles diferencias y qué regiones muestran mayores rezagos en la materia.

El objetivo del estudio es medir los niveles de bancarización en las regiones de Chile, en el período 2001-2012, construyendo indicadores (índices sintéticos)

* *Este trabajo se desarrolla en el contexto del proyecto número 10/12 (2012-2013) Bancarización en las regiones de Chile: disparidades y determinantes y el Núcleo de Investigación Economía Regional de la Universidad de Los Lagos.*
** *Magíster en Administración, Departamento de Ciencias Administrativas y Económicas - Universidad de Los Lagos, Osorno – Chile. E-mail: vmontana@ulagos.cl*
*** *Doctora en Economía Aplicada y Gestión Regional, Departamento de Ciencias Administrativas y Económicas Universidad de Los Lagos, Osorno – Chile. E-mail: lferrada@ulagos.cl*

que permitan estimar valores asociados a cada región y medir distancias entre ellas, según dimensiones o componentes y en forma global.

La información proviene de una base de datos de indicadores de bancarización en las distintas dimensiones y por región, la que se construye para estos fines con información obtenida de la Superintendencia de Bancos e Instituciones Financieras (SBIF).

Los resultados muestran que, si bien la región Metropolitana de Santiago aporta significativamente a las disparidades en profundidad y cobertura, se observan diferencias importantes entre las restantes regiones; además, las posiciones relativas que estas asumen difieren en función de cada dimensión.

El artículo se estructura como sigue: en la sección II se efectúa una revisión bibliográfica referente a cómo medir la bancarización y los estudios efectuados en algunos países latinoamericanos. En la sección siguiente se presentan los datos y se describe el modelo empírico utilizado en el estudio. Luego en la sección IV se presentan los resultados obtenidos. La última sección resume el análisis y las conclusiones.

II. REVISIÓN DE LA LITERATURA

La actividad bancaria es parte fundamental del sistema financiero en los diferentes países, en especial en los emergentes y, aunque han estado presentes en la sociedad desde hace muchos años, solo se ha incrementado su importancia en las últimas décadas. Diferentes estudios (según lo resumen Buchieri et al., 2012; Lagos, 2012) muestran la existencia de una relación positiva entre el crecimiento económico de un país y el nivel de desarrollo que logra su sistema financiero.

Una forma recurrente de dimensionar el desarrollo del sistema bancario de un país o región es a través de la denominada bancarización, que comprende el acceso a los servicios financieros y la profundización de estos. Por acceso se entiende la capacidad de la población de utilizar estos servicios sin que existan obstáculos que lo prevengan (Felaban, 2007). Por su parte, la profundización financiera es una medida agregada que relaciona volúmenes transados con el PIB. Cabe entonces preguntarse ¿Cómo se mide la bancarización? Los estudios empíricos usan principalmente indicadores de profundidad financiera, asociada a créditos y ahorros, para efectuar comparaciones entre países o analizar la evolución de la bancarización en un mismo país a lo largo del tiempo. Sin embargo, hoy en día los productos o servicios financieros son más amplios, lo que permite obtener un número mayor de indicadores. Para efectos de determinar el acceso a los servicios financieros, Honohan (2007) plantea un indicador que refleja el porcentaje de la población adulta que utiliza la intermediación financiera (mencionado en Rojas-Suarez y Gonzales, 2008). Siguiendo a Morales y Yáñez (2006), identifican la bancarización con el "establecimiento de relaciones estables y amplias entre las instituciones financieras y sus usuarios,

respecto de un conjunto de servicios financieros disponibles" y reconocen tres dimensiones de esta: profundidad, cobertura e intensidad de uso de productos y servicios financieros. La cobertura se asocia a "la distribución de los servicios financieros entre los distintos grupos de usuarios" y la intensidad a "la cantidad de transacciones bancarias realizadas por una población de referencia". Para cada una de ellas, establecen una serie de indicadores, lo que dificulta encontrar una medida de bancarización global.

Según Felaban (2007), la disponibilidad de información sobre bancarización entre países de América Latina es limitada, lo cual genera restricciones para efectuar análisis que comparen los países; sin embargo, existen estudios a nivel país que resultan interesantes. En Argentina, están los estudios de Anastasi et al. (2010) y De Nigris (2008), quienes asumen una perspectiva territorial, reconociendo la existencia de una dependencia espacial entre los resultados de cada provincia y destacando el análisis local para posteriormente analizar datos agregados. En Colombia, Tafur (2009), quien efectúa un análisis descriptivo de la cobertura del sistema financiero entre los años 1990 y 2006 y efectúa comparaciones con otros países y entre regiones y ciudades de Colombia. En Chile, Zahler (2008) analiza el proceso de bancarización a nivel agregado, destacando las barreras, cómo se han ido superando y el aporte de entidades no bancarias, y Larraín (2006), por su parte, aporta en el análisis de los obstáculos que impiden avanzar en la bancarización.

Por lo tanto, la distribución geográfica de los servicios financieros en Chile es un tema no abordado aún en la literatura financiera, lo que puede deberse a la escasez de antecedentes regionalizados de los flujos financieros extrabancarios, como es el caso de operaciones crediticias en el *retail* y de las operaciones del mercado de valores.

III. DATOS Y MODELO EMPÍRICO

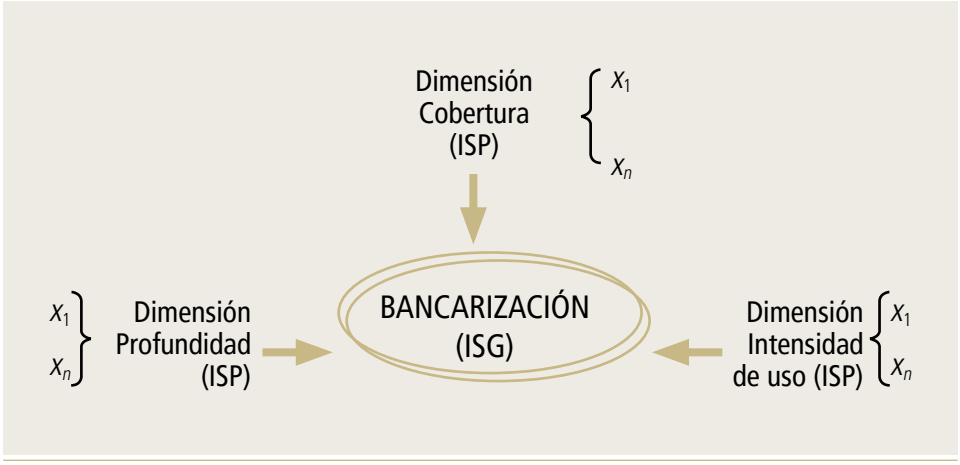
La base de datos se construye con información mensual y anual del sistema bancario. Trata sobre montos transados, números de transacciones efectuadas, número de productos financieros utilizados, número de sucursales bancarias, número de cajeros automáticos y personal bancario, del período comprendido entre enero del 2001 y diciembre del 2012. La fuente de datos corresponde a las estadísticas financieras de la Superintendencia de Bancos e Instituciones Financieras (SBIF), publicadas en su página web. Además, para el cálculo de índices se usan los resultados del PIB y la proyección de la población de cada región y año, los que se obtienen del Banco Central de Chile y del Instituto Nacional de Estadísticas (INE), respectivamente. Si bien las regiones de Chile son 15 actualmente, dos de ellas —Los Ríos, y Arica y Parinacota— son relativamente nuevas, por lo que solo cuentan con información desde el año 2008 en adelante.

Siguiendo las tres dimensiones de bancarización planteadas por Morales y Yáñez (2006), profundidad, cobertura e intensidad de uso; un conjunto de indicadores asociados a cada una de las dimensiones conforman la base de datos. Los resultados promedios de cada indicador, para cada región y año, se muestran en el apéndice A.

Por lo tanto, se tiene un conjunto de indicadores que miden resultados de la situación de bancarización asociada a una variable específica, por región y año; sin embargo, constituyen individualmente medidas parciales, que en consecuencia no permiten dar cuenta de la situación en cuanto a bancarización de cada región.

El objetivo del trabajo es precisamente construir una medida que permita agregar la información parcial de cada indicador, sintetizando la información relevante en tres indicadores parciales (profundidad, cobertura e intensidad de uso) y luego un indicador global de bancarización. El modelo propuesto se sintetiza en el siguiente esquema:

Composición del Índice Sintético Global



Para la estimación se utiliza análisis multivariado, específicamente el análisis de componentes principales (ACP). Se trata de estudiar la interacción entre variables indicativas de bancarización regional, para construir indicadores parciales y uno global.

El procedimiento se basa en la matriz de correlaciones, en este caso a partir del conjunto de indicadores. Mediante transformaciones lineales se obtienen nuevas variables no observadas o componentes principales (en número igual a la cantidad de variables iniciales), los que pueden ordenarse según la cantidad de información (varianza) que contengan. Para el estudio se escogieron los dos primeros, pues aportan una proporción suficientemente grande de la varianza inicial (80%) conforme al valor propio obtenido.

No obstante, antes de estimar los componentes a través del estadístico de Bartlett se constata, a un 5% de significancia, la hipótesis nula de que la matriz de correlaciones es igual a la matriz de identidad. Como veremos, en cada caso se rechaza.

Los ponderadores de cada indicador se calculan como una proporción entre el valor propio (p_i) y la suma de todos ellos) $\sum_{i=1}^{i=n} p_i$, como

$$w_n = p_i \Big/ \sum_{i=1}^{i=n} p_i,$$

siendo n el número de factores seleccionados.

Luego, para la construcción de los índices sintéticos por dimensión o índice sintético parcial (ISP) se aplica la técnica de ACP por separado. De esta forma, cada uno corresponde a una media ponderada de los componentes principales, lo que da origen al ISP (uno por dimensión y región). Si se obtienen dos componentes, el ISP será:
$ISP = \sum \left(C_1 * w_1 + C_2 * w_2 \right)$, en que cada componente (C) es exógeno y ambos capturan suficiente información de dimensión.

El índice sintético global (ISG), se calcula aplicando la misma técnica (ACP), considerando todos los indicadores iniciales de bancarización, independientemente de la dimensión a la que corresponde. Al igual que en los índices parciales, se estima el número de componentes que asegure un 80% de varianza. Para las tres dimensiones definidas, se calcula como:
$ISG = \sum \left(C_1 * w_1 + C_2 * w_2 + C_3 * w_3 \right)$.

Como se ha señalado, en el período estudiado se crean dos nuevas regiones en Chile, lo que impacta en los datos de aquellas regiones que se dividieron. Es por ello que cada indicador se estimará en dos series: 2001- 2007 y 2008-2012; en la primera para cada una de las 13 regiones, y luego, para las 15 vigentes.

IV. RESULTADOS

Esta sección presenta los resultados obtenidos en función de la metodología indicada en el contexto de los objetivos propuestos.

En primer lugar, analizando los valores obtenidos para los indicadores parciales de bancarización, se puede observar que el nivel de bancarización de cada región está en función de la perspectiva financiera que se analice.

En términos promedio, destacan: la región Metropolitana de Santiago en las diferentes dimensiones, pero particularmente en profundidad, y la región de Magallanes que posee mayores indicadores en cobertura e intensidad de uso. A la vez, las regiones menos bancarizadas, en el ámbito de profundidad, son Antofagasta, Atacama y Tarapacá; y en cobertura e intensidad de uso, se identifican las regiones de La Araucanía y El Maule.

La posición privilegiada de la región Metropolitana de Santiago se puede explicar por el hecho de que concentra mayor volumen de transacciones en proporción al PIB o de la población. Por ejemplo, reúne 76% de los montos de colocaciones y 84% de los montos de depósitos y captaciones del país, y su PIB representa 48% del país; asimismo, concentra 68,8% del personal bancario, en comparación con la población, la que equivale aproximadamente a 40% del país.

Los coeficientes de variación de los indicadores (apéndice B), presentan los primeros indicios de disparidades entre las regiones del país, las cuales dependen de la dimensión abordada y de los indicadores en particular. Las principales diferencias se presentan en el ámbito de la profundidad, donde se hace necesario destacar la contribución de la región Metropolitana de Santiago a esta y a las otras disparidades.

Luego, al efectuar el análisis de varianza (Anova) para cada indicador de las diferentes dimensiones, como se aprecia en el apéndice C, se rechazan las hipótesis nulas de igualdad de varianza entre regiones, obteniéndose diferencias estadísticamente significativas en todos los indicadores, ya que el nivel de significancia en todos los casos es menor que 0,05. Con ello se evidencia el comportamiento heterogéneo entre las regiones para las distintas variables de bancarización, que se observa con los promedios, midiendo ahora, en términos de dispersión global, para todo el período de análisis. Luego se muestra que existe suficiente asociación entre las variables (prueba de Bartlett), lo que permite aplicar ACP para obtener el indicador sintético en cada dimensión de bancarización.

1. Análisis de disparidades regionales en profundidad bancaria

Al utilizar la metodología de componentes principales se identificaron dos componentes, que recogen el 83% de la varianza total. El primero (*C1*) se

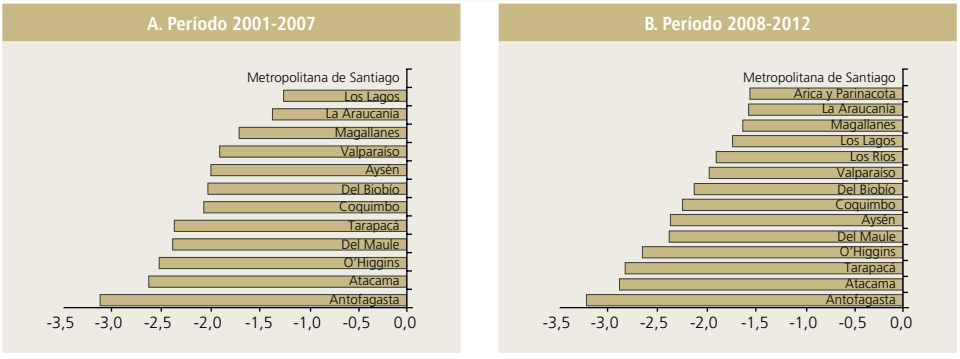
relaciona positivamente con colocaciones, depósitos y cajeros automáticos; el segundo, (*C2*), positivamente con tarjetas de crédito y negativamente con cheques y letras/pagarés. Dados los valores propios estimados, se obtienen las ponderaciones y las funciones: $IP_{pr2001-2007} = C1 * 0,75 + C2 * 0,25$ e $IP_{pr2008-2012} = C1 * 0,74 + C2 * 0,26$ siendo $C1$ y $C2$ el valor (coordenadas) de las componentes 1 y 2 para la región en el año respectivo. De esta forma se obtiene un IP para cada región. Los resultados permiten identificar un *ranking* en el indicador, teniendo como referencia la región Metropolitana de Santiago. Como se señala (gráfico 1, A y B), todas las regiones observan menor profundidad bancaria que la referencia.

Al comparar las posiciones relativas de las regiones en ambos períodos, se tiene que Tarapacá, Aysén y Los Lagos bajan dichas posiciones, en el período 2008-2012, respecto del período anterior. De las nuevas regiones, una se ubica cercana a la región Metropolitana de Santiago (Arica y Parinacota) y la otra en sexta posición (Los Ríos), cercana a su región de origen.

Llama la atención que la región de Antofagasta ocupe la última posición del *ranking*, siendo que constituye la zona que más aporta al PIB nacional (12,2% promedio), luego de la región Metropolitana de Santiago. En este caso, no se está cumpliendo la asociación entre desarrollo financiero y crecimiento económico que indica la literatura.

Gráfico 1

Distancia entre indicador parcial de profundidad para cada región y la región Metropolitana de Santiago



Fuente: Elaboración propia a base de datos obtenidos de la SBIF.

Sin embargo, dicho análisis esconde comportamientos entre territorios. De esta forma, para cada indicador que presenta diferencias significativas, se identifican subgrupos de regiones con comportamientos homogéneos, cuyo número depende del indicador, tal como se observa en el apéndice D, cuadro D1. Las mayores diferencias están en indicadores referentes a captaciones y depósitos, y colocaciones, formando mayor número de subconjuntos. Al contrario, la menor diferencia está en el indicador relativo a cheques. Cabe agregar que la región Metropolitana de Santiago se ubica en el último subconjunto para cada indicador y solo en tarjetas de débito se acerca al nivel de otra región (Arica y Parinacota).

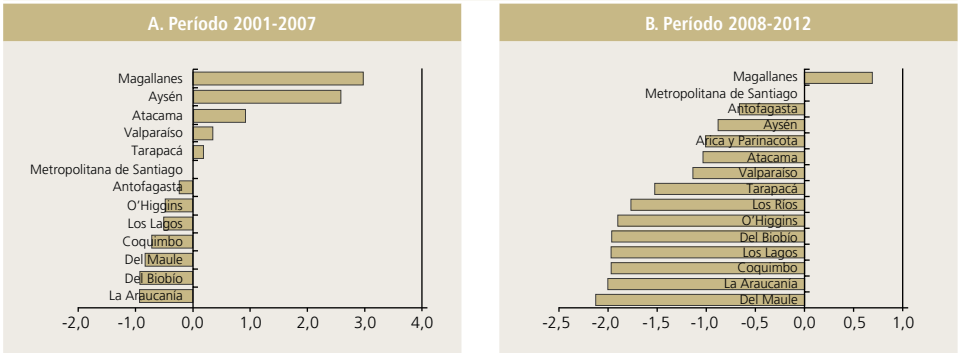
2. Análisis de disparidades regionales en cobertura bancaria

En esta dimensión se obtienen los dos componentes iniciales que explican el 87% de la varianza total. El primer componente se relaciona positivamente con el número de cuentas corrientes, tarjetas de débito, colocaciones, personal bancario, sucursales y cajeros; y el segundo componente se relaciona también positivamente con el número de depósitos y sucursales, y negativamente con la cantidad de tarjetas.

Dados los valores propios estimados se obtienen las ponderaciones y con ellas el indicador por región, esto es: $IP_{cr2001-2007} = C1 * 0,78 + C2 * 0,22$ e $IP_{cr2008-2012} = C1 * 0,83 + C2 * 0,17$. Luego se calculan las diferencias entre el valor del índice para cada región y la región Metropolitana de Santiago (gráfico 2, A y B).

Gráfico 2

Distancia entre indicador parcial de cobertura para cada región y la región Metropolitana de Santiago



Fuente: Elaboración propia a base de datos obtenidos de la SBIF.

En este caso los indicadores se obtienen según número de habitantes, con lo cual se elimina el efecto PIB evidenciado en el punto anterior. De esta forma se observa en el primer caso, (cuando se incluye el período 2001-2007), que existen cinco regiones que manifiestan una posición relativa mejor que la región Metropolitana de Santiago; sin embargo, para el período 2008- 2012, solo Magallanes registra una mejor posición, manifestándose nuevamente la tendencia a la concentración. A través del tiempo, regiones como Antofagasta y Metropolitana de Santiago; han mejorado su posición relativa, en cambio Aysén, Atacama, Valparaíso, Tarapacá, El Maule y Los Lagos han retrocedido.

Pese a lo anterior, se observa subconjuntos de regiones con comportamientos homogéneos en cada indicador, siendo los indicadores relativos al número de personal bancario y el número de sucursales, los que alcanzan a siete subconjuntos. El referido a cajeros automáticos solo posee cuatro subconjuntos, reflejando una menor disparidad, lo que se detalla en el cuadro D2 del apéndice D.

3. Análisis de disparidades regionales en intensidad de uso de productos o servicios bancarios

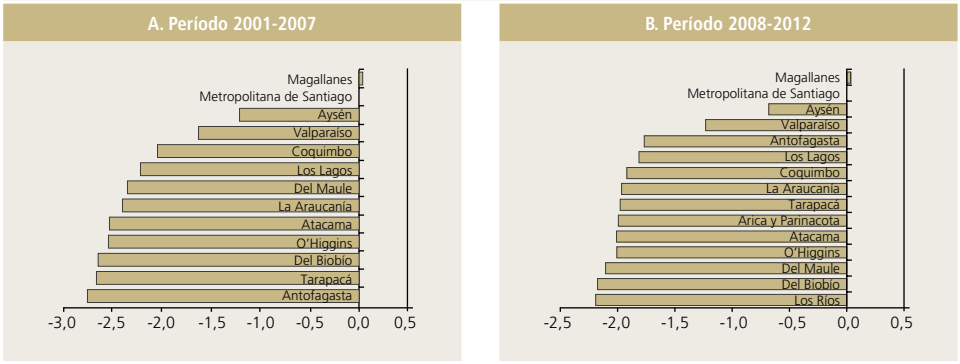
Tal como en las otras dimensiones, se evalúa el nivel de bancarización en intensidad de uso estimando un indicador. Mediante ACP se estiman dos componentes que capturan el 90% de la varianza total. El primer componente se relaciona positivamente con indicadores sobre cajeros, tarjetas y cheques; y el segundo componente se relaciona en forma negativa con indicadores sobre cajeros y tarjetas, y en forma positiva aquellos referentes a letras y pagarés.

