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A REAL TIME EVALUATION OF THE CENTRAL BANK OF CHILE GDP GROWTH FORECASTS

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Abstract

In this paper we evaluate the Central Bank of Chile annual GDP growth forecasts over the period 1991-2009 using a real-time database. We compare the Central Bank of Chile forecasts with those of the Survey of Professional Forecasters (SPF), Consensus Forecasts, and simple time-series models. We compare all forecasts to first and quasi-final GDP growth vintages. We evaluate a number of different forecast properties, including forecast accuracy and efficiency. We report mixed results in terms of root mean squared prediction errors. Depending on the sample period, the forecast horizon and the vintage used in the analysis, forecasts from the Central Bank of Chile may outperform or be outperformed by the benchmarks. Despite these mixed results, differences in root mean squared prediction errors are generally moderate and have no statistical significance. Nevertheless, our efficiency analysis, in addition to the fact that in some periods the forecasts produced by the Central Bank of Chile have been outperformed by alternative forecasts, opens the question about the room for improvement in the accuracy of the Central Bank of Chile forecasts. While the room for improvement may actually exist, our results suggest that this room seems to be small for point forecasts and larger for interval forecasts.

We are grateful to Gustavo Leyva and Cristián Muñoz for excellent research assistantship and to Michael Pedersen for sharing the real time database. We also thank Felipe Stanger, María Pilar Pozo and Andrea Contreras for their valuable contribution in an alternative real time database. Helpful and insightful comments from José De Gregorio, Manuel Marfán, Sebastián Claro, Rodrigo Vergara, Pablo García, Ricardo Vicuña, Claudio Soto, Juan Pablo Medina, Andrea Bentancor and Luis Felipe Céspedes have enriched this paper. All errors are our own responsibility. Correspondence: Agustinas 1180, Santiago-Chile. Tel: 56-2-670-2874, Fax: 56-2-670-2836. E-mail: ppinchei@bcentral.cl.

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UNA EVALUACIÓN EN TIEMPO REAL DE LOS PRONÓSTICOS DE CRECIMIENTO DEL PIB DEL BANCO CENTRAL DE CHILE

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Resumen

En este artículo evaluamos las proyecciones de crecimiento el PIB efectuadas por el Banco Central de Chile en el periodo 1991-2009 utilizando una base de datos en tiempo real. Comparamos las proyecciones del Banco Central con las de la Encuesta de Expectativas Económicas, *Consensus Forecasts* y aquellas provenientes de simples modelos de series de tiempo. Comparamos todos los pronósticos con las primeras señales de crecimiento del PIB, así como con los datos revisados y cuasidefinitivos de crecimiento. Evaluamos una gran variedad de propiedades de los pronósticos, incluyendo precisión y eficiencia. Reportamos resultados mixtos en términos de la raíz del error cuadrático medio. Dependiendo del periodo muestral, del horizonte de proyección y de la señal contra la cual se comparan los pronósticos, el Banco Central de Chile puede mostrar resultados mejores o peores que los pronósticos de referencia utilizados. A pesar de estos resultados mixtos, las diferencias en la raíz del error cuadrático medio son en general moderadas y sin significancia estadística. No obstante estos hallazgos, nuestro análisis de eficiencia, sumado al hecho de que por algunos subperíodos muestrales algunos pronósticos de referencia han sido más precisos que los del Banco Central, abre la pregunta acerca del espacio que existiría para mejorar los pronósticos del Banco Central de Chile. Si bien este espacio parece existir, nuestros resultados sugieren que este espacio es pequeño cuando nos referimos a las proyecciones puntuales del Banco Central, y más grande cuando nos referimos a los intervalos de proyección.

We are grateful to Gustavo Leyva and Cristián Muñoz for excellent research assistantship and to Michael Pedersen for sharing the real time database. We also thank Felipe Stanger, María Pilar Pozo and Andrea Contreras for their valuable contribution in an alternative real time database. Helpful and insightful comments from José De Gregorio, Manuel Marfán, Sebastián Claro, Rodrigo Vergara, Pablo García, Ricardo Vicuña, Claudio Soto, Juan Pablo Medina, Andrea Bentancor and Luis Felipe Céspedes have enriched this paper. All errors are our own responsibility. Correspondence: Agustinas 1180, Santiago-Chile. Tel: 56-2-670-2874, Fax: 56-2-670-2836. E-mail: ppinchei@bcentral.cl.

I. Introduction

In this article we evaluate the Central Bank of Chile's annual GDP growth forecasts during the period 1991-2009. We compare the Central Bank of Chile' forecasts (CBCh) with those from the Survey of Professional Forecasters (SPF), Consensus Forecasts, and also with those obtained using simple time-series models. We evaluate a number of different forecast properties, including forecasts accuracy and efficiency. In particular we place our attention on Root Mean Squared Prediction Errors (RMSPE) and autocorrelation in forecast errors.