El indicador se obtiene de: $IP_{ir2001-2007} = C1 * 0,69 + C2 * 0,31$ y $IP_{ir2008-2012} = C1 * 0,67 + C2 * 0,33$ conforme a los valores propios calculados. Se obtiene nuevamente un alto grado de concentración de la transacciones en torno a la región Metropolitana de Santiago. En el gráfico 3 se aprecia que la distancia entre el valor del índice para cada región y la región Metropolitana de Santiago es negativa en todos los casos, solo Magallanes obtiene intensidad en el uso de los servicios financieros similares a los de la referencia, tanto para el período 2001-2007 como para 2008-2012. Los cambios de posición relativa más relevantes, de un período a otro, se observan en las regiones de Antofagasta y Tarapacá.

Tal como en las dimensiones analizadas precedentemente, en este caso también se analiza si existen similitudes entre subgrupos. Como muestra el cuadro D1-C en el apéndice, para el índice referido a cheques, se obtiene el mayor número (siete) de subconjuntos de regiones, manifestando mayor dispersión. Al contrario, el relativo a tarjetas de débito se concentra en solo cuatro subconjuntos.

Gráfico 3

Distancia entre indicador parcial de intensidad de uso para cada región y la región Metropolitana de Santiago



Fuente: Elaboración propia a base de datos obtenidos de la SBIF.

4. Índice sintético global

El índice sintético global se obtuvo, como se indica en el apartado metodológico, obteniendo las siguientes funciones: $IP_{2001-2007} = C1 * 0,59 + C2 * 0,25 + C3 * 0,16$ e $IP_{2008-2012} = C1 * 0,62 + C2 * 0,25 + C3 * 0,13$. Los resultados se presentan en la segunda columna del cuadro 1, A y B.

Para efectos de análisis, luego se estima el ISG corregido (ISGC), es decir se asignó el puntaje base (cero) a la región con menor índice, para luego agregárselo a las demás regiones; de esta forma se puede observar las distancias y evidenciar el alto nivel de concentración del desarrollo bancario en torno a la región Metropolitana de Santiago. Solo la región de Magallanes observa resultados cercanos a ella. Estos resultados confirman el análisis por dimensión anterior. Las regiones con menor ISG son O`Higgins, si se considera el período 2001-2007, y Atacama, en el período 2008-2012.

Con todo, al menos tres aspectos llaman la atención: (1) que los centros urbanos cercanos a la región Metropolitana de Santiago no capturen el dinamismo de esta, con la excepción de Valparaíso, lo que lleva a preguntarse qué competencias o recursos requieren dichos territorios para atraer dichas actividades; (2) regiones con alto PIB del norte de Chile, como Antofagasta y Atacama, no acceden a los beneficios de la bancarización, y (3) las regiones del extremo sur, Aysén y Magallanes, tienen altos niveles de bancarización en el período 2001-2007, y en el período 2008-2012, Magallanes mantiene su posición relativa, pero también ocupa un lugar destacado la región de Arica y Parinacota, en el extremo norte.

Cuadro 1

Índice sintético global (ISG)

A. Período 2001-2007			B. Período 2008-2012		
Región	ISG	ISGC	Región	ISG	ISGC
Metropolitana de Stgo.	1,946	2,436	Metropolitana de Stgo.	2,112	2,660
Magallanes	0,756	1,246	Magallanes	0,725	1,272
Aysén	0,149	0,639	Arica y Parinacota	0,165	0,712
Valparaíso	0,053	0,543	Valparaíso	0,132	0,679
Los Lagos	-0,047	0,443	La Araucanía	0,044	0,591
La Araucanía	-0,209	0,281	Los Lagos	0,017	0,564
Tarapacá	-0,296	0,195	Aysén	-0,071	0,476
Coquimbo	-0,299	0,191	Los Ríos	-0,189	0,358
Del Maule	-0,365	0,125	Coquimbo	-0,263	0,284
Atacama	-0,367	0,124	Del Biobío	-0,268	0,279
Del Biobío	-0,400	0,091	Del Maule	-0,355	0,192
Antofagasta	-0,429	0,062	Tarapacá	-0,453	0,094
O`Higgins	-0,490	0,000	O`Higgins	-0,507	0,040
			Antofagasta	-0,541	0,006
			Atacama	-0,547	0,000

Fuente: Elaboración propia en base a datos obtenidos de la SBIF.

V. ANÁLISIS Y CONCLUSIONES

El propósito de este artículo es determinar indicadores de bancarización de las regiones del país y evaluar distancias relativas en los períodos 2001-2007 y 2008-2012, lo que se logra calculando indicadores reconocidos en la literatura especializada, y aplicando análisis de componentes principales para obtener índices que integren diferentes variables.

Con los análisis efectuados se encuentra evidencia de la existencia de diferencias regionales en las tres dimensiones de bancarización y a nivel global. Se muestra que: (i) la dispersión que registra cada una de las variables en el período de análisis, refleja un comportamiento heterogéneo territorialmente; (ii) la bancarización en cada dimensión indica que la región Metropolitana de Santiago ocupa una posición privilegiada, asumiendo importantes distancias respecto de las restantes regiones, principalmente en el ámbito de la profundidad bancaria, lo cual confirma la concentración de la actividad bancaria en torno a este territorio; (iii) a nivel global se confirma lo anterior, para ambos períodos; (iv) los mayores cambios en posiciones relativas, de un período a otro, se visualizan en la dimensión de cobertura, donde la región Metropolitana de Santiago avanza, desplazando de lugar a cuatro regiones que entre el 2001 y el 2007 se ubicaban en mejor posición; esto incide en que, en términos globales, se produzcan bajas en las posiciones para las regiones de Aysén, Tarapacá y Atacama; (v) en el ámbito de la profundidad, no necesariamente las regiones

con mayor o menor PIB registran mayores o menores niveles de bancarización; ejemplos de ello son regiones como Arica, Magallanes y La Araucanía, que poseen alto índice de profundidad y están asociadas a menores PIB, que las regiones de Antofagasta y Valparaíso con bajo índice, pero que registran mayores PIB, indicando que una región del país que genera mayor riqueza no necesariamente está más bancarizada, y viceversa, y (vi) las regiones con mayor rezago en bancarización son: Atacama, especialmente en materia de profundidad, Antofagasta y O'Higgins, en profundidad e intensidad de uso, y El Maule en todas las dimensiones.

Los resultados referentes al rol que juega la región Metropolitana de Santiago en la materia, son coherentes con la fuerte centralización financiera manifestada en el trabajo de Daher (1995). Lo anterior permite señalar que la concentración de la actividad financiera en torno a la región Metropolitana de Santiago persiste a través del tiempo.

La principal contribución a la literatura es que se propone integrar indicadores que tienen la particularidad de medir diferentes ámbitos de la bancarización, a través de diversas variables, y a la vez, entregar una medida global, además de generar información para cada región e identificar diferencias entre ellas. Llama la atención el desarrollo dispar y concentrado de la bancarización, por lo que se confirma que existen espacios para avanzar en este concepto en las regiones. Como lo señala la literatura, una bancarización menos heterogénea probablemente aporte a un crecimiento económico regional y nacional y a la disminución de la brecha con países desarrollados.

Esta investigación constituye un punto de partida en cuanto a la bancarización en las regiones de Chile. Al respecto quedan algunas preguntas abiertas para posibles investigaciones futuras, como, por ejemplo ¿Es esperable cierta convergencia regional en bancarización? ¿Qué variables determinan si una región está más o menos bancarizada?

Por ahora no se ha pretendido buscar causas de las disparidades señaladas; sin embargo, dado que las funciones del sistema bancario no se desempeñan equitativamente en el territorio, es ineludible plantear ¿Qué condiciones se requieren en el territorio para reducir la inequidad en bancarización?

Finalmente, no parece lógico que regiones con alto PIB, como Antofagasta, tengan baja bancarización. Es probable que se deba a que los beneficios asociados a la concentración del sector en torno a Santiago aún sean superiores y, por lo tanto, es previsible que las actividades financieras las trasladen al centro del país. No es casual encontrar direcciones de empresas mineras en comunas de la región Metropolitana de Santiago. Por tanto, cabe plantearse posibles señales desde el Estado que favorezcan la desconcentración.

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APÉNDICE A

ÍNDICE PROMEDIO ANUAL DE BANCARIZACIÓN

Cuadro A1

A. Dimensión de profundidad financiera

Región	Monto coloc./PIB	Monto dep. y capt/PIB	Monto ATMs/PIB	Monto tarj. débito/PIB	Monto cheques/PIB	Monto letras y pagaré/PIB
Arica y Parinacota*	0,458	0,299	0,299	0,043	1,550	0,004
Tarapacá	0,246	0,151	0,151	0,010	1,336	0,009
Antofagasta	0,119	0,057	0,057	0,007	0,444	0,001
Atacama	0,192	0,114	0,114	0,010	1,059	0,004
Coquimbo	0,357	0,176	0,176	0,013	1,492	0,015
Valparaíso	0,375	0,256	0,256	0,018	2,001	0,013
O`Higgins	0,259	0,163	0,163	0,009	1,209	0,012
Del Maule	0,406	0,222	0,222	0,007	1,735	0,024
Del Biobío	0,362	0,224	0,224	0,016	1,825	0,009
La Araucanía	0,573	0,303	0,303	0,016	2,410	0,015
Los Ríos*	0,208	0,267	0,267	0,008	0,771	0,002
Los Lagos	0,627	0,305	0,305	0,016	3,194	0,013
Aysén	0,376	0,192	0,192	0,013	1,728	0,006
Magallanes	0,479	0,308	0,308	0,023	1,989	0,008
Metropolitana de Stgo.	1,078	1,083	1,083	0,029	12,197	0,045
TOTAL PAÍS	0,670	0,605	0,605	0,020	6,418	0,026

B. Dimensión de cobertura financiera

Región	Nº cta. cte. c/10.000 hab.	Nº dep. a plazo c/10.000 hab.	Tarj. débito c/10.000 hab.	Personal bancario c/10.000 hab.	ATMs c/10.000 hab.	Sucursales c/10.000 hab.
Arica y Parinacota*	1.066	10.468	4.881	14,73	4,43	1,07
Tarapacá	1.011	7.654	3.131	16,48	3,45	1,04
Antofagasta	1.168	7.201	4.822	18,97	4,33	1,37
Atacama	831	8.349	2.940	16,02	3,51	1,40
Coquimbo	645	6.927	2.096	13,11	2,92	0,93
Valparaíso	1.101	8.025	3.011	17,36	3,70	1,20
O`Higgins	670	7.271	2.020	12,48	2,64	0,94
Del Maule	663	6.971	1.765	12,22	2,19	0,83
Del Biobío	780	6.960	2.693	12,32	2,58	0,81
La Araucanía	661	7.034	2.011	11,55	2,54	0,82
Los Ríos*	919	7.519	3.353	13,85	3,95	1,08
Los Lagos	765	6.954	2.268	14,10	2,89	0,86
Aysén	1.102	9.582	2.829	19,10	3,01	1,69
Magallanes	1.719	11.079	5.341	25,68	4,59	1,80
Metropolitana de Stgo.	1.772	7.780	6.271	46,91	4,39	1,31
TOTAL PAÍS	1.216	7.540	4.057	27,41	3,56	1,12

C. Dimensión de intensidad de uso

Región	Nº trans. ATMs/ 10.000 hab.	Nº de trans. tarj. débito/10.000 hab.	Nº de trans. letras y pagaré/10.000 hab.	Nº de trans. con cheques/10.000 hab.
Arica y Parinacota*	257.697	115.745	269	77.884
Tarapacá	182.662	54.586	419	116.434
Antofagasta	242.561	56.645	514	119.351
Atacama	179.361	36.067	482	112.437
Coquimbo	146.419	28.911	894	88.619
Valparaíso	176.933	43.464	1.002	145.780
O`Higgins	125.816	17.901	504	94.200
Del Maule	92.198	12.534	550	92.257
Del Biobío	127.327	26.421	366	101.586
La Araucanía	113.703	17.838	601	93.094
Los Ríos*	162.950	57.508	157	94.906
Los Lagos	131.661	27.909	506	127.375
Aysén	138.315	26.971	1.019	180.981
Magallanes	219.698	77.731	1.383	277.865
Metropolitana de Stgo.	222.328	89.103	1.880	219.815
TOTAL PAÍS	175.991	53.777	1.124	156.599

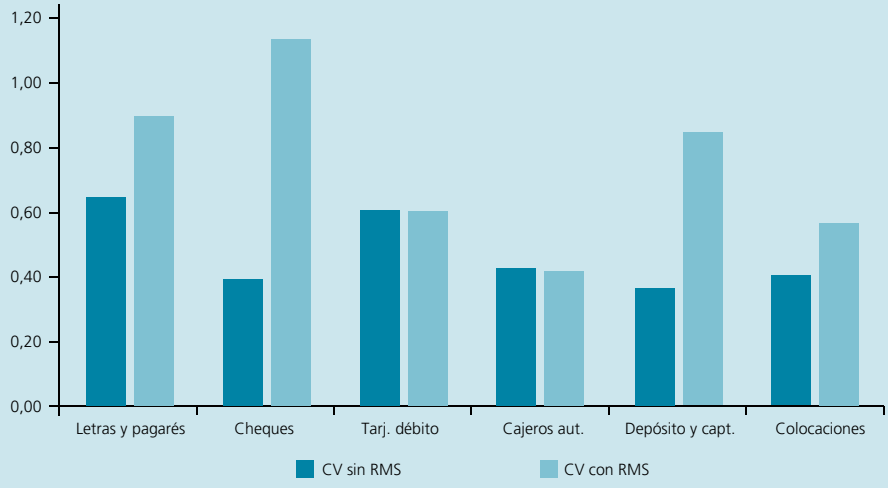
Fuente: Elaboración propia a base de datos obtenidos de la SBIF, el BCCh y el INE.
(*) Corresponde al promedio de los últimos 5 años, dado que registran cifras como región, desde el año 2008 en adelante.

APÉNDICE B

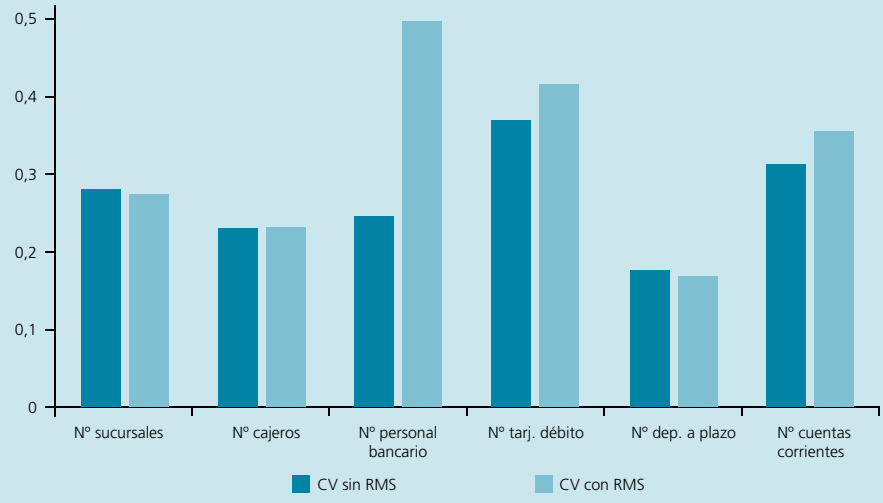
COEFICIENTES DE VARIACIÓN, INDICADORES PROMEDIO, PERÍODO 2001-2012

Gráfico B1

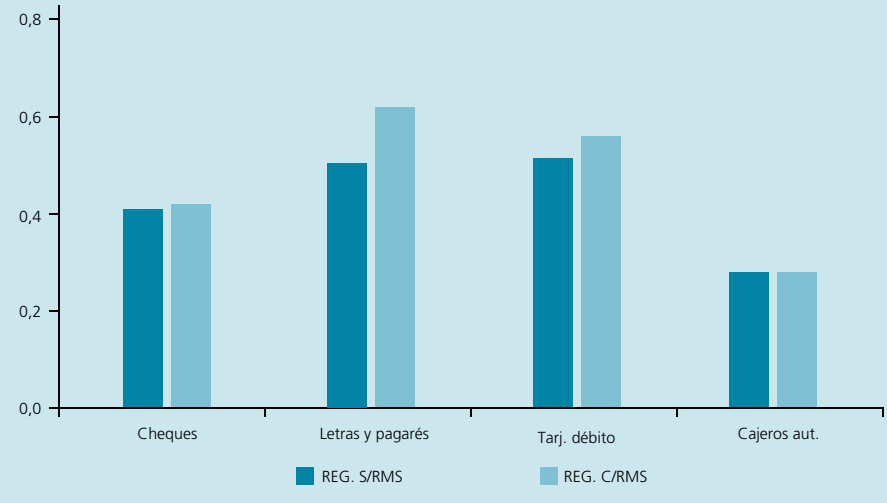
A. Dimensión de profundidad



B. Dimensión de cobertura



C. Dimensión de intensidad de uso



Fuente: Elaboración propia a base de datos obtenidos de la SBIF y el BCCh.

APÉNDICE C

ANÁLISIS DE VARIANZA (ANOVA), PERÍODO 2001-2012

Cuadro C1

A. Dimensión de profundidad bancaria

Indicadores		Suma de cuadrados	gl	Media cuadrática	F	Sig.
Monto colocaciones/PIB	Inter-grupos	8,59	14	0,61	64,58	0
	Intra-grupos	1,44	151	0,01		
	Total	10,03	165			
Monto depósitos y captaciones/PIB	Inter-grupos	9,36	14	0,67	220,11	0
	Intra-grupos	0,46	151	0,00		
	Total	9,82	165			
Monto ATMs/PIB	Inter-grupos	0,55	14	0,04	18,57	0
	Intra-grupos	0,32	151	0,00		
	Total	0,88	165			
Monto tarjetas débito/PIB	Inter-grupos	0,01	14	0,00	6,11	0
	Intra-grupos	0,02	151	0,00		
	Total	0,03	165			
Monto cheques/PIB	Inter-grupos	1.167,87	14	83,42	29,14	0
	Intra-grupos	432,21	151	2,86		
	Total	1.600,08	165			
Monto letras y pagarés/PIB	Inter-grupos	0,02	14	0,00	7,82	0
	Intra-grupos	0,02	151	0,00		
	Total	0,04	165			

B. Dimensión de cobertura bancaria

Indicador		Suma de cuadrados	gl	Media cuadrática	F	Sig.
N° ctas. ctes./10.000 hab.	Inter-grupos	21.149.654	14	1.510.689,54	35,31	0
	Intra-grupos	6.461.201	151	42.789,41		
	Total	27.610.855	165			
N° dep. plazo/10.000 hab.	Inter-grupos	257.748.652	14	18.410.618,02	49,98	0
	Intra-grupos	55.618.464	151	368.334,20		
	Total	313.367.116	165			
N° cajeros /10.000 hab.	Inter-grupos	96	14	6,86	5,10	0
	Intra-grupos	203	151	1,35		
	Total	299	165			
N° tarj. déb/10.000 hab.	Inter-grupos	343.981.015	14	24.570.072,51	7,99	0
	Intra-grupos	464.598.097	151	3.076.808,59		
	Total	808.579.112	165			
N° pers. banc./10.000 hab.	Inter-grupos	13.108	14	936,31	216,29	0
	Intra-grupos	654	151	4,33		
	Total	13.762	165			
N° sucursales /10.000 hab.	Inter-grupos	16	14	1,16	34,88	0
	Intra-grupos	5	151	0,03		
	Total	21	165			

C. Dimensión de intensidad de uso

Indicador		Suma de cuadrados	gl	Media cuadrática	F	Sig.
N° trans. ATMs/10.000 hab.	Inter-grupos	355.040.203.071	14	25.360.014.505	9,66	0
	Intra-grupos	396.258.583.833	151	2.624.229.032		
	Total	751.298.786.903	165			
N° trans. tarj. déb./10.000 hab	Inter-grupos	110.297.671.925	14	7.878.405.137	5,08	0
	Intra-grupos	233.989.628.161	151	1.549.600.186		
	Total	344.287.300.086	165			
N° trans. letras y pagaré/10.000 hab.	Inter-grupos	29.157.185	14	2.082.656	9,99	0
	Intra-grupos	31.492.267	151	208.558		
	Total	60.649.451	165			
N° Trans. cheques/10.000 hab.	Inter-grupos	475.117.252.718	14	33.936.946.623	72,46	0
	Intra-grupos	70.722.655.951	151	468.361.960		
	Total	545.839.908.669	165			

Fuente: Elaboración propia.

APÉNDICE D

NÚMERO DE REGIONES EN CADA SUBCONJUNTO

Cuadro D1

A. Dimensión de profundidad bancaria (*)

Indicadores	Subconjuntos							
	1	2	3	4	5	6	7	8
Monto colocaciones/PIB	4	6	6	8	4	4	1	
Monto depósitos a plazo/PIB	2	5	6	5	5	7	7	1
Monto cajeros /PIB	5	10	7	2	2	2		
Monto tarjetas débito/PIB	12	11	8	3				
Monto cheques/PIB	13	13	1					
Monto letras y pagarés/PIB	13	10	1					

B. Dimensión de cobertura bancaria (*)

Indicadores	Subconjuntos						
	1	2	3	4	5	6	7
N° ctas. ctes./10.000 hab.	8	6	6	6	2		
N° dep. plazo/10.000 hab.	10	7	5	2	2		
N° cajeros/10.000 hab.	11	10	10	11			
N° tarj. déb./10.000 hab.	11	9	8	7	4		
N° pers. banc./10.000 hab.	8	5	5	4	5	1	1
N° sucursales/10.000 hab.	8	8	6	5	4	4	2

C. Dimensión de intensidad de uso (*)

Indicadores	Subconjuntos						
	1	2	3	4	5	6	7
N° trans. en cajeros /10.000 hab.	8	10	7	6	6		
N° trans. tarj. déb./10.000 hab.	12	12	10	7			
N° trans. letras y pagarés/10.000 hab.	11	11	11	4	2		
N° trans. cheques/10.000 hab.	7	9	7	5	1	1	1

Fuente: Elaboración propia a base de datos obtenidos de la SBIF y el BCCh.
(*) $\alpha = 0{,}05$.

NOTAS DE INVESTIGACIÓN

Esta sección tiene por objetivo divulgar artículos breves escritos por economistas del Banco Central de Chile sobre temas relevantes para la conducción de las políticas económicas en general y monetarias en particular. Las notas de investigación, de manera frecuente, aunque no exclusiva, responden a solicitudes de las autoridades del Banco.

THE USE OF FOREIGN EXCHANGE DERIVATIVES BY EXPORTERS AND IMPORTERS: THE CHILEAN EXPERIENCE*

Faruk Miguel L.**

I. INTRODUCTION

This research note analyses the use of foreign exchange (FX) derivatives by Chilean exporters and importers (EXIM) that conduct international transactions in foreign currencies. It seeks to answer the questions of how many derivatives are used, how are they used and what are their characteristics. These questions are highly relevant as EXIM firms generate currency mismatches between their assets and liabilities and potentially increase their exposure to financial instability due to exchange rate fluctuations.

In practice, firms can hedge their currency mismatches by using different types of financial instruments, including foreign-denominated debt and FX derivatives. As an example, exporters can take advantage of natural hedges by aligning their revenues in foreign currency with foreign-denominated debt obligations. On the other hand, both exporters and importers may reduce the uncertainty of their expected cash flow by fixing a future exchange rate with FX derivatives. Indeed, Allayannis and Ofek (2001) show that "exposure through foreign sales and trade" is the only significant determinant of the usage level of FX derivatives.

One of the most important lessons learned from the Global Financial Crisis (GFC) was the need for policy makers to have access to a wide range of reliable,

* *This is a revised version of an original paper prepared for the 8th IFC Conference on "Statistical implications of the new financial landscape" held at the Bank for International Settlements in Basel, Switzerland on 8-9 September 2016. The paper has benefitted from helpful comments from Alejandro Jara, Erika Arraño, Paulina Rodríguez, Pablo Filippi, and Alexander Hynes. The views expressed in this note do not necessarily represent those of the Central Bank of Chile.*
** *Statistics Division, Central Bank of Chile. E-mail: fmiguel@bcentral.cl*

timely and detailed financial statistics (BIS, 2010). Consistent with this idea, this paper exploits a database of FX derivatives catalogued by the Central Bank of Chile (CBC) at the contractual level and studies the FX coverage strategies employed by EXIM firms from 2000 to 2015. This database is unique in the revised literature in terms of the scope of businesses covered and the length of time analyzed.

By taking advantage of contract-by-contract data from more than 5,600 firms over the sample period, this paper seeks to gain a better understanding of the structural characteristics of the FX derivatives markets in developing countries. Moreover, a solid set of stylized facts regarding the use of FX derivatives at the micro level are established in order to study the FX risk management strategies followed by EXIM firms in Chile.

The paper establishes clear evidence of high concentration in the use of FX derivatives among EXIM firms, as well as a visible differentiation among their strategies. The paper shows a positive relation between firm size and the number of firms that use FX derivative hedging strategies. Furthermore, a direct relationship is observed between the level of foreign trade flows and turnover in the FX derivatives market. The most common instruments used are Chilean peso against U.S. dollar forward agreements maturing in less than 180 days.

The remainder of the paper is organized as follows. The next section reviews the literature on existing studies of the FX derivatives markets. Section III describes relevant details regarding the Chilean FX derivatives market. Section IV discusses the data used. Sections V and VI outline aggregate FX derivatives usage and analyze the data at the micro level. Finally, the conclusions and main findings are summarized in section VII.

II. LITERATURE REVIEW

The literature presenting stylized facts on FX derivatives use by EXIM firms is limited, especially for emerging or developing economies. Some exceptions include cross-country studies as well as some specific case studies for countries like England, New Zealand, the Czech Republic, Uruguay, Brazil and Chile.

Bartram et al. (2009) compare the use of derivatives for a wide range of countries. This study relies on accounting information from 7,000 non-financial corporations to show that 60% of the firms in their sample use some type of derivative. In particular, 45% use FX derivatives, 33% use interest rate derivatives and only 10% use commodity price derivatives. The latter two show a marked difference across industry types, while those that use FX derivatives show more widespread usage across industries. Across all countries, large firms tend to use more coverage than their smaller counterparts.

The Bank of England (1998) looks at survey information in order to characterize the use of derivatives by exporters in England. They show that 78% of exporters,

especially larger ones, hedge themselves against exchange rate risk exposures, while smaller exporters are less inclined to do so. The coverage type taken is also shown to differ depending on firm size, with smaller firms typically hedging through standardized products such as bank overdrafts and loans. This is related to the fact that smaller firms possess more limited resources to identify, understand and manage exchange rate risk.

On the other hand, Briggs (2004) uses interviews with large banks and 42 EXIM firms in New Zealand as a principal input to show that exchange rate hedging is more important for smoothing revenue as opposed to generating net gains. Fabling and Grimes (2008) also consider New Zealand but only focus on exporting firms in a wide ranging database. They show that exporters hedge approximately 65% of their exposure and that hedging is positively correlated with firm size. They also find a positive relationship between export intensity and hedging which is related to the larger balance sheet risk arising from currency fluctuations.

More recently, Čadek et al. (2011) analyze the hedging behavior of 184 Czech exporting firms, relying on information from surveys and bank interviews. The vast majority of exporters (approximately 60%, covering over 88% of exports) hedge their FX exposures with natural hedging or derivatives contracts. Forwards and zero-cost options are the most widely-used instruments in maturities ranging from three months to one year. They find that hedging increases with firm size as well as with the foreign sales (exports) to sales ratio.

Buscio et al. (2011) use survey data to show that the use of FX derivatives by Uruguayan firms ranges between 6% and 7%. This use is positively related with the size of the firm, the firm's orientation towards exports and whether or not the firm is publicly listed. They attribute this moderate use of FX derivatives to a poor awareness of exchange rate exposures and the implicit insurance produced by official interventions in the FX market. Specifically, EXIM firms tend to have income and cost structures in foreign currency that provide natural coverage.

Júnior (2007) uses accounting information from publicly traded firms in Brazil (more than half of which are exporters) to present evidence of increasing hedging using FX derivatives.[1] Currency swaps are found to be the most commonly utilized instrument, pointing to the importance of coverage versus speculation. The authors also find a negative relationship between hedging and the foreign sales (exports) to sales ratio. Factoring in natural coverage, the author associates low FX derivatives usage with the belief by exporters that there is a low probability of appreciation of the Brazilian real.

Finally, there are several studies that analyze the use of derivatives in EXIM firms in Chile. Acharán et al. (2009) finds evidence that lower global activity

1 The increase in exchange rate hedging is associated with the adoption of a floating exchange rate regime in Brazil.

after the fall of Lehman Brothers did not produce a reduction in the usage of FX derivatives by exporters, irrespective of size. Rodríguez and Villena (2009) show that for different EXIM firm sizes there was an acceleration in the growth of FX derivatives usage between 1998 and 2008.

This note expands on these previous works to analyze the use of FX derivatives in Chile. Whereas previous papers used aggregate data to analyze the number and size of Chilean EXIM firms using derivatives, as well as their behavior during the GFC, this article employs transaction-level data to highlight the different types of instruments, currencies and maturities used. It also draws attention to new evidence that presents the different net derivative positions (NDPs) between exporters and importers at the aggregate, sectoral and individual firm levels. Furthermore, a micro-level analysis examines the degree of concentration of EXIM firms, as well as the relationship between foreign trade and activity in the FX derivatives market. This unique examination yields micro-based evidence confirming the aggregate conclusions found in previous literature, which is that the usage of FX derivatives in Chile by EXIM firms is growing. This is particularly true for larger-sized firms or firms that conduct more foreign trade.

III. THE CHILEAN FX DERIVATIVES MARKET

This section benefits greatly from Villena and Salinas (2014) in order to provide an overview of the general characteristics of the Chilean FX derivatives market within which Chilean EXIM firms carry out their hedging activities. They observe significant growth in this market between 1998 and 2013. In particular, the volume of derivatives market activity grew from US$76 billion to US$903 billion during the period studied. From an international perspective, Chile shows greater levels of depth[2] than both emerging economy and Latin American averages. This development is explained by a variety of general and specific factors: the elimination of capital controls in 2001, a higher level of international trade and greater stocks of assets and liabilities outside the country throughout the sample and, perhaps most importantly, the need to hedge growing pension fund investments.[3]

This article shows that, for the year 2013, derivatives operations were undertaken almost only in over-the-counter (OTC) markets and that the most used FX derivatives are forward contracts and FX swaps, which account for 96% of the total amount traded. The remaining 4% corresponds to currency swaps and options. Almost all (98%) transactions are Chilean pesos against U.S. dollars. In terms of settlement of non-interbank transactions, the vast majority of contracts are cash-settled (98%) with the remaining (2%) being physically

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2 Measured as notional amounts normalized by GDP.

3 Avalos and Moreno (2013) present evidence that the greater depth and liquidity in the Chilean FX market is due largely to the necessity to cover pension funds.

delivered. The decomposition of the outstanding positions by sector shows that pension funds constitute the most relevant sector, followed closely by real sector and financial companies (excluding banks and institutional investors), and then insurance companies.

IV. DATA DESCRIPTION

Since 1992, the CBC has collected daily information on FX derivatives transactions made through the Formal Foreign Exchange Market (FEM).[4] Using this database, the CBC produces separate series on turnover and amounts outstanding and is used as a main input in understanding the FX derivatives market in Chile. For this article, a monthly series was created from 2000 to 2015 for turnover, amounts outstanding, contractual term length, currency type and instrument. Additionally, the database of the National Customs Service was utilised to identify FX derivatives contracts between FEM institutions and EXIM firms.[5]

The aggregate analysis performed at the CBC shows that FX derivatives contracts with maturities less than seven days can be associated with a speculative nature. Given that the focus of this article is to study the use of FX derivatives for hedging purposes, the analysis excludes contracts with maturities shorter than seven days. This is also justified by the fact that most international trade by EXIM firms has payment timeframes longer than 30 days.

In order to identify EXIM firms, the "net" definition of exporters (importers) is used. Thus, those firms having a level of exports (imports) higher than imports (exports)[6] during a calendar year are considered exporters (importers)[7] in that year. This permits a correct interpretation of the expected FX derivatives position of a particular type of business. Furthermore, because data are difficult to obtain and, in line with Briggs (2004), this investigation does not consider international trade in services.

As a result of the definition of an EXIM firm used, the database yielded a sample of more than 5,600 FX derivatives-using companies. The revised literature on FX derivatives usage stresses the convenience of having access to more detailed

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4 According to CBC surveys, 96% of Chilean market transactions take place through FEM channels. The institutions that make up the FEM include banks and banking institutions (other financial firms) that are legally obligated to make daily reports on all signed foreign exchange derivatives contracts. See Orellana and Rodriquez (2009) for a description of the statistical collection methodology utilized by the CBC.

5 Counterparty information is matched with National Customs Service data via the unique tax identification number (RUT) held by all legal persons and entities residing in Chile. Furthermore, firms were matched to sectors using the CBC directory using the same legal ID. It is important to note that both databases contain individuals. For simplicity, these are treated as businesses here.

6 Čadek et al. (2011) use an alternative definition of exporters for the Czech Republic: firms that have a share of exports in total sales greater than 50%, or those whose nominal exports sum to more than CZK 1 billion.

7 This paper is focused on "direct" exporters. A firm that sells a product to another national firm, which exports said product, is an "indirect" exporter, not considered here.

information such as larger databases or administrative contract registries (Čadek et al. (2011), Fabling and Grimes (2008), Briggs (2004) and Bank of England (1998)). This database, which utilizes contract-by-contract information from bank administrative records combined with a sample of all Chilean EXIM firms from 2000 to 2015, makes this work unique in this research area due to the sheer number of companies included and the breadth of time covered.

1. General aspects of EXIM firms

International goods trade growth in Chile has averaged 7.7% annually over the past 16 years, even as it was interrupted briefly by the GFC where exports and imports contracted by 19% and 31% respectively from peak to trough. The number of importers reached a peak of more than 160,000 firms in 2015 with an average annual growth rate of 19% between 2008 and 2015. This compares with an annual growth rate of 2% before the GFC[8] (2000 to 2008). For their part, the number of exporters is substantially lower, with a sample peak of 8,400 in 2014.

In order to gain insight into the structure of EXIM firms, the gross amounts of exports and imports were calculated for each firm over the entire sample period. This provided a number of exporters and importers on a "gross" basis. After applying the "net" definition of an EXIM firm, the number of exporters was reduced by 40% and the number of importers was reduced by 6%. This net effect confirms that exporters generally import goods as well, as they often require inputs from abroad.[9]

Throughout the sample period, a total of 25,058 exporters and 558,818 importers were observed including both hedgers and non-hedgers. The differences that exist in the composition of EXIM firms by size are shown in table A1 of the appendix. On average, more than 93% of importers are small (importing less than US$500,000 worth of goods annually) while only 66% of exporters are small (exporting less than US$500,000 worth of goods annually). Furthermore, the rotation of businesses and individuals that enter and exit the sample annually was greater for exporters. For exporters, 47% remained in the sample for at least four years with only 3% in all 16 sample years. On the other hand, 65% of importers remained in the sample for at least four years with only 5% in all 16 years (table A2 of the appendix).

8 This difference is explained, in part, by the incorporation of small importers once several bilateral free trade agreements became active.

9 Rébora and Vivanco (2016) confirm this finding by showing that Chilean exporters have made significant use of imported goods in recent years.

V. DO EXIM FIRMS HEDGE?

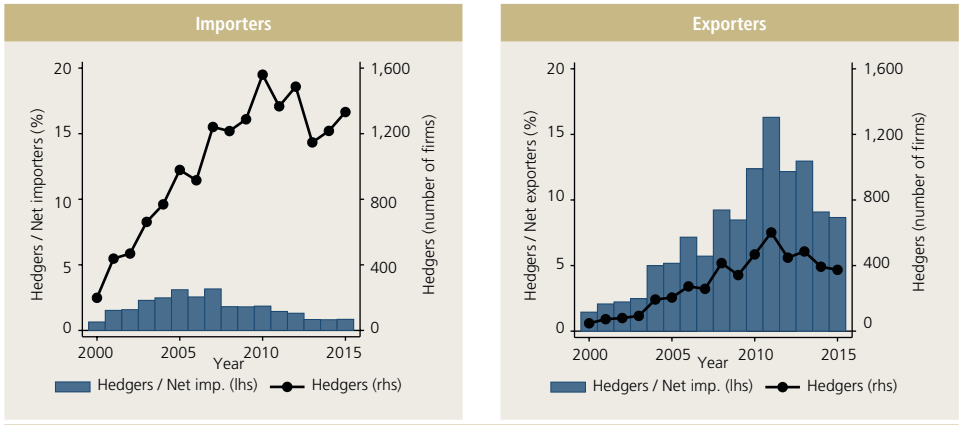
1. FX derivatives usage

Figure 1 shows the number of EXIM firms that use FX derivative contracts (hedgers) as well as the proportion of hedgers within exporters and importers over time. Increasing usage of FX derivatives by both exporters and importers is observed over this sample period. In 2000 only 48 exporting companies utilized derivatives contracts (hedgers). Eleven years later this figure reached a peak of 602. For its part, the number of hedging importers went from 199 in 2000 to a sample peak of 1,560 in 2010.

As importers outnumber exporters 22:1 in the sample, and even more so if we consider only smaller firms, the utilization rate is smaller for importers than for exporters. This rate is measured as the number of firms that use derivatives (hedgers) divided by the total number of firms (hedgers and non-hedgers). For exporters, the figure exhibits a clear upward trend in the utilization rate which is also in line with the growth in the total number of hedgers. This reveals that new exporting firms entering the sample tend to use FX derivatives. This same trend in the utilization rate is observed for importers, but only until 2007. From then on the rate decreases due to the incorporation of far more smaller importing firms[10] that tend not to use FX derivatives.

Figure 1

Derivatives usage



Source: Author's calculations using CBC data.

10 The large growth in smaller importing firms is associated with the entry into force of free trade agreements between Chile and its trading partners during this period.

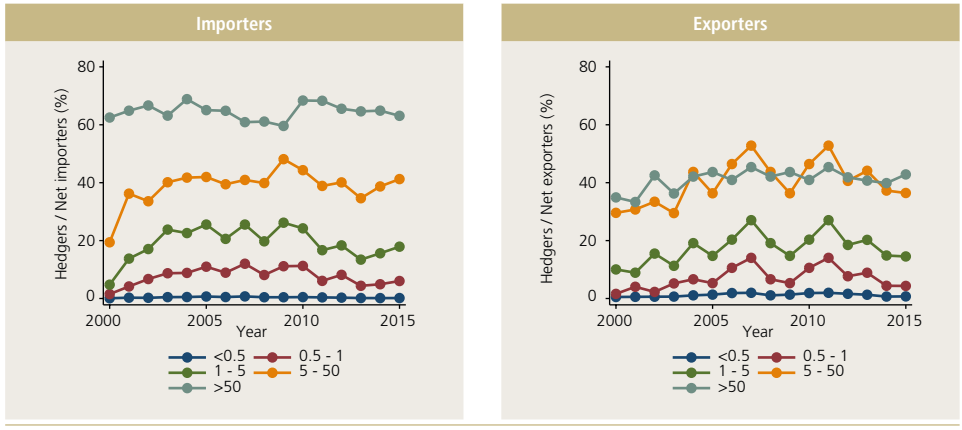
As shown in figure 2, the utilization rate is not homogeneous among different-sized firms. Following Rodriguez and Villena (2009) and Acharán et al. (2009), firm size is calculated as the total value exported for exporting firms and the total value imported for importing firms. These firm sizes are classified into five groups ranging from values of less than US$500,000 to values of more than US$50 million. The utilization rate is then calculated as the number of hedgers divided by the total number of firms within each tranche. Larger sized firms exhibit higher utilization rates than their smaller counterparts.

As noted previously, firms that import less than US$500,000 per year exhibit very low utilization rates. This compares with firms importing more than US$50 million that exhibit utilization rates of between 60% and 70%. Similarly, larger exporters display higher utilization over the entire sample. However, exporting firms in the two largest groups by firm size only present utilization rates between 40% and 50%. While Rodriguez and Villena (2009) use a different methodology to define EXIM firms, their results regarding the use of FX derivatives are consistent with the results of this paper.

The fact that smaller firms exhibit lower utilization rates is expected as implementation of exchange rate hedging requires a more sophisticated level of financial management. Furthermore, due to the credit lines associated with FX derivatives usage, the greater inherent credit risk of smaller firms restricts their participation in the market. The fixed cost of this type of product is another factor limiting their use by smaller firms as the relative cost of hedging is higher when the amounts to cover are lower.

Figure 2

Derivatives utilization rates by firm size



Source: Author's calculations using CBC data.
Note: Legend numbers refer to millions of USD.

For the specific case of small exporters, the Bank of England (1998) provides an analysis of vulnerabilities to an appreciation in the domestic currency. This includes the facts that they have less negotiating power in external markets, their sales are generally concentrated in only a few markets, it is more difficult for them to cut prices in order to maintain market share and they use fewer imported inputs, which diminishes the benefits received when import prices fall. That smaller firms may be more vulnerable, and therefore more likely to hedge, runs counter to the observed results in this paper which shows a low utilization by small exporting firms.

2. Long or short?

The previous subsection showed that both exporters and importers use financial derivative instruments; however, the strategies employed by each vary across business types. This section outlines expected strategies that would be employed by an exporter. It then tries to empirically verify whether or not the evidence supports this expected behavior for both exporting and importing firms at the aggregate level and by sector.

Assuming an exporter sells US$5 million in goods on 31 March and both parties agree that payment should be made in 90 days. At the current exchange rate of 650 pesos per dollar the equivalent value in pesos is CLP3,250 million. In 90 days, if the Chilean peso falls to 600 pesos per dollar, the equivalent value in pesos would be CLP3,000 million. Without hedging, this would create an unfavorable difference for the exporter of CLP250 million. In order to avoid uncertainty about future cash flows, the exporter could sign an FX derivatives contract in which the exporter agrees to sell the US$5 million at a fixed exchange rate of 640 pesos per dollar. This "short position" would guarantee a cash flow of CLP3,200 million in 90 days.

This hypothetical situation is reversed for the case of importers because they are interested in fixing the exchange rate for the future purchase of foreign currency. This "long position" can guarantee a fixed cost for the importer in the future.

International trade operations generate FX risks because the exchange rate can vary between the moment an obligation occurs and when the payment is made.[11] Derivatives contracts allow firms to reduce this uncertainty and stabilize their cash flows by providing protection against unexpected exchange rate movements. It should be noted that derivatives do not guarantee a better result than simply waiting and making the transaction via the spot market. Nonetheless, the elimination of uncertainty allows firms to focus on and optimize core business elements.

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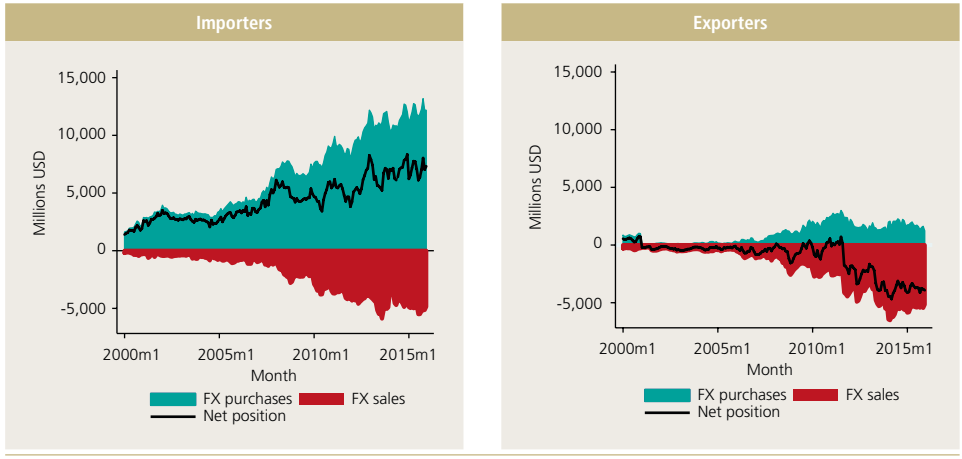
11 Buscio et al. (2011) show that the reasons for derivatives use in Uruguay are 1) to cover operating expenses in foreign currency and 2) to cover costs.

Figure 3 presents the gross positions for purchases and sales, as well as net positions (purchases minus sales), of foreign currency by EXIM firms. On average, the observed NDP is negative (short) for exporters and positive (long) for importers throughout the period, as expected. Importers display a markedly positive NDP throughout the period. However, exporters show occasional periods where the NDP is positive. Reasons for the latter include: (i) exporters also hedge their imports; (ii) it is normal to close or terminate contracts by taking the opposite position; (iii) large companies that use derivatives usually have natural hedges via obligations (liabilities) in foreign currency. Also noted are the large gross positions held by importers as compared to exporters.

The amount of coverage chosen by these companies, measured as the NDP divided by the net flow of foreign trade, averages around 9% for exporters and 19% for importers.[12] Note that this only considers hedging through FX derivatives, so effective coverage is underestimated. With broader coverage measures, Fabling and Grimes (2008) and Čadek et al. (2011) found higher coverage ratios in more developed countries.

Figure 3

Gross positions for purchases and sales and net derivative position

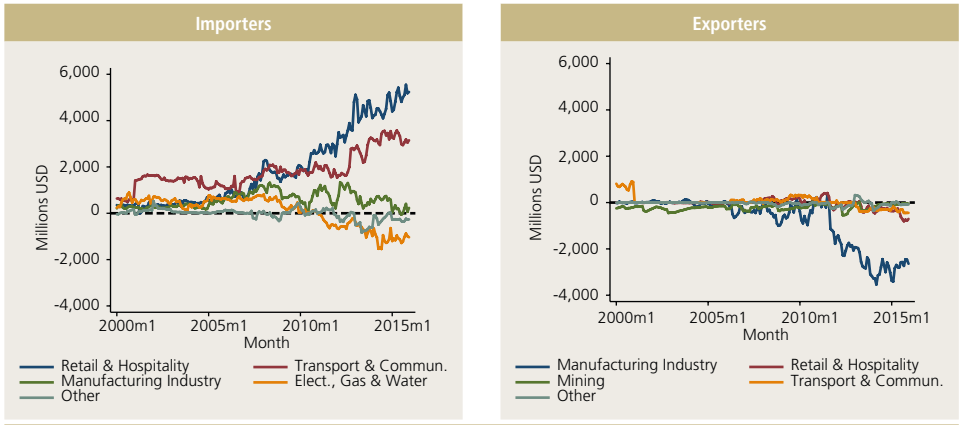


Source: Author's calculations using CBC data.

12 Using Chilean firms from 2008 and 2009, Acharán et al. (2009) find that smaller firms display higher coverage than their larger counterparts because the latter tend to utilize more natural hedges.

Figure 4

Net derivatives position by sector



Source: Author's calculations using CBC data.

The expected NDP for importers is displayed across the majority of economic activities and/or sectors[13] (figure 4). Indeed, 92% of the NDP is explained by four sectors: Commerce, Restaurants and Hotels (32%); Transportation and Communication (26%); Manufacturing industry (18%); and Electricity, gas and water (16%). For their part, exporters show a higher grade of concentration with 90% NDP held across just three sectors: Manufacturing industry (67%); Commerce, restaurants and hotels (14%); and Mining (9%). It should be noted that even though mining is the highest exporting sector in Chile,[14] it has a relatively low participation in derivative markets. This is so probably because of strong natural hedging due to currency matching of foreign-denominated assets and liabilities in the industry. Specifically, a large part of the mining industry's liabilities are held in foreign currency while many make utility payments in that same foreign currency, as in many cases they are owned by foreign firms.[15]

3. Contract characteristics

FX derivatives contracts are characterized by annual turnover by instrument, currency and maturity. The shares of each characteristic are presented in figures 5 and 6.

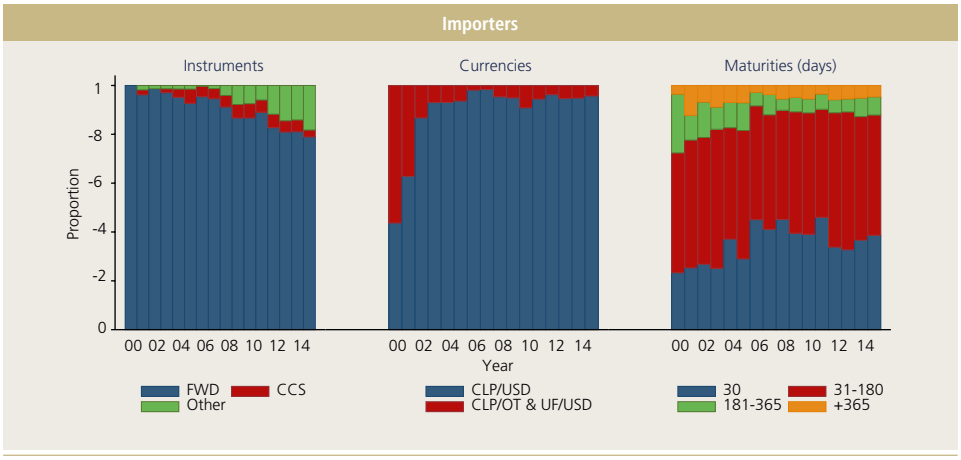
13 Firms are grouped using a CBC characterization method with the following categories: Manufacturing industry; Retail and hospitality; Mining; Transport and communications; Agriculture; Business and financial services; Fishing; Electricity, gas and water; Construction; Personal services; and Others.

14 In 2015 the mining industry accounted for more than 50% of total exports.

15 According to Bank of England (1998), hedging in each industry depends on contract length in each industry, each firm´s capacity to project cash flow, and the cost of hedging.

Figure 5

Contract characteristics for importers



Source: Author's calculations using CBC data.

The FX derivative instruments contracted by both types of firm have similar characteristics. The vast majority of contracts are forwards with an average share of over 80% for the entire period.[16] A greater diversification into more sophisticated instruments has been observed however over the sample period. Among them, cross-currency swaps (CCS) have played an important role, along with options, FX swaps and combinations thereof (classified as "Other").

The most traded currency pair by far is the CLP/USD. However, the figures show a high proportion of contracts other than CLP/USD at the beginning of the sample period, which includes both currency pairs labelled as CLP/OT (other currencies) and UF[17]/USD. For the purposes of this analysis, the latter currency pair can be considered a transaction between the national currency and the U.S. dollar. As such, almost all of the coverage includes the U.S. dollar on one side of the transaction. Within "Other foreign currencies", the euro and the Japanese yen make up the most significant proportion.

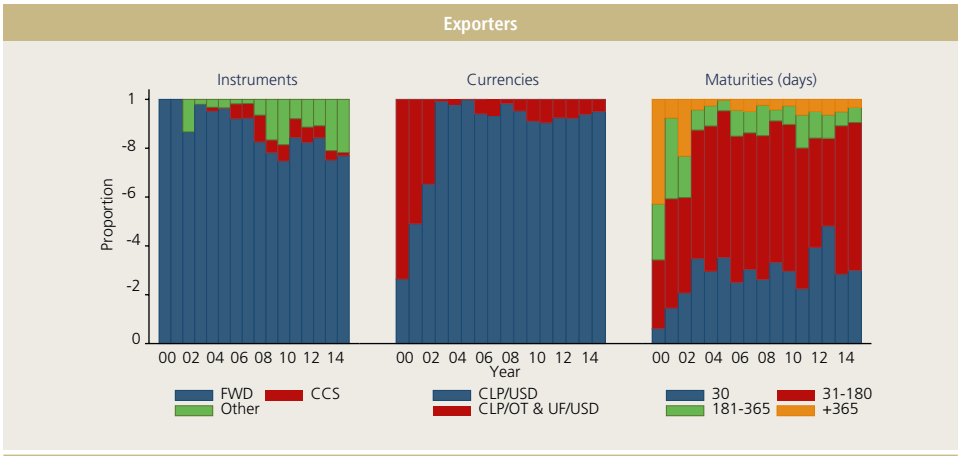
On average, more than 80% of contracts have maturities of less than 180 days. Of these, two-thirds are between 31 and 180 days. Those with longer maturities (more than one year) are mostly CCS's. This is related to the use of CCS's as a debt hedging instrument which regularly have longer-term obligations.

16 The high popularity of forward contracts is due to their simplicity and low entry costs, as no payment is required at the beginning of the operation.

17 The UF (Unidad de Fomento) is an indexed measure widely used in Chilean financial markets that varies daily with past inflation. This tool was particularly important before the nominalization of Chilean monetary policy in August 2001 (Jara et al., 2003).

Figure 6

Contract characteristics for exporters



Source: Author's calculations using CBC data.

VI. MICRO-LEVEL ANALYSIS

This section studies the behavior of FX derivatives use at the micro level. Firstly, the degree of concentration of the total amount outstanding is analyzed. The expected NDP is then studied to see if it is satisfied at the individual level. Subsequently, the relationship between the magnitude of foreign trade flows and derivatives market activity exhibited by EXIM firms is examined.

To measure the degree of concentration, a graphical representation of the distribution of wealth, known as the Lorenz curve (Lorenz, 1905), is used. As an application of this study, the wealth variable is replaced by the gross derivative position (purchases + sales).[18] The concentration analysis reveals that 80% of exporters and importers accumulate less than 1% of the total gross positions throughout the period. The related Gini coefficient (Gini, 1912), which measures the degree of inequality based on the Lorenz curve, shows a value of 0.886 for importers and 0.872 for exporters, implying a high degree of concentration in both cases.[19]

The high level of concentration could lead one to think that the NDPs observed at the aggregate level (figure 3) do not correspond to the hedging strategies taken by most companies. However, this is ruled out by analyzing the empirical distributions of NDPs for the last month of each year (figure 7), represented by

18 *Figure A1 of the appendix shows the Lorenz curves for exporters and importers.*

19 *This index ranges from 0 to 1, where 0 represents perfect equality and 1 represents perfect inequality.*

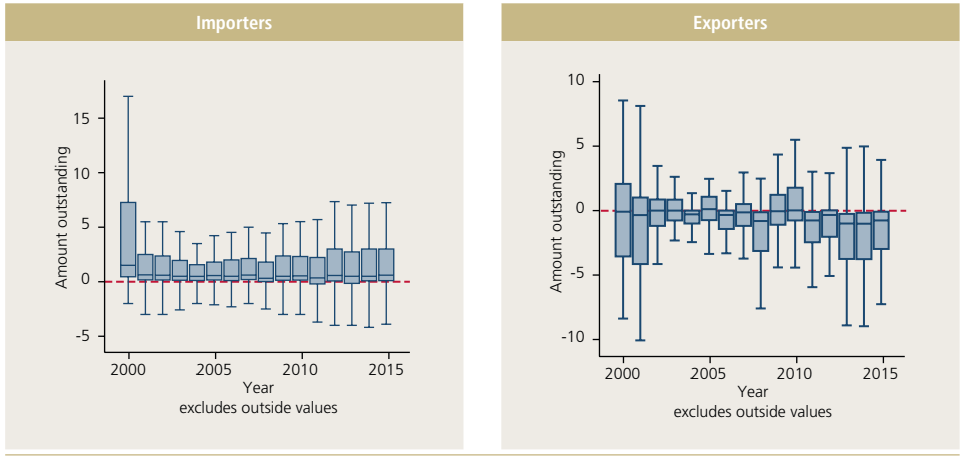
a boxplot. These distributions confirm that the expected behavior also holds at the individual level. It is noted that on average 75% of importers display their expected NDPs. Exporters also display their expected NDPs, never falling below 50% in any of the sample years. Put another way, from the first quartile upwards (denoted by the lower limit of the box), the distribution of importers exhibits a NDP greater than zero; and for exporters, from at least the median line and below (denoted by the band inside the box), the NDP distribution is negative.

Figure 8 presents some key points in the relationship between the flow of foreign trade of each company and the frequency of FX derivatives transactions. The horizontal axis shows gross exports and imports while the vertical axis shows turnover of FX derivatives, with both classified into 20 quantiles. The colors simulate the density of companies through an index ranging from 0 to 100. Cooler colors represent a lower density of firms with warmer colors representing a higher density.

Warmer colors dominate the lower quantiles of trade flows and turnover. This implies a greater density of EXIM firms with low levels of foreign trade flows and turnover in the derivatives market compared to the total of companies analyzed. In other words, a high number of small EXIM firms display lower activity in the FX derivatives markets.

Figure 7

Distribution of net derivative positions

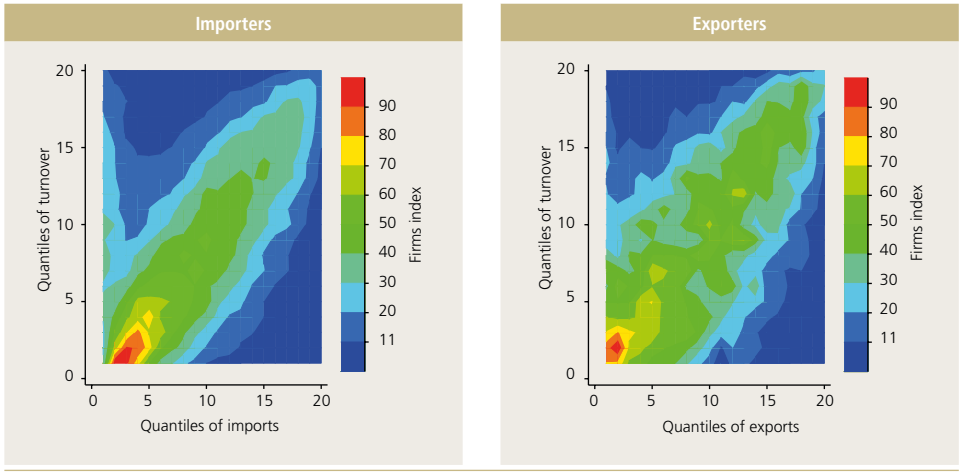


Source: Author's calculations using CBC data.

Note: Excludes outlier values. The limits of the internal box are the first and third quartiles with the band inside representing the median. The upper whisker represents the highest value still within 1.5 times the interquartile range (IQR) of the upper quartile. The lower whisker represents the lowest value still within 1.5 times the IQR of the lower quartile. This is often called the Tukey boxplot (Tukey, 1977).

Figure 8

Quantiles of foreign trade flows and turnover, 2000-2015



Source: Author's calculations using CBC data.

Furthermore, the cold colors are concentrated in two distinct areas: (1) high turnover and low levels of foreign trade flows, (2) low turnover and high levels of foreign trade flows. Therefore, a positive relationship is observed between the level of foreign trade and activity in the FX derivatives market. This is in line with previous empirical evidence and literature.[20] This result also corroborates Villena and Salinas (2014), who suggest that the increased activity noticed in the Chilean FX market between 1998 and 2013 was influenced by greater international trade flows during this period.

VII. CONCLUSIONS

A unique micro-level database has been exploited in order to characterize the structure of FX derivatives usage by EXIM firms in Chile. Evidence is presented of a growing number of EXIM firms utilizing FX derivatives as a hedging strategy against exchange rate risk. Furthermore, the research note shows a positive relation between firm size and the number of firms that use FX derivative hedging strategies. A direct relationship is also observed between the level of foreign trade flows and turnover in the FX derivatives market.

The development of hedging strategies is in line with the currency mismatches experienced by different firms. Thus, importers exhibit net purchase (long)

20 In figure A2 of the appendix this figure is broken down into sub-periods of the sample (three 5-year periods) and the conclusions remain consistent. Nevertheless, the relationship is less obvious exporters in the period 2000-2005 due to the smaller number of observations (there is an average of 115 hedgers in the 2000-2005 sub-period as compared to an average of 460 hedgers in the 2011-2015 sub-period).

positions on FX derivatives while exporters exhibit net sale (short) positions. In both cases, the expected net derivatives position is found to hold for most sectors and for the majority of individual firms. The latter is true despite the high concentration in the FX derivatives market, where 80% of EXIM firms hold less than 1% of the total amount outstanding.

Even though there is a general trend towards the use of more diversified and sophisticated financial instruments, forward contracts are by far the principal instruments used by EXIM firms in Chile (with maturities of less than 180 days). This is consistent with the maturities of outstanding accounts payable or receivable in foreign trade operations. Breaking down these contracts by maturity shows that about two-thirds of them are between 31 and 180 days. Companies also cover foreign-denominated debt using cross-currency swaps with maturities longer than one year. Most exchange rate protection measures are taken against the U.S. dollar.

The database constructed for this project as well as the initial evidence presented in this article can be used as a starting point for future research questions. These elements, used in conjunction with the financial statements of companies, could be used to examine in more detail the determinants of FX derivatives usage in Chile. This database could also shed light on the financial results of currency hedging made by EXIM firms. Finally, given the amount of available information in the dataset, analysis could be undertaken on how hedging strategies evolve over time due to changes in exchange rate volatility.

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APENDIX A

Table A1

Average concentration of EXIM firms by firm size, 2000 – 2015

	Firm size by amount imported or exported (US$ million)				
	<0.5	0.5 - 1	1-5	5-50	>50
Importers	93.2%	2.3%	3.0%	1.3%	0.2%
Exporters	66.6%	7.6%	14.4%	9.2%	2.2%

Source: Author's calculations using CBC data.

Table A2

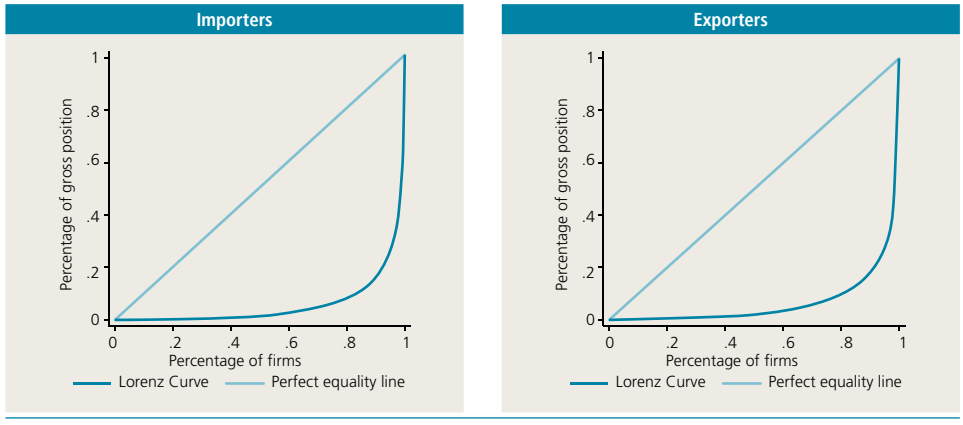
Turnover of EXIM firms (hedgers and non-hedgers) within the sample period

Years in the sample	Exporters		Importers	
	Number	Percent	Number	Percent
1-4	31,457	46.9%	749,814	65.5%
5-8	14,472	21.6%	206,491	18.0%
9-12	8,854	13.2%	83,932	7.3%
13-16	12,359	18.4%	105,195	9.2%

Source: Author's calculations using CBC data.

Figure A1

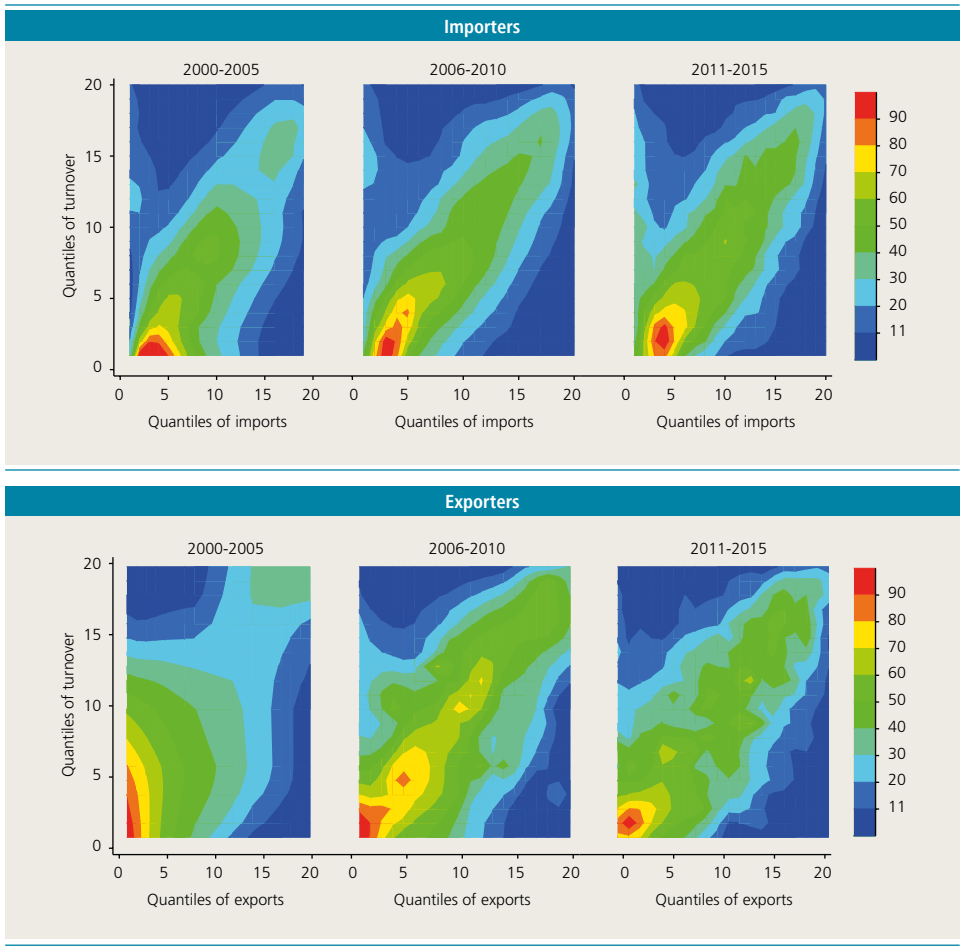
Lorenz Curve for EXIM firms



Source: Author's calculations using CBC data.

Figure A2

Quantiles of foreign trade flows and turnover



Source: Author's calculations using CBC data.

EL MERCADO INTERBANCARIO EN CHILE: ESTRUCTURA DE LA RED Y EVOLUCIÓN EN EL TIEMPO

José Gabriel Carreño B.*
Rodrigo Cifuentes S.*

I. INTRODUCCIÓN

Este trabajo presenta por primera vez una caracterización del tamaño, los instrumentos y la estructura de interconexiones del mercado interbancario chileno, entregando una descripción única de la evolución de dichas dimensiones en el tiempo y por instrumento.

La importancia de contar con esta información radica en que las implicancias sistémicas de una situación de estrés en una institución financiera está determinada por la estructura (Acemoglu et al., 2015) y la complejidad (Caballero y Simsek, 2013) de las interconexiones del sistema financiero. Por lo tanto, tal como argumenta Yellen (2013), más y mejor información sobre las interconexiones entre instituciones financieras son clave, ya que esta permite identificar cómo una situación de estrés en una parte del sistema podría propagarse por el sistema financiero y terminar afectando a una parte importante del mismo.

De esta manera, este trabajo levanta información esencial tanto para autoridades interesadas en la medición de riesgo sistémico y supervisores en el desarrollo de ejercicios de tensión, como para investigadores interesados en estudiar los determinantes del riesgo sistémico y entender mecanismos de transmisión en el mercado financiero.

En particular, construimos una base diaria para el período 2009.1-2015.6 que incluye las posiciones bilaterales interbancarias para todos los bancos del sistema en los ocho tipos de exposiciones interbancarias definidas por el regulador: préstamos interbancarios, cuentas corrientes, repo, derivados, depósitos a plazo, bonos bancarios, préstamos interbancarios con colateral y operaciones con liquidación en curso.

Partiendo desde lo más general hacia lo particular, un primer hallazgo de este trabajo es que el financiamiento interbancario es la segunda fuente de financiamiento mayorista de los bancos (7,3% de los activos del sistema), después de los fondos mutuos (9,7%), pero por delante de los fondos de pensiones (4,9%).

* *Gerencia de Investigación Financiera, Banco Central de Chile. E-mails: jcarreno@bcentral.cl; rcifuent@bcentral.cl*

Para algunos bancos, las posiciones interbancarias pueden superar el 50% de sus activos.

En segundo lugar, en términos de los distintos instrumentos, encontramos que los depósitos a plazo y derivados representan en conjunto 79,3% de las exposiciones interbancarias (64,0% y 15,3%, respectivamente). Esto los constituye como los principales canales potenciales de contagio del mercado interbancario. Los préstamos interbancarios, tradicionalmente identificados como el instrumento usado por los bancos para manejar sus necesidades de liquidez diaria, representan en promedio solamente 3% de las exposiciones interbancarias[1].

En tercer lugar, en relación con la concentración de las posiciones activas y pasivas en depósitos a plazo y derivados, encontramos que en los primeros la provisión de liquidez está altamente concentrada en un banco, no así por el lado del financiamiento, donde observamos una menor concentración. En particular, la concentración de las posiciones pasivas de depósitos a plazo es similar a la concentración de los activos totales del sistema bancario. En derivados, la concentración es baja y similar entre posiciones activas y pasivas, si bien ha ido aumentando en el último tiempo.

Por último, cuando miramos el comportamiento de los bancos en depósitos a plazo y derivados a nivel bilateral a través de algunas medidas de red ampliamente utilizadas, encontramos importantes cambios en el tiempo en la densidad, reciprocidad, *out-degree*[2] e *in-degree*[3] en los depósitos a plazo, al tiempo que las relaciones interbancarias muestran una alta persistencia. Además, mostramos diferencias importantes entre depósitos a plazo y derivados, tanto en sus características promedio como en su evolución en el tiempo, con lo que estos tendrían diferentes propiedades en términos de contagio y riesgo sistémico[4].

El resto de este trabajo está estructurado de la siguiente manera. La sección II revisa la literatura relevante. La sección III describe la construcción de la base de datos, y muestra la importancia del mercado interbancario y de los instrumentos que lo componen utilizando información agregada del sistema. La sección IV, muestra el comportamiento bilateral de los bancos en el mercado interbancario y el análisis de redes. Finalmente, la sección V resume los principales mensajes del trabajo.

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1 Sin embargo, a nivel de flujo, los depósitos a plazo y los préstamos interbancarios son equivalentes. Esto se explica por la diferencia en los plazos. Mientras que los depósitos a plazo tienen un promedio de 90 días, los préstamos interbancarios son principalmente "overnight", es decir, a un día.

2 Número de bancos a los cuales un banco les presta.

3 Número de bancos que proveen financiamiento a un banco.

4 Es consistente con los resultados de Bargigli et al. (2013) para el mercado interbancario italiano y los resultados de Molina-Borboa et al. (2015) para el mercado interbancario mexicano.

II. LITERATURA RELACIONADA

Este trabajo se relaciona con múltiples ramas de la literatura de contagio y riesgo sistémico en redes financieras.

En relación con la información utilizada, este trabajo caracteriza el mercado interbancario (o alguna propiedad de la red) usando exposiciones bilaterales efectivas por instrumento. Otros trabajos similares son Martinez-Jaramillo et al. (2014); Silva et al. (2016); Bargigli et al. (2013); Langfield et al. (2014).

Langfield et al. (2014) caracterizan el mercado interbancario británico a partir de información de las 20 mayores exposiciones de cada banco en el sistema financiero, identificando la contraparte y el instrumento. Los autores describen el mercado interbancario por instrumento definiendo una red de exposiciones y una red de financiamiento. Encuentran que la estructura de interconexiones difiere entre ambas, y que dentro del mercado interbancario los bancos juegan distintos roles. Una limitación de este trabajo es que cuenta con información solo para el año 2011. En contraste, una perspectiva de tiempo más larga, como la que tenemos en este trabajo, nos permite hacer un juicio de la persistencia de las relaciones interbancarias, y de los cambios en la estructura de interconexiones en el tiempo.

Relacionado con la descripción del mercado interbancario, esta nota de investigación es cercana a varios trabajos que utilizan herramientas de la literatura de redes para estudiar interconexiones financieras (Boss et al., 2004; Martinez-Jaramillo et al., 2014; Molina-Borboa et al., 2015, Bargigli et al., 2013). Tradicionalmente, estos trabajos utilizan medidas como las de *in-degree*, *out-degree*, densidad, reciprocidad de las interconexiones, coeficiente de agrupamiento (*clustering coefficient*), distancia promedio de la red (*average shortest path length*) y medidas de centralidad (*closeness, Bonacich, betweenness,* etc.) para describir el patrón de interconexiones de una red. A diferencia de ellos, en este trabajo nos concentramos en un subgrupo de medidas que permiten estudiar propiedades documentadas en otras redes financieras e identificadas como importantes a la hora de estudiar contagio y riesgo sistémico: densidad de las interconexiones (Allen y Gale, 2000), simetría de las posiciones (Upper y Worms, 2004), estabilidad de las relaciones (Cocco et al., 2009) y número de contrapartes (*out-degree* e *in-degree*) (Vivier-Lirimont, 2006).

Finalmente, esta nota se relaciona con trabajos que estudian las implicancias sobre el riesgo sistémico de considerar las diferencias e interacciones que puedan existir entre los distintos instrumentos a través de los cuales se puede producir la exposición interbancaria (Montagna y Kok, 2013). Dichos trabajos concluyen que estudiar el riesgo sistémico sin considerar estas diferencias, puede llevar a una subestimación del mismo debido a la interacción entre instrumentos, que se produce cuando un banco participa en varios mercados con estructuras de interconexiones diferentes. En esta nota mostramos que los instrumentos más importantes del mercado interbancario, esto es, depósitos a plazo y derivados, tienen diferentes estructuras de interconexiones.

III. CONSTRUCCIÓN DE LA BASE DE DATOS Y ANÁLISIS DEL MERCADO INTERBANCARIO CON DATOS AGREGADOS

Esta nota está basada en información no pública de la Superintendencia de Bancos e Instituciones Financieras (SBIF) e información agregada proveniente del Depósito Central de Valores. La información que se presenta aquí se encuentra, o bien agregada, o bien innominada en el caso de información individual. La información de la SBIF proviene tanto del informe diario de las obligaciones con otros bancos en ocho instrumentos desde septiembre del 2008, como de la información también diaria de todas las tenencias de activos financieros no derivados de los bancos, disponible desde enero del 2009. De esta manera, la base final tiene información de las exposiciones efectivas para todos los bancos del sistema (23)[5], en ocho instrumentos (ver detalle en cuadro A1) en base diaria desde enero del 2009 hasta junio del 2015.

Finalmente, para el resto del análisis y con el objetivo de preservar el anonimato de los bancos, agrupamos los bancos en dos categorías: grandes y medianos (11), y bancos de consumo y de tesorería (12).

1. Tamaño del mercado interbancario

En esta sección, mostramos la relevancia del mercado interbancario. Para esto, primero presentamos el tamaño de este mercado en relación con otras fuentes de financiamiento, y luego la composición por instrumentos del mercado interbancario a nivel agregado. Finalmente, estudiamos la evolución y concentración de los dos mercados más relevantes del mercado interbancario: depósitos a plazo y derivados.

De manera similar a otros sistemas bancarios alrededor del mundo[6], las posiciones interbancarias representan un porcentaje importante del balance de los bancos. El gráfico 1 apila el *stock* (a fin de mes) de activos y pasivos interbancarios para los 23 bancos como porcentaje de los activos totales del sistema. Encontramos que el mercado interbancario representa en promedio para este período 7,3% de los activos del sistema, posicionándolo como la segunda fuente de financiamiento mayorista de los bancos, detrás de los fondos mutuos (9,7%) y por delante de los fondos de pensiones (4,9%)[7].

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5 No se consideran bancos que se incorporaron a partir de enero del 2015.

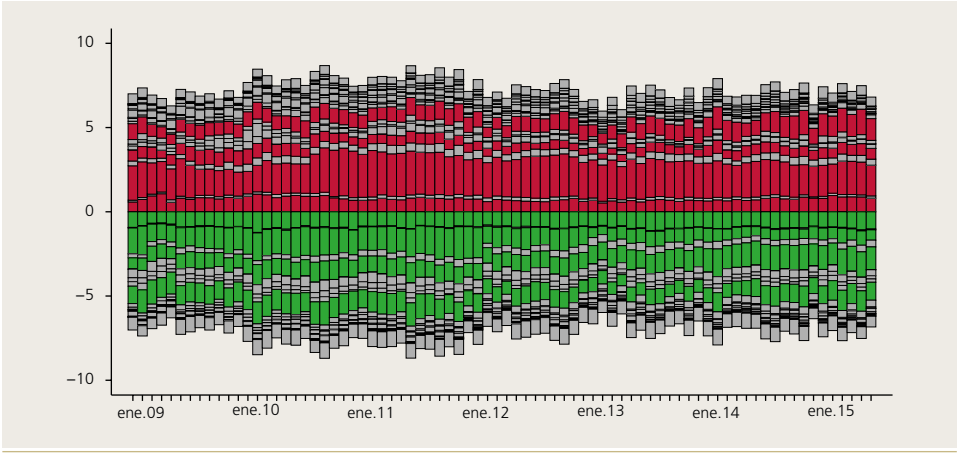
6 Basado en la base de datos de Bankscope para 225 bancos alrededor del mundo, sabemos que el mercado interbancario representa aproximadamente 6,8% de los activos del sistema.

7 Estos porcentajes se calculan sobre la base de información del Depósito Central de Valores (DCV).

Gráfico 1

Stock de activos y pasivos interbancarios apilados por mes y para los 23 bancos del sistema bancario

(período 2009.1-2015.6, como porcentaje de los activos totales del sistema)



Fuentes: SBIF y Banco Central de Chile.

Notas: El mercado interbancario incluye préstamos interbancarios, cuentas corrientes, repos, derivados, depósitos a plazo, bonos bancarios, préstamos interbancarios con colateral y operaciones con liquidación en curso.

Sobre la línea 0, activos interbancarios; por debajo, pasivos interbancarios. Pintamos el *stock* de los cuatro bancos más grandes del sistema, en rojo para activos y en verde para pasivos.

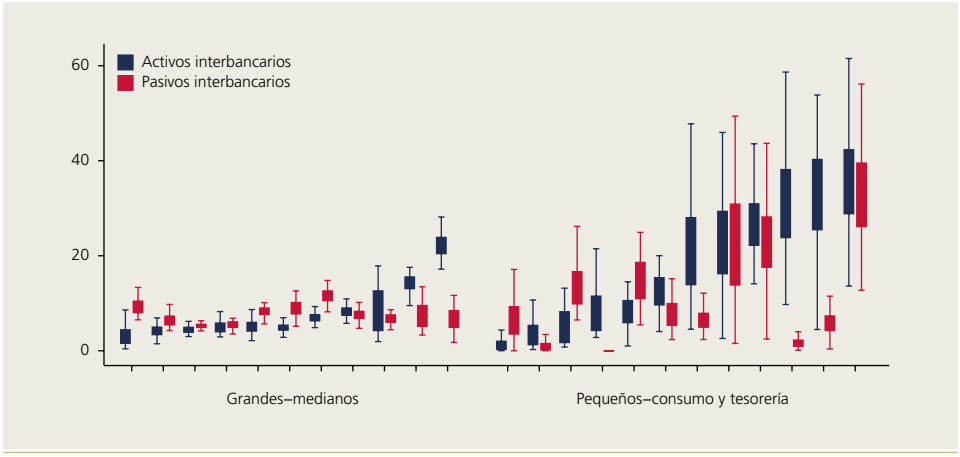
Si bien los montos asociados a los bancos grandes (segmentos de mayor tamaño relativo) superan los de los otros bancos, la importancia de estos montos para cada banco es heterogénea. En el extremo, algunos bancos pequeños están más expuestos en este mercado que los bancos grandes en relación con su propio balance. El gráfico 2 muestra la distribución diaria de los activos y pasivos interbancarios para cada banco en relación con sus activos totales. Mientras el mercado interbancario representa solamente 5% de los activos de bancos grandes y medianos (mediana de activos interbancarios sobre activos totales), para los bancos pequeños el mercado interbancario puede llegar a representar 40% de sus activos (mediana)[8]. Encontramos también que la participación de los bancos, en relación con sus posiciones activas y pasivas, es heterogénea. Mientras algunos bancos tienen regularmente posiciones asimétricas en el mercado interbancario (la mayor parte del tiempo prestan más de lo que se financian o viceversa), otros mantienen una posición equilibrada.

8 Esto implica que los riesgos asociados al mercado interbancario podrían ser significativos. En términos de patrimonio efectivo, los bancos grandes y medianos exponen en general (mediana, período 2009-2015.6) 70% de su patrimonio efectivo en el mercado interbancario, mientras que los bancos pequeños en general (ídem anterior) exponen 52%.

Gráfico 2

Distribución de activos y pasivos interbancarios para cada banco

(período 2009.1-2015.6, porcentaje de los activos totales de cada banco)



Fuentes: SBIF y Banco Central de Chile.

Nota: Cajas muestran los percentiles 5, 25, 75 y 95 de la distribución mensual. Dentro de cada grupo, los bancos están ordenados en forma ascendente por la medida de sus activos interbancarios.

2. Composición del mercado interbancario por instrumento

Estos resultados, interesantes en sí mismos, esconden, sin embargo, el hecho de que las exposiciones interbancarias se componen de varios tipos de instrumentos. El cuadro A2 en el apéndice muestra el tamaño relativo de los ocho instrumentos que en conjunto componen el mercado interbancario a nivel agregado. Los depósitos a plazo representan en promedio 64% del mercado interbancario, las exposiciones por contrato de derivados 15%, las operaciones con liquidación en curso 14%, los bonos bancarios 3% y los préstamos interbancarios, 3%. El resto de los instrumento representa en promedio 0%. Así, los depósitos a plazo y los derivados son los dos instrumentos más importantes del mercado interbancario[9].

Es interesante notar que la composición de instrumentos en mercados interbancarios de otros países es diferente. Por ejemplo, para el Reino Unido, Langfield et al. (2014) muestran que en el lado de las exposiciones[10], los

9 Las operaciones con liquidación en curso no son un instrumento en sí, sino exposiciones generadas como consecuencia de otras operaciones, tanto propias del banco como de sus clientes. Si bien estas exposiciones generan riesgo en los bancos, las excluimos del análisis por su naturaleza más bien pasiva y no directamente relacionada con una decisión de toma de riesgo de contraparte por parte de los bancos.

10 Los autores construyen dos redes, una red de exposiciones y una red de financiamiento, porque existen algunos instrumentos que se encuentran solamente en un lado del balance. En este trabajo, las redes son iguales en términos de instrumentos considerados.

depósitos a plazo (valores negociables) representan 16% del total de exposiciones interbancarias, mientras los derivados y préstamos interbancarios representan 44% y 25%, respetivamente. Por el lado del financiamiento, los repos y los préstamos interbancarios representan 66% y 29% de total de financiamiento interbancario, respectivamente. También, para el mercado interbancario mexicano, Molina-Borboa et al. (2015) muestran que los repos representan más del 50% del mercado. Así, el uso del depósito a plazo como instrumento de financiamiento interbancario por sobre el repo[11] parece ser una característica particular del mercado interbancario chileno, lo cual es bastante llamativo si consideramos que el repo es un préstamo con colateral, mientras que los depósitos a plazo son un préstamo sin colateral.

Documentada la importancia del mercado interbancario y su composición, a continuación estudiamos la dinámica de los dos instrumentos más importantes del mercado interbancario: depósitos a plazo y derivados. El gráfico 3 replica la figura del gráfico 1, pero ahora considerando sola y separadamente depósitos a plazo (A) y derivados (B). Observamos, a diferencia del gráfico 1, una rica dinámica en ambos mercados, escondida a nivel agregado.

En particular, observamos en el gráfico 3A un crecimiento en el *stock* de depósitos a plazo desde mediados del 2009 hasta finales del 2010. Luego de mantenerse relativamente constante hasta finales del 2012, dicho *stock* cayó lentamente a los niveles de 2009 (4,5% aprox.) hacia mediados del 2014. El primer período (crecimiento) coincide con la implementación por parte del Banco Central de Chile (BCCh) de la Facilidad de Liquidez a Plazo (FLAP)[12].

En el contexto de la crisis financiera global, el BCCh implementó entre julio de 2009 y mayo de 2010 la FLAP con el objetivo de otorgar financiamiento a las empresas bancarias a 90 y 180 días a tasa TPM (0,5%), aceptando como colateral depósitos a plazo de otros bancos. Esto ocurrió en un contexto en que los bancos tendieron a mantener altos saldos de liquidez en respuesta a la fuerte incertidumbre que se vivía en ese momento. La FLAP permitió que los bancos pudieran volver a poner esa liquidez en circulación a través de la toma de depósitos a plazo de otros bancos, confiados en que de ser necesario podrían transformar esos depósitos en liquidez otra vez a través de la FLAP. Además, el diferencial de tasas entre lo que rendían los depósitos y el costo de los fondos en la FLAP hacía más atractiva para los bancos la toma de depósitos a plazo[13]. Por último, aun sin este incentivo, el impacto de la FLAP en la tenencia cruzada de depósitos interbancarios puede haber sido un reflejo de la falta de otros colaterales (instrumentos del Banco Central o letras hipotecarias) para acomodar las necesidades de liquidez agregada del momento[14].

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11 El repo interbancario es poco usado, pero el repo como fuente de financiamiento con otras instituciones financieras no bancarias es alto, situándose en 2% de los activos del sistema en diciembre del 2014.

12 Una discusión detallada sobre la FLAP en el Informe de Estabilidad Financiera del BCCh, primer semestre 2010.

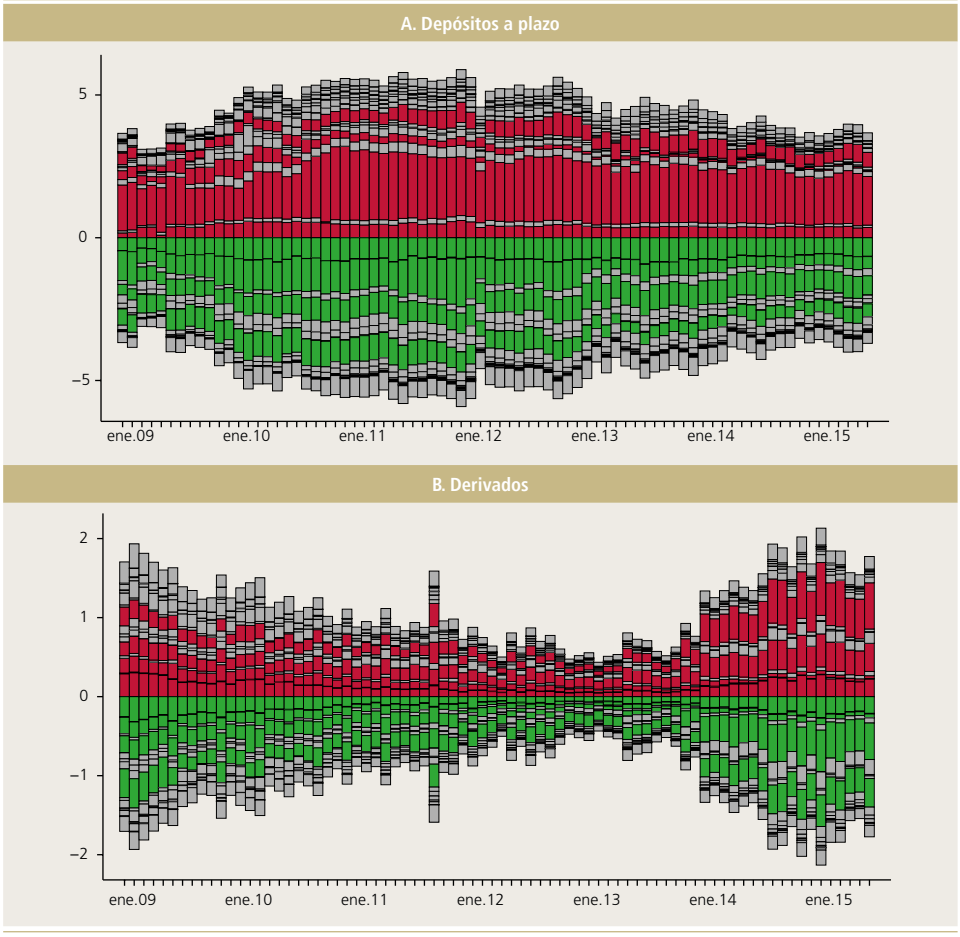
13 La tasa de captación bolsa a 90 días en pesos promedio en el período FLAP fue de 0,86%.

14 La FLAP fue ampliamente utilizada por los bancos, alcanzando un máximo de $3.284 billones de pesos (cerca de US$6.500 millones), a mediados de enero del 2010, equivalente aproximadamente a 40% del capital y reservas del sistema bancario (Céspedes et al., 2013).

Gráfico 3

Stock de activos y pasivos interbancarios en depósitos a plazo (A) y derivados (B), apilados por mes y para los 23 bancos del sistema bancario

(período 2009.1-2015.6, porcentaje de los activos totales del sistema)



Fuentes: SBIF y Banco Central de Chile.

Nota: El mercado interbancario incluye préstamos interbancarios, cuentas corrientes, repos, derivados, depósitos a plazo, bonos bancarios, préstamos interbancarios con colateral y operaciones con liquidación en curso. Sobre la línea 0, activos interbancarios: por debajo, pasivos interbancarios. Pintamos el *stock* de los cuatro bancos más grandes del sistema, en rojo para activos y en verde para pasivos.

Por otra parte, lo que vemos para derivados, parece ser muy distinto a lo observado para depósitos a plazo. El gráfico 3B muestra que, desde enero del 2009 hasta finales del 2012, el *stock* cayó constantemente, lo que explica por qué no veríamos la evolución en los depósitos a plazo en las posiciones interbancarias agregadas (gráfico 1). Cuando los depósitos a plazo crecían a mediados del 2009, los derivados caían rápidamente como porcentaje de los activos del sistema. A partir del 2014, los derivados comenzaron a crecer rápidamente, regresando, en promedio, al 2% de los activos del sistema registrado a principios del 2009.

Hasta donde sabemos, esta evolución no ha sido documentada antes. Los motivos que la originan escapan al objetivo de este trabajo.

3. Concentración en la provisión de liquidez y en el financiamiento interbancario

Finalmente, exploramos en detalle la concentración de la provisión de liquidez y del financiamiento interbancario. El gráfico 4 presenta el índice de concentración Herfindahl-Hirschman (HHI) para activos y pasivos en depósitos a plazo (A) y derivados (B). El HHI puede tomar valores entre 1 y 10.000[15]. Si, por ejemplo, existe solamente un banco que provee liquidez en el sistema, este banco concentra todos los activos interbancarios (en depósitos a plazo, por ejemplo), y el HHI será igual a 10.000 en la provisión de liquidez vía depósitos a plazo.

El gráfico 4A muestra que, para depósitos a plazo, el HHI de los activos es sustancialmente mayor que el de los pasivos, en casi toda la muestra. Así, la provisión de liquidez (tenencia de activos interbancarios) se encuentra más concentrada que el uso del financiamiento interbancario. La concentración de este último es similar a la concentración de los activos totales del sistema bancario (línea verde segmentada). Por otra parte, cabe notar que la concentración observada en los activos se produce por un banco. Esto lo podemos verificar comprobando que, si sacamos ese banco del cálculo del HHI, encontramos que la concentración en la provisión de liquidez es incluso menor que la concentración observada para el financiamiento interbancario en casi todo el período (línea roja segmentada del gráfico 4A)[16].

Notamos, también, que la FLAP habría tenido un efecto significativo en depósitos a plazo, no solo en el efecto ya mencionado en términos de montos (gráfico 3A) sino también en relación con la concentración en la provisión de liquidez. En particular, en el período que operó la FLAP (julio del 2009 a mayo del 2010), se observa una fuerte desconcentración de la provisión de liquidez (línea roja), explicado por un número mayor de bancos tomando depósitos a plazo en este período.

Finalmente, el gráfico 4B muestra los derivados. La concentración en derivados es igual entre posiciones activas y pasivas, y menor que la concentración esperada solamente por el tamaño de los bancos hasta la segunda mitad del 2013. Es decir, en derivados los bancos participan de manera más homogénea de lo que indicarían sus tamaños relativos en ambos lados del mercado, marcando un fuerte contraste con lo observado en depósitos a plazo. Sin perjuicio de lo anterior, a partir de abril del 2013 la concentración tanto de activos como de pasivos ha comenzado a aumentar. Cabe notar que la evolución de estas características se debería haber visto afectada por la reciente entrada en operaciones de la Entidad de Contraparte Central en derivados (ComDer) en julio del 2015.

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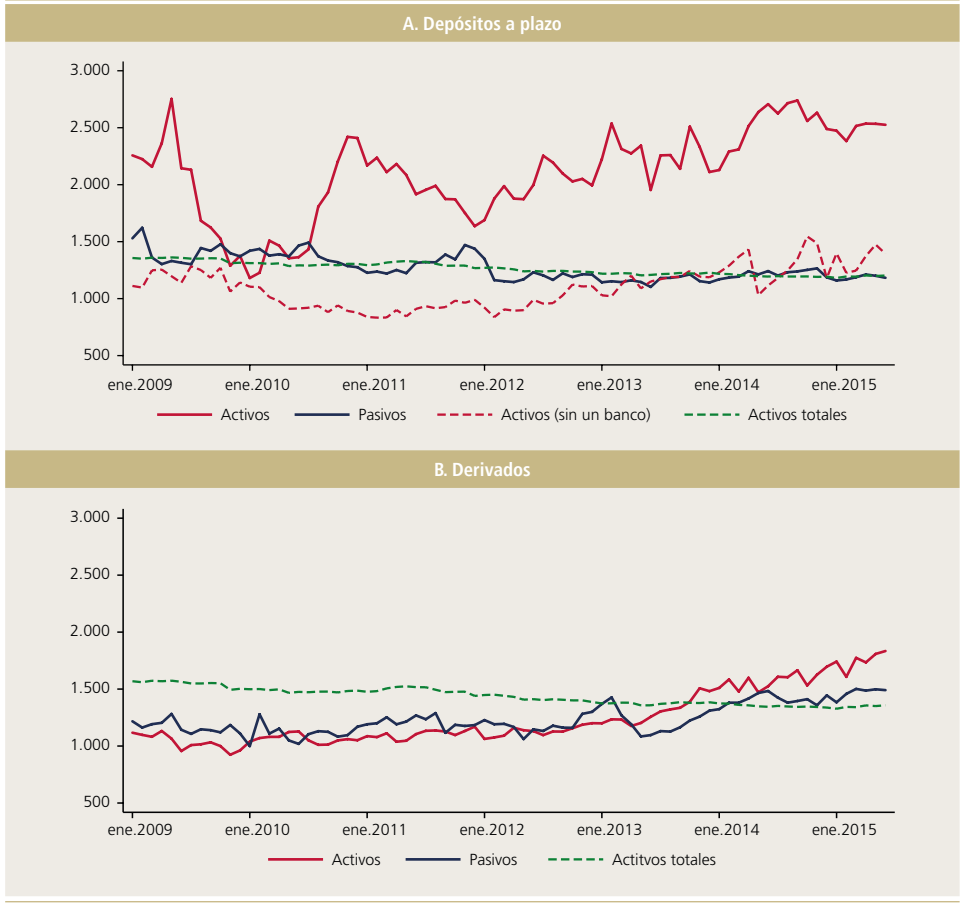
15 El índice se calcula como $HHI = 100^2 * \sum_{i=1}^{23} s_i^2$ *donde* s_i *es la participación de cada banco i en el interbancario en relación con sus activos o pasivos, según sea el caso.*

16 A diferencia de nuestro trabajo, Langfield et al. (2014) muestra que a nivel agregado la concentración de la red de exposiciones y la red de financiamiento es casi equivalente.

Gráfico 4

Índice de concentración Herfindahl-Hirschman (HHI) para activos y pasivos interbancarios en depósitos a plazo y derivados

(período 2009.1-2015.6)



Fuente: Cálculo de los autores a base de información de la SBIF.

Los dos gráficos incluyen la concentración de activos totales en el sistema bancario (línea verde segmentada). En A se incluye el HHI de los activos sin considerar el banco con mayor participación en activos (línea roja segmentada).

Nota: Ver nota 13 del texto.

En suma, los resultados previos muestran que: (i) el mercado interbancario es una fuente de financiamiento importante para los bancos; (ii) algunos bancos pueden llegar a exponer una parte significativa de sus activos en él; (iii) depósitos a plazo y derivados son los principales instrumentos del mercado interbancario; (iv) en depósitos a plazo la provisión de liquidez se encuentra concentrada (no así el uso de esta vía de financiamiento), mientras que en derivados la concentración de las posiciones activas y pasivas son similares.

IV. COMPORTAMIENTO DE LOS BANCOS EN EL MERCADO INTERBANCARIO A NIVEL BILATERAL

En esta sección analizamos las posiciones bilaterales de los bancos usando métricas de redes que permiten estudiar propiedades documentadas en otras redes financieras e identificadas como importantes a la hora de estudiar contagio y riesgo sistémico. En particular estudiamos la densidad, reciprocidad, persistencia, *out-degree* e *in-degree* de las interconexiones. Comenzamos describiendo visualmente algunas de las propiedades de las redes que forman las interconexiones en depósitos a plazo y derivados, para después analizar su evolución en el tiempo.

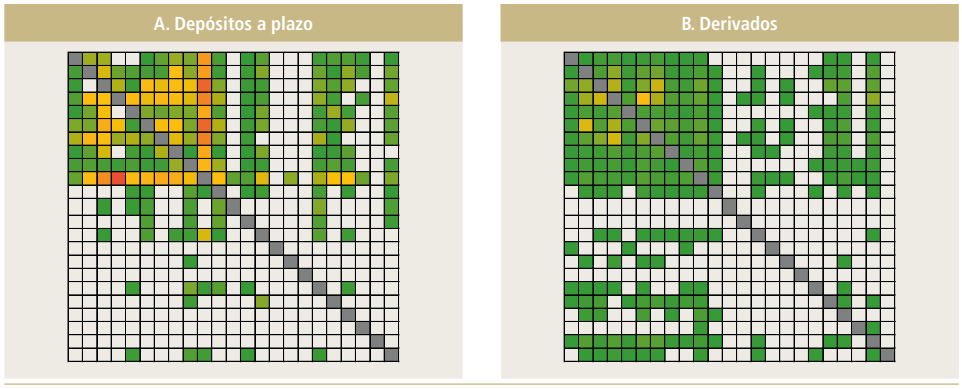
1. Matriz de exposiciones interbancarias

El gráfico 5 presenta las posiciones bilaterales banco a banco en forma de matriz para los 23 bancos que componen el mercado interbancario, en la red que forman los depósitos a plazo y los derivados. Esta representación es un buen recurso para una introducción visual a los conceptos, cuya evolución en el tiempo se presentará después a través de medidas numéricas. La entrada (A, B) de la matriz, representa una *obligación* del banco de la fila A hacia el banco de la columna B o, desde el punto de vista del otro banco, una *exposición* del banco B al banco A. El valor de la posición bilateral entre el banco *i* y el banco *j* representada en el gráfico, corresponde a la mediana de las posiciones diarias observadas. El color representa el tamaño relativo del monto, donde verde es un monto bajo (en relación con los otros montos observados en la red), amarillo un monto mediano y rojo un monto alto. La relación entre el color y el tamaño es la misma entre depósitos a plazo y derivados.

Gráfico 5

Mercado interbancario para la red formada por depósitos a plazo y derivados en un día específico de la muestra

(período 2009.1-2015.6)



Fuente: Cálculo de los autores a base de información de la SBIF.

La posición (A,B), donde A indica la fila y B la columna, tiene color si el banco A tiene una obligación con el banco B. El color muestra la intensidad del monto bilateral entre dos bancos, donde verde es un monto bajo (en relación con los otros montos observados en la red), amarillo un monto mediano y rojo un monto alto. Los colores son equivalentes entre depósitos a plazo y derivados.

En primer lugar, cabe destacar que estas dos redes son visualmente muy diferentes. En particular, la red formada por depósitos a plazo es menos densa que aquella para derivados, esto es, la proporción de celdas con color es menor. En segundo lugar, hay una mayor dispersión en los valores (colores) de las posiciones bilaterales en la matriz de exposiciones en depósitos a plazo. En tercer lugar, las posiciones bilaterales son menos simétricas (recíprocas) en depósitos a plazo que en derivados. Esto se verifica comparando las matrices triangulares superior e inferior para ambos productos. Todas estas características, invisibles a nivel agregado, son claves para entender la dinámica de contagio en un escenario de estrés financiero. Por ejemplo, Martinez-Jaramillo et al. (2014), encuentran que el nivel de interconectividad de un banco no está necesariamente relacionado con el tamaño del banco, pero sí lo está con el contagio que puede causar. Así, la aproximación de redes nos permite levantar hechos relevantes para el estudio del riesgo sistémico en el mercado interbancario chileno.

2. Evolución de las medidas de red en el tiempo

El gráfico 6 muestra la densidad y la reciprocidad en frecuencia diaria, para depósitos a plazo (panel A) y derivados (panel B). La densidad es el porcentaje de interconexiones que existe en el mercado interbancario sobre el total posible ($506 = 23 \times 22$) dado el número de bancos (23), mientras la reciprocidad es la densidad cuando consideramos solamente interconexiones recíprocas (A presta a B y B presta a A). La densidad para depósitos bancarios es 30% en promedio, significativamente más alta que la documentada para los sistemas financieros de otros países[17]. A partir de mediados del 2009, la densidad creció de manera importante, desde 25% a 40% hacia fines del 2011, probablemente por el efecto de la FLAP en este mercado, que estimuló la toma de posiciones en depósitos a plazo. Sin embargo, desde el 2013 la densidad ha vuelto a caer, llegando en junio del 2015 a representar 35% de las interconexiones posibles. Así, la toma de posiciones debida a la FLAP habría estimulado la formación de conexiones, las cuales habrían perdurado en el tiempo[18]. El gráfico indica, también que, prácticamente la totalidad de estas nuevas interconexiones fueron recíprocas. En particular, la reciprocidad creció desde 11% hasta 25% hacia fines del 2011, equivalente al crecimiento observado en la densidad.

Para el caso de los derivados, la densidad es aun mayor, alcanzando en promedio a 50% de las interconexiones posibles. Esta densidad, a diferencia de la observada para depósitos a plazo, se ha mantenido constante en el tiempo, después de un pequeño crecimiento a fines del 2010.

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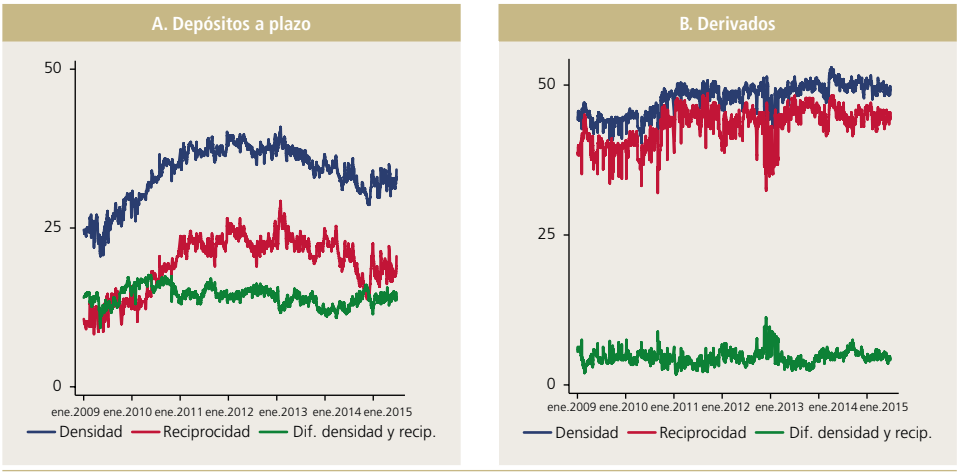
17 Craig y von Peter (2014) reportan para el caso de Alemania con 2.000 bancos una densidad de 0,41%, Somaräki et al. (2006) reportan para el caso de Estado Unidos una densidad con 5.086 bancos de 0,3% y Pröpper et al. (2008) reportan para el caso de Holanda con 183 bancos una densidad del 12%. Nótese, sin embargo, que la densidad tiene relación con el tamaño de la red. Si suponemos que los bancos forman un número fijo de interconexiones, la densidad tiende a cero con el tamaño de la red.

18 En particular, aproximadamente 50% de las interconexiones creadas en el período de la FLAP, perduran hasta el fin de nuestro período de estudio (junio del 2015, resultados no presentados en este trabajo).

Gráfico 6

Densidad, reciprocidad y diferencia entre ambas, para la red formada por depósitos a plazo y derivados

(período 2009.1-2015.6, porcentaje de las interconexiones posibles)



Fuente: Cálculo de los autores a base de información de la SBIF.

Nota: Densidad es el porcentaje de interconexiones que existe en un momento en el tiempo en el mercado interbancario sobre el total de interconexiones posibles. La reciprocidad es la densidad cuando consideramos solo interconexiones recíprocas (A presta a B y B presta a A).

En cuanto a la reciprocidad, encontramos que esta es menor para depósitos a plazo que para derivados. En el caso de depósitos a plazo, observamos que en promedio, la mitad de las interconexiones que existen en este mercado son simétricas[19].

En derivados, el resultado de alta reciprocidad (en relación con las interconexiones observadas) tiene implicancias relevantes en términos de riesgo sistémico. En efecto, dado que en derivados existe *close-out netting*[20] en el caso de la quiebra de un banco, la existencia de reciprocidad disminuye el impacto patrimonial en los bancos expuestos al banco que quiebra, ya que pueden netear sus posiciones activas (que les generan pérdidas) con las posiciones pasivas que pudieran tener con ese banco. Si sumamos a la alta reciprocidad observada el hecho de que los montos son similares, entonces, dado el neteo, el riesgo sistémico generado por estas posiciones es bajo.

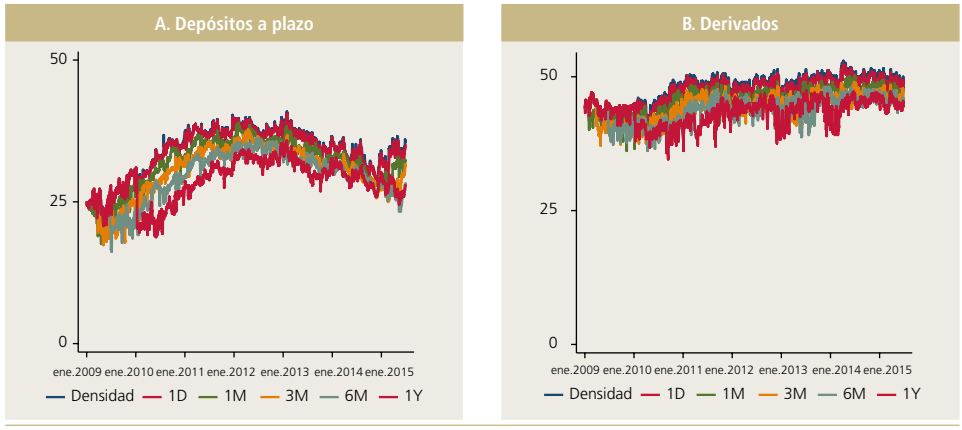
19 Aunque esta es menor que la reportada para México (Molina-Borboa et al., 2015; figura 2), donde se encuentra una reciprocidad promedio cercana al 70%.

20 Ver tabla V1.1 del Informe de Estabilidad Financiera del segundo semestre del 2009 para una discusión detallada del "close-out netting" en Chile.

Gráfico 7

Densidad y persistencia para la red formada por depósitos a plazo y derivados

(período 2010.1-2015.6, como porcentaje de las interconexiones posibles)



Fuente: Cálculo de los autores a base de información de la SBIF.

Nota: Cada serie comienza desde la fecha posible, dado el rezago definido. Por ejemplo, la serie a un año (1Y) comienza el año 2010. Densidad (línea azul) y persistencia para la red formada por depósitos a plazo (A) y derivados (B). La persistencia es la densidad cuando la interconexiones en el día T existía en el día T-X también, donde X es un día (1D), o un mes (1M), o tres meses (3M), o seis meses (6M) o un año (1Y).

En cuanto a la persistencia, el gráfico 7 muestra la densidad de la red junto con una medida de persistencia que solo considera las interconexiones que existían hace solamente un día (1D), un mes (1M), tres meses (3M), seis meses (6M) y un año (1Y). Así, la persistencia es la densidad de las relaciones que duraron dichos períodos. Graficamos para depósitos a plazo (A) y derivados (B). Encontramos que la persistencia es alta y estable en el tiempo, especialmente para derivados, lo que significa que el grupo de bancos al que los bancos prestan (o se financian) tiende a cambiar poco en el tiempo. El cuadro A3 muestra la distribución de la persistencia en las interconexiones en el tiempo y por instrumento. El cuadro A3 muestra que la mediana del porcentaje de interconexiones existentes en un momento del tiempo que existían un año antes es de 85%. Para los derivados, este porcentaje alcanza a 89%. Estos resultados indican una mayor persistencia que la reportada por Molina-Borboa et al. (2015), para el caso del mercado interbancario mexicano de repos, utilizando una metodología similar[21].

Tomando en conjunto estos resultados, tenemos que las interconexiones de la red creada por depósitos a plazo y derivados tienen un grado alto de persistencia y reciprocidad, especialmente los derivados. Sin embargo, estas propiedades son diferentes entre instrumentos, en línea con los resultados de Bargigli et

21 Para repos, los autores muestran que la fracción promedio de relaciones que fueron vistos de nuevo el siguiente día, la siguiente semana, el siguiente mes y a los siguientes seis meses fue de 98%, 90%, 80% y 50%, respectivamente.

al. (2013) para el mercado interbancario italiano y Molina-Borboa et al. (2015) para el mercado interbancario mexicano, los cuales documentan diferentes estructuras entre instrumentos que componen estos mercados. También, todas estas medidas muestran que la estructura de interconexiones ha cambiado fuertemente en este período para el caso de los depósitos a plazo[22].

Finalmente, exploramos el número de interconexiones de los bancos. El gráfico 8 muestra la distribución diaria del *out-degree* (número de bancos a los cuales un banco les presta) y del *in-degree* (número de bancos que proveen financiamiento a un banco) para depósitos a plazo (panel superior) y derivados (panel inferior). Estos indicadores permiten ver dimensiones distintas de la evolución en el tiempo de la estructura de red descrita hasta ahora. Vemos que ambos describen un aumento en las interconexiones, pero la distribución permite ver cómo se distribuye este aumento entre los bancos. En el caso del *out-degree* de depósitos a plazo (gráfico 8A), vemos un fuerte crecimiento en la mediana del número de conexiones entre los bancos, a partir de mediados del 2009, el que fue seguido aproximadamente un año después por los bancos en el percentil 25 (con particular intensidad entre fines del 2011 y fines del 2012), y por aquellos en el percentil 75, si bien de manera moderada. De esta manera podemos colegir que: (i) el aumento de interconexiones se tradujo particularmente en un mayor número de contrapartes deudoras para bancos que prestaban a un número intermedio y bajo de contrapartes; (ii) los cambios se han extendido por un largo período (cinco años), y (iii) el sistema parece estar convergiendo a una estructura distinta de la inicial, con un mayor número de contrapartes deudoras de los bancos con más contrapartes de ese tipo.

En el caso de la evolución del *in-degree*, este también muestra un aumento de las contrapartes acreedoras. La dinámica de este aumento es marcadamente distinta de aquella del *out-degree*. Es muy fuerte a partir de mediados del 2009 en el percentil 75, estabilizándose solo un año después. Esta estabilización coindice con un aumento moderado en el número de contrapartes acreedoras en la mediana. Por otra parte, a comienzos del 2010 se observa un aumento en el percentil 25, donde bancos que no tenían contraparte acreedora bancaria en depósitos a plazo comienzan a tenerlas. De manera similar al caso del *out-degree*, el sistema parece haber convergido a fines del período, a una estructura distinta de la inicial, con todos los bancos aumentando el número de contrapartes acreedoras.

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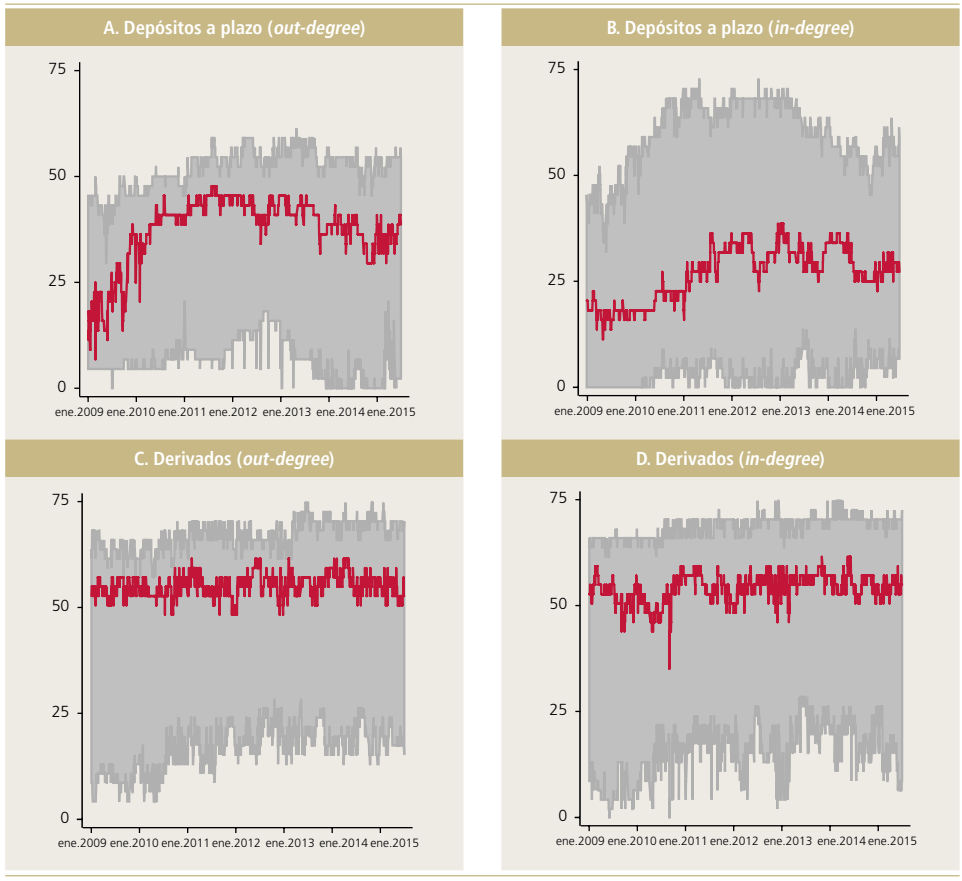
22 Sin embargo, notamos que estamos trabajando con "stocks", que para el caso de depósitos a plazo, tienen un plazo promedio de 140 días. Esto implica que, en términos de estabilidad, parecería normal ver estabilidad en las interconexiones por el traslape de depósitos a plazo en el tiempo. Sin embargo, los resultados de persistencia muestran que, a pesar del traslape de posiciones, las posiciones bilaterales son estables, porque, por ejemplo, el percentil 50 de la persistencia de las interconexiones sobre los tres meses (92%) es similar a la persistencia observada para un año (85%), indicando que el traslape no explicaría la estabilidad observada. También notamos que la estabilidad, en el contexto de redes financieras, significa que solo en ausencia de una severa situación de estrés para los bancos, que es el caso del mercado interbancario chileno en el período 2009.1-2015.6, esperamos ver estabilidad de las interconexiones en el tiempo, porque una grave situación de estrés financiero se caracteriza por rápidas transiciones de una red densa de relaciones de crédito a redes con menos interconexiones (congelamiento del crédito). Ver Anand et al. (2012) para un trabajo teórico sobre topología de redes y crisis sistémicas.

Gráfico 8

Distribución diaria del *out-degree* y del *in-degree* para la red formada para depósitos a plazo y derivados

(período 2009.1-2015.6, como porcentaje de las interconexiones posibles)



Fuente: Cálculo de los autores a base de información de la SBIF.

Nota: *In-degree* es el número de bancos que le prestan al banco A y el *out-degree* es el número de bancos a los cuales el banco A les presta. Línea roja indica el percentil 50. Área gris muestra los percentiles 25 y 75.

De esta manera, la lectura conjunta de ambos gráficos nos indica que, desde mediados del 2009, bancos con un nivel medio o bajo de contrapartes deudoras aumentaron el número de estas. Este aumento en el número de contrapartes deudoras se concentró en pocos bancos; en particular, en aquellos que ya tenían un número alto de contrapartes. Este desarrollo de mayor exposición del sistema a pocos bancos implica un aumento en el riesgo sistémico[23]. Esta situación decrece en ambos lados (*out-degree* e *in-degree*) desde mediados del 2013.

23 Este hecho se verifica en un trabajo en proceso de los autores, aún sin publicar.

Por último, en derivados observamos que el *out-degree* (gráfico 8C) se ha mantenido constante en el tiempo, al igual que el *in-degree* (gráfico 8D), siendo ambos equivalentes, lo cual es coherente con la simetría documentada en el gráfico 5. Los bancos en derivados toman posiciones activas y pasivas con el mismo número de bancos, siendo la mayoría de estas relaciones recíprocas.

Estos resultados confirman que las propiedades documentadas en depósitos a plazo y derivados son diferentes entre estos instrumentos, tanto en los niveles como en la dinámica observada en el tiempo.

V. CONCLUSIONES

En este trabajo, mostramos evidencia única sobre el mercado interbancario chileno, que permite identificar y caracterizar la estructura de interconexiones, para depósitos a plazo y derivados, para el período 2009.1-2015.6. Encontramos que el mercado interbancario es una fuente de financiamiento mayorista importante para los bancos, y que los depósitos a plazo y los derivados son los principales instrumentos que los bancos utilizan para transar en dicho mercado. Cuando medimos la concentración en cada de unos estos instrumentos, en relación con la provisión de liquidez y financiamiento, encontramos que la provisión de liquidez en depósitos a plazo se encuentra concentrada en un único banco, muy por sobre la concentración observada para el financiamiento. Para derivados, encontramos que las posiciones activas como pasivas, se encuentran igual de concentradas y ambas han ido creciendo desde enero del 2014.

Cuando miramos el comportamiento de los bancos en depósitos a plazo y derivados a nivel bilateral, a través de medidas de red, encontramos que las interconexiones cambian en el tiempo y que una fracción alta de las relaciones formadas son recíprocas (los bancos se prestan mutuamente) y persistentes en el tiempo. Adicionalmente, la evidencia presentada en este trabajo permite dar cuenta del efecto que habría tenido la FLAP en el mercado interbancario y en las interconexiones formadas por los bancos. En particular, la implementación de la FLAP coincidió con un aumento importante de las interconexiones recíprocas del sistema. Además, la evolución del *out-degree* y del *in-degree* da indicios de un posible aumento del riesgo sistémico.

Los resultados documentados en este trabajo permiten hacer una primera comparación con otros mercados interbancarios a nivel internacional. En particular, el tamaño se encuentra en línea con la evidencia internacional, pero no así la composición de instrumentos del interbancario, en la cual observamos un predominio del depósito a plazo por sobre el repo interbancario. En cuanto a las medidas de red, encontramos que la densidad es alta cuando comparamos con la evidencia disponible (Holanda, Estados Unidos y Alemania). Para reciprocidad, encontramos que esta es baja cuando comparamos con el caso de México, aunque no existe evidencia adicional disponible. Finalmente, documentamos una mayor persistencia a la encontrada para el caso mexicano. Desde una perspectiva de la investigación, los resultados sobre el tamaño del

mercado interbancario, sus instrumentos, la estructura de interconexiones y la persistencia de las mismas, levantan hechos esenciales para investigadores desarrollando herramientas de ejercicios de tensión, especialmente cuando estas consideran interconexiones entre bancos.

Finalmente, esta es una primera caracterización del mercado interbancario chileno con información completa de exposiciones bilaterales para un período largo. Existen varias avenidas para investigación futura. Por ejemplo, estudiar econométricamente la formación de relaciones de crédito en el mercado interbancario y/o estimar las implicancias, desde una perspectiva de riesgo sistémico, de la estructura de interconexiones observada en el mercado interbancario.

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APÉNDICE A

INSTRUMENTOS DEL MERCADO INTERBANCARIO CHILENO

Cuadro A1

Detalle de los instrumentos que componen el mercado interbancario

N°	Cuenta	Descripción
1	Préstamos interbancarios	Corresponde a préstamos interbancarios, sobregiros en cuentas corrientes, depósitos a plazo intransferibles, préstamos obtenidos a largo plazo y otras obligaciones. Incluye también otras obligaciones a la vista, las a que a la vez corresponden a vales vista, cuentas de depósito a la vista, depósitos por consignaciones judiciales, boletas de garantía pagaderas a la vista, recaudaciones y cobranzas efectuadas por enterar, pagos por efectuar por venta de instrumentos financieros, retornos de exportaciones por liquidar, órdenes de pago pendientes, amortizaciones extraordinarias letras de crédito, pagos a cuenta de créditos por liquidar, saldos inmovilizados artículo 156 LGB, depósitos a plazo vencidos, cupones de bonos y letras de crédito vencidos y otras obligaciones a la vista.
2	Repo	Corresponde a contratos de retrocompra con otros bancos y obligaciones por préstamos de valores.
3	Depósitos a plazo	Corresponde a depósitos a plazo transferibles.
4	Derivados	Corresponde al valor razonable negativo de contratos de derivados vigentes con el respectivo banco, que incluye contratos de negociación y contratos para cobertura contable.
5	Préstamos interbancarios con colateral	Obligaciones que se encuentran exentas del cómputo para límites por estar caucionadas con garantías válidas para el efecto, de acuerdo a lo indicado en el Capítulo 12-7 de la Recopilación Actualizada de Normas.
6	Operaciones con liquidación en curso	Corresponde a pagos de contrapartes por liquidar y divisas pendientes de transferencia.
7	Bonos	Corresponde a bonos bancarios.
8	Cuentas corrientes	Corresponde a los saldos contables de las cuentas corrientes que mantienen los respectivos bancos.

Fuente: Superintendencia de Bancos e Instituciones Financieras (SBIF).

Nota: Las cuentas corresponden al archivo C-18, menos bonos bancarios que viene del archivo P40. El detalle de las cuentas C18 se encuentra en el Compendio de Normas Contables, Capitulo C-3, Circular N° 3.555 -02.10.2013.

Cuadro A2

Tamaño relativo de los ocho instrumentos que componen el mercado interbancario chileno

N°	Instrumento	Tamaño relativo (%)					
		Media	p5	p25	p50	p75	p95
1	Depósitos a plazo	64,0	48,1	56,5	65,2	69,6	75,1
2	Derivados	15,3	7,5	10,3	13,7	19,5	26,4
3	Operaciones con liquidación	14,0	7,5	11,5	13,8	16,8	21,0
4	Bonos bancarios	3,4	2,0	2,5	3,2	4,5	5,4
5	Préstamos interbancarios	2,9	0,7	1,6	2,7	3,8	7,2
6	Cuentas corrientes	0,2	0,1	0,1	0,2	0,3	0,4
7	Repo	0,1	0,0	0,0	0,0	0,0	0,7
8	Préstamos interbancarios con colateral	0,0	0,0	0,0	0,0	0,0	0,0

Fuente: Superintendencia de Bancos e Instituciones Financieras (SBIF).

Nota: Para una descripción detallada, ver el Compendio de Normas Contables, Capitulo C-3, Circular N° 3.555 -02.10.2013. El detalle de las cuentas C18 se encuentra en el Compendio de Normas Contables, Capitulo C-3, Circular N° 3.555 -02.10.2013.

Cuadro A3

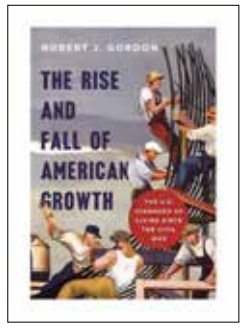
Distribución de la persistencia de interconexiones para la red formada por depósitos a plazo y derivados

			Persistencia interconexiones (porcentaje de la densidad)				
	Distribución	Densidad	1D	1M	3M	6M	1Y
Depósito a plazo	p25	36,6	99	94	90	86	77
	p50	37,7	99	95	92	90	85
	p75	39,1	99	95	92	90	86
Derivados	p25	47,6	98	93	90	88	86
	p50	48,8	99	95	93	91	89
	p75	49,8	99	96	93	92	90

Nota: La persistencia es la densidad cuando las interconexiones en el día *T* existían en el día *T-X* también, donde *X* es un día (1D), o un mes (1M), o tres meses (3M), o seis meses (6M) o un año (1Y).

Calculado desde el 2010 porque la serie 1Y comienza en el año 2010.

REVISIÓN DE LIBROS



COMENTARIO AL LIBRO

"THE RISE AND FALL OF AMERICAN GROWTH: THE U.S. STANDARD OF LIVING SINCE THE CIVIL WAR"

por Robert J. Gordon
Princeton University Press, 2016.

Jorge Lorca*

Es común escuchar en comunidades académicas acerca de publicaciones que se adelantaron a su tiempo, o que, en general, no fueron contemporáneas al apogeo de las discusiones que pretendían abordar. Tal descalce temporal, sin embargo, no atañe al monumental libro publicado este año por el profesor Robert J. Gordon, pues su recopilación acerca de los estándares de vida en Estados Unidos complementa el interés y la preocupación general sobre las causas y consecuencias de la ralentización cuasi-uniforme del crecimiento mundial reciente: ediciones íntegras del *World Economic Outlook*, o de revistas como *Foreign Affairs*, *The Atlantic*, libros acerca del estado de la innovación en EE.UU., amplios reportajes en el *Financial Times* y el *Wall Street Journal*, y discusiones extensas dentro de las minutas del Comité de Mercado Abierto de la Reserva Federal reflejan el interés amplio y contingente a la publicación de Gordon[1].

Este libro, a diferencia de publicaciones técnicas recientes sobre las causas del menor crecimiento global, es un extenso ensayo historiográfico que detalla la transición del estándar de vida de la sociedad norteamericana desde 1870 hasta el presente, y que el autor utiliza para elaborar el siguiente juicio: dada la particularidad y relevancia única del avance tecnológico y material de la primera parte del siglo XX en EE.UU. —sumada a la concentración de las innovaciones recientes en el mejoramiento de las comunicaciones— resulta escasamente probable que la mayor economía del mundo pueda evadir el concepto de estancamiento secular de Alvin Hansen.

El libro se divide en tres partes, con dos entreactos que —dada la extensión del libro— sirven para remarcar las ideas principales. Las dos primeras partes caracterizan las subdivisiones simétricas del período 1870–2010, y la tercera

* *Facultad de Economía y Negocios, Universidad de Chile. Economista senior, Banco de Chile. E-mail: jlorcag@fen.uchile.cl*

1 Véase, entre otros, "Can America Put Itself Back Together?" por James Fallows, en The Atlantic, marzo del 2016 y "Is Engine of Innovation in Danger of Stalling?" por Chistopher Mims, en Wall Street Journal, 20 de noviembre de 2016.

se concentra en analizar las barreras actuales contra el mayor crecimiento. En palabras del autor, el libro provee una "explicación enciclopédica y unificada acerca de por qué el crecimiento de la productividad [en EE.UU.] fue tan fuerte entre 1920 y 1970, y tan lenta después", con una reflexión final acerca de las perspectivas del crecimiento norteamericano en las próximas décadas.

La primera parte del libro, dividida en ocho capítulos temáticos, asienta dos ideas: primero, que el crecimiento económico es un fenómeno extremadamente reciente cuando se aborda una perspectiva temporal de mayor extensión que los últimos dos siglos, y luego, e íntimamente ligado a lo anterior, se documenta la espectacularidad de los cambios en el patrón de vida de la sociedad norteamericana en un intervalo de 70 años, desde 1870. En esta parte radica el aporte más sólido del libro, al concentrar la narración de cómo una sociedad rural, disgregada y con esperanza de vida de 45 años pasó a ser —en apenas dos generaciones— una sociedad donde la forma en que se trabajaba, se comunicaba, se alimentaba, se viajaba, se socializaba, y se consumía pasó a ser radicalmente diferente, todo inducido por los avances tecnológicos ilustrados en las figuras de Eddison, Benz y Ford.

En esta parte, la evidencia anecdótica utilizada resulta particularmente nostálgica e impactante al ser comparada con los estándares actuales: el control de la electricidad y el posterior desarrollo de aparatos eléctricos como "los fonógrafos permitieron a la gente por primera vez escuchar música interpretada adecuadamente por profesionales" (p. 188), y la masificación del automóvil liberó a los habitantes rurales de "mantener reuniones sociales con aquellos [...] alcanzables a distancia de caballo" (p. 163). En esta parte, además, el libro proclama la subvaloración de estos avances en las cifras del PIB.

La segunda parte del libro utiliza seis capítulos para estudiar mediante el mismo enfoque casuístico de la primera parte aquellos desarrollos entre 1940 y 2015. En esta parte del libro, no sin eludir un tono lúgubre en su argumentación, Gordon establece la mera continuidad de los incrementos en los estándares de vida desde el período anterior, e incluso aborda retrocesos en materia de salud, y en la evolución de su costo, además del avance de la inequidad económica y la focalización de los avances técnicos en los sectores de entretención y comunicación, donde el autor resalta el bajo potencial de estos para inducir alto crecimiento.

La parte final del libro es la más interesante desde el enfoque de política económica y del debate actual, pues Gordon primero expone la evidencia acerca del crecimiento de la productividad norteamericana en distintos períodos desde 1890 (fig. 17-2, p. 575) y luego discute con detalle la posibilidad de que los avances tecnológicos, económicos y sociológicos recientes puedan alcanzar el extraordinario avance productivo acaecido entre 1920 y 1970. Tanto la concentración de los avances técnicos en los sectores de entretención y comunicación, así como el aumento del costo de la educación universitaria, de la deuda pública, y de la desigualdad, son a juicio del autor barreras insalvables que harán converger la economía norteamericana al estancamiento secular popularizado por Lawrence Summers.

En esta parte del libro, además, y en un aporte final de purismo científico, Gordon revisa las fuentes eventuales de avance tecnológico y de crecimiento económico enarboladas por sus contrincantes intelectuales (como Joel Mokyr), y que Gordon, sin evadir algo de desdén, denota como "tecno-optimistas". El principal conjunto de críticas conceptuales a las que Gordon se ve expuesto por tal grupo radica en la mayor competencia e innovación inducida por la globalización, y por los prometedores avances de la neurociencia y de la impresión 3-D. Sin embargo, luego de revisar minuciosamente tales argumentos rivales, la conclusión de Gordon permanece incólume basada tanto en los órdenes de magnitud que aduce como en el hecho de que el rendimiento del sector manufacturero no se vería afectado si su producción se llevara a cabo en fábricas u hogares. Con todo, el autor pronostica un crecimiento del producto por trabajador de 0,8% por año entre el 2015 y el 2040, menos de un tercio de aquel entre 1920 y 1970 (tabla 18-4, p. 637).

En suma, mediante la recopilación y análisis de 649 referencias en el ámbito cultural, sanitario, sociológico, científico y económico, Gordon finaliza un monumental trabajo académico, y que además se publica en el momento óptimo para contribuir a la discusión sobre la pregunta más relevante en la coyuntura de estos días: la factibilidad de elevar el crecimiento mundial en el ambiente de ralentización actual.

Si bien la perspectiva que el libro aporta es lúgubre en el sentido de establecer que lo inusual en la historia económica es observar crecimiento económico, Gordon alcanza un cometido de mayor relevancia, cual es poner el peso de la prueba en el lado de los tecno-optimistas: el conjunto de información disponible apunta a que el crecimiento futuro no está garantizado por la mera innovación privada actual en los sectores de comunicación y entretención. Si la evidencia de los próximos 25 años le da finalmente la razón o no resulta irrelevante frente al punto establecido en este libro: sin acciones de política económica de por medio, existen más barreras que catalizadores para observar crecimiento económico en el horizonte cercano.

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REVISIÓN DE PUBLICACIONES

DICIEMBRE 2016

Esta sección tiene por objetivo presentar las más recientes investigaciones publicadas sobre diversos tópicos de la economía chilena. La presentación se divide en dos partes: una primera sección de listado de títulos de investigaciones y una segunda de títulos y resúmenes de publicaciones. Las publicaciones están agrupadas por área temática, considerando la clasificación de publicaciones del *Journal of Economic Literature (JEL)*, y por orden alfabético de los autores.

CATASTRO DE PUBLICACIONES RECIENTES

Los resúmenes de los artículos indicados con (*) se presentan en la siguiente sección.

Código JEL: E / MACROECONOMÍA Y ECONOMÍA MONETARIA

*Amador-Torres, J.S., J.E. Gómez-González, J.N. Ojeda-Joya, O.F. Jaulin-Méndez y F. Tenjo-Galarza (2016). "Mind the Gap: Computing Finance-Neutral Output Gaps in Latin-American Economies". *Economic Systems* 40(3): 444–52.

Díaz, J. y G. Wagner (2016). "Inversión y Capital: Chile, 1833-2010" Documento de Trabajo N°479, Departamento de Economía, Pontificia Universidad Católica de Chile.

Código JEL: F / ECONOMÍA INTERNACIONAL

Daher, A. y D. Moreno (2016). "Crisis Financieras y Sustentabilidad Socioeconómica Subnacional". *Lecturas de Economía* 85: 211–42.

*Dingemans, A. (2016). "Trying to Stay Ahead of the Curve in Chile's Economic Development: Exploring a Way Out of the Middle-Income Trap through Pragmatic Export Development". *Development Policy Review* 34(5): 643–69.

Kang, Y. (2016). "Is Agglomeration a Free Lunch for New Exporters? Evidence from Chile". *Annals of Regional Science* 57(1): 195–222.

Código JEL: G / ECONOMÍA FINANCIERA

*Inzunza, A., R. Moreno, A. Bernales y H. Rudnick (2016). "CVaR Constrained Planning of Renewable Generation with Consideration of System Inertial Response, Reserve Services and Demand Participation". *Energy Economics* 59: 104–17.

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Código JEL: O / DESARROLLO ECONÓMICO, CAMBIO TECNOLÓGICO Y CRECIMIENTO

*Álvarez, R. (2016). "The Impact of R&D and ICT Investment on Innovation and Productivity in Chilean Firms". Documento de Trabajo N°428, Departamento de Economía, Universidad de Chile.

Candia, C., M. Aguirre, N. Correa y M.J. Herrera (2016). "La Productividad Total de Factores en el Sector Manufacturero Chileno". *Revista de Economía Institucional* 18(35): 229–55.

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Código JEL: Y / NO CLASIFICADOS

Álvarez, R. y D. Vergara (2016), "Natural Resources and Education: Evidence from Chile". Documento de Trabajo N°433, Departamento de Economía, Universidad de Chile.

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Santos, H. y G. Elacqua (2016). "Segregación Socioeconómica Escolar en Chile: Elección de la Escuela por los Padres y un Análisis Contrafactual Teórico". *Revista de la CEPAL* 119: 133–48.

Wu, R. y H. Shi (2016). "Trade Liberalization and Exports Promotion: A Dynamic and Heterogeneous Analysis under the Case of Chile". *Emerging Markets Finance and Trade* 52(11): 2636–45.

Zajac, A. (2016). "Carbon Mitigation in Latin America: Is a Regional Emissions Trading System a Realistic Option?" *New York University Journal of International Law and Politics* 48(2): 621–72.

RESÚMENES DE ARTÍCULOS SELECCIONADOS

Los textos presentados a continuación son transcripciones literales del original.

Código JEL: E / MACROECONOMÍA Y ECONOMÍA MONETARIA

*Amador-Torres, J.S., J.E. Gómez-González, J.N. Ojeda-Joya, O.F. Jaulin-Méndez y F. Tenjo-Galarza (2016). "Mind the Gap: Computing Finance-Neutral Output Gaps in Latin-American Economies". *Economic Systems* 40(3): 444–52.

We compute a measure of the finance-neutral potential output for Colombia, Chile and Mexico. Our methodology is based on Borio et al. (2013, 2014) and incorporates the cycle of credit, house prices and the real exchange rate on the computation of the output gap. Our results show that around the financial crises of the 1990s the finance-neutral output gap behaved differently than the traditional measures observed by policymakers. In particular, gaps are higher before crises and lower after them. Our findings also show that conventional techniques underestimate the current output gap by not taking into account the stance of the financial cycle in Colombia and Mexico.

Código JEL: F / ECONOMÍA INTERNACIONAL

*Dingemans, A. (2016). "Trying to Stay Ahead of the Curve in Chile's Economic Development: Exploring a Way Out of the Middle-Income Trap through Pragmatic Export Development". *Development Policy Review* 34(5): 643–69.

Underneath impressive growth levels, the Chilean economy displays signs of being caught in a middle-income trap. It has been unable to improve its productivity, increase the added value of its exports or upgrade its value chain. Its economy cannot compete either with low-wage countries or highly productive, innovative countries. Its export strategy based on export promotion seems to have outlived its usefulness. It achieved remarkable quantitative success, but must now attend qualitative attributes. Instead of regarding market-driven export promotion and state-led export development as substitutes, this article proposes to view them as alternatives in different stages of development. To choose the appropriate time, more attention should be given to non-traditional, structural indicators, like export sophistication and political-institutional capabilities.

Código JEL: G / ECONOMÍA FINANCIERA

* Inzunza, A., R. Moreno, A. Bernales y H. Rudnick (2016). "CVaR Constrained Planning of Renewable Generation with Consideration of System Inertial Response, Reserve Services and Demand Participation." *Energy Economics* 59: 104-17.

Integration of renewable generation can lead to both diversification of energy sources (which can improve the overall economic performance of the power sector) and cost increase due to the need for further resources to provide flexibility and thus secure operation from unpredictable, variable and asynchronous generation. In this context, we propose a cost-risk model that can properly plan generation and determine efficient technology portfolios through balancing the benefits of energy source diversification and cost of security of supply through the provision of various generation frequency control and demand side services, including preservation of system inertia levels. We do so through a scenario-based cost minimization framework where the conditional value at risk (CVaR), associated with costs under extreme scenarios of fossil fuel prices combined with hydrological inflows, is constrained. The model can tackle problems with large data sets (e.g. 8760 hours and 1000 scenarios) since we use linear programming and propose a Benders-based method adapted to deal with CVaR constraints in the master problem. Through several analyses, including the Chilean main electricity system, we demonstrate the effects of renewables on hedging both fossil fuel and hydrological risks; effects of security of supply on costs, risks and renewable investment; and the importance of demand side services in limiting risk exposure of generation portfolios through encouraging risk mitigating renewable generation investment.

Código JEL: O / DESARROLLO ECONÓMICO, CAMBIO TECNOLÓGICO Y CRECIMIENTO

*Álvarez, R. (2016). "The Impact of R&D and ICT Investment on Innovation and Productivity in Chilean Firms". Documento de Trabajo N°428, Departamento de Economía, Universidad de Chile.

This paper examines the impact of information and communication technology (ICT) and research and development (R&D) investment on innovation and productivity in Chilean firms, in particular those in the services industry. It provides new evidence on this topic for a developing country and also for firms in the services sector, areas in which existing evidence is limited. The findings for services industries are relevant because this sector in Latin America has a large productivity gap when compared to the sector in developed countries. The results show that ICT contributes positively to innovation and productivity in both the total sample and the services industry. They also confirm that ICT investment increases productivity directly and not only through innovation, suggesting that this investment would have additional effects on productivity.

Código JEL: Y / NO CLASIFICADOS

*Fairfield, T. y M. Jorratt (2016). "Top Income Shares, Business Profits, and Effective Tax Rates in Contemporary Chile". *Review of Income and Wealth* 62: S120–44.

We contribute to research on inequality and world top incomes by presenting the first calculations of Chilean top income shares and effective tax rates using individual tax return microdata from 2005 and 2009. We pay special attention to business income, which dominates at the top. Our analysis includes not only distributed profits, but also the large proportion of accrued profits retained by firms, which are rarely analyzed given the difficulty of identifying individual owners. Our most conservative top 1 percent income-share estimate is 15 percent—the fifth highest in the top incomes literature. When distributed profits are adjusted for evasion, the top 1 percent share reaches 22-26 percent. When we broaden the income concept to include accrued profits, which we impute to taxpayers using ownership shares calculated from business tax forms, the top 1 percent share increases to a minimum of 23 percent. Despite this impressive income concentration, the top 1 percent pays modest average effective income-tax rates of 15-16 percent.

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