This is not the first written article comparing the CBCh annual GDP growth forecasts. Nevertheless, the main contribution of our article is significant. This is because we make use of a real time database, already used in Pedersen (2009), containing both quasi-final and first releases of annual GDP growth for Chile[2]. For a given date in the past, this database contains the last revisions of GDP growth observations that were actually available at that moment in time[3]. This allows us to properly generate real time forecasts with simple time series models and make a fair comparison of these forecasts with those of the CBCh. This is important because, otherwise, times series forecasts based upon revised data would count with the benefit of revisions, which of course, were not available at the moment of prediction.

It is important to emphasize that during the sample period official GDP growth observations were released in four different reference years. These reference years are 1977, 1986, 1996 and 2003. These multiple changes in reference years induce a missing observations problem in the computation of the CBCh's forecast errors. This happens because, in a few occasions, the CBCh released their forecasts at a moment in time in which the new methodology associated with the

[2] Quasi-final releases correspond to the last revision available for a given reference year. Quasi-final releases may or may not coincide with final releases. Actually they are the same with the exception of the following years: 1991, 1992, 1999, 2000, 2004 and 2005. Quasi-final and final data differ in that final observations are never revised in the future. Quasi-final observations may be revised in the future, but if they are revised the revision is expressed in a new reference year.

[3] Other articles dealing with real-time-data for activity measures in Chile are Chumacero and Gallego (2002), Morandé and Tejada (2008) and Pincheira and Rubio (2009).

new reference year was not yet released[4]. Nevertheless, when official data of that particular year was released, it was expressed in the new methodology corresponding to the new reference year. As a consequence, the CBCh never issued a forecast for that particular year in that particular reference year, so we rather prefer to treat that figure as a missing observation.

Besides this missing observations problem, we face the additional limitation of an extremely small sample. We have 19 observations of what we call "one-step-ahead" forecasts (OSA forecasts) from the CBCh and 20 observations of what we call "two-step-ahead forecasts". (TSA forecasts). The small sample problem is even worst when we turn to private forecasters. Just to give an example, there are only 8 OSA forecasts from Consensus Forecasts and 10 OSA forecasts from the SPF.

Despite this small sample issue, we think that a work like ours is extremely important both from a policy and academic point of view. From a policy point of view, we need to recall that the Central Bank of Chile follows a flexible inflation targeting regime. In this particular monetary regime, inflation and output forecasts are the building blocks of monetary policy decisions. Furthermore, good forecasts not only help policy makers to make appropriate decisions, they also play a major role in the construction of a central bank key asset: credibility. This is so, because forecasts provide a solid and objective measure of the ability that a central bank may have to understand the economy. Good forecasts may help to strengthen the credibility of a central bank and therefore the efficiency of monetary policy. Bad forecasts may well work in the opposite direction.

From the academic point of view this paper is also appealing. The Central Bank of Chile works with many state of the art models to characterize the economy. A forecast evaluation of the type we make here, could be indirectly indicating the usefulness of those models either to provide good forecasts or, at least, a good understanding of the economy that enable policy makers to make well informed judgmental forecasts. Of course, in this article we are no

[4] We will assume that this ignorance about the future reference year methodology also holds true for every single forecaster.

evaluating these state of the art models directly. We are evaluating the final output of a long decision making process in which these models may play a role.

We show results covering a wide variety of issues. We compare the accuracy of the CBCh`s forecasts using both first vintages and revised GDP growth data. We also analyze whether the forecasts by the CBCh are optimistic or pessimistic when compared with private analysts' forecasts. We also analyze forecast efficiency and whether forecasts have been more accurate in the recent years or in the distant past. Finally, we analyze the empirical coverage of the forecasting intervals reported by the CBCh.

We report mixed results in terms of root mean squared prediction errors. Depending on the benchmark, the sample period, the forecast horizon, and the vintage used in the analysis, forecasts from the Central Bank of Chile may outperform the benchmarks or may be outperformed by them. Despite these mixed results, differences in root mean squared prediction errors are, in general, moderate and with no statistical significance, with only one exception favoring forecasts from the Central Bank of Chile. Nevertheless, our efficiency analysis, in addition to the fact that in some periods the forecasts produced by the Central Bank of Chile have been slightly outperformed by alternative forecasts, opens the question about the room for improvement in the accuracy of the Central Bank of Chile forecasts. While the room for improvement seems to be small for point forecasts, it seems larger for interval forecasts.

The rest of the document is organized as follows: in section II we present a literature review. In the third section we describe the methodology we use to compute forecasts errors and to compare the CBCh forecasts errors with those from private analysts and simple time series models. In section IV we deliver the main results of this paper, and in section V we provide conclusions and a brief summary of our results.

II. Literature Review

Most of the forecasting literature relies on statistical measures of accuracy to compare different forecasts. Actually, the most commonly used statistical measure of forecast accuracy is the

Mean Squared Prediction Error (MSPE) or its squared root denoted by RMSPE[5]. Another branch of the literature focuses on measures of forecast efficiency. This approach aims at detecting whether a particular forecast has or has not been able to properly use all the available information at the moment when forecasts were made. This idea is of old vintage and many papers have derived either tests or theoretical results on forecasts efficiency under different assumptions, see for instance Elliot and Timmermann (2008). In particular, under quadratic loss, efficient forecast errors should be unbiased and uncorrelated with variables in the information set used for the construction of forecasts. If past forecast errors belong to this information set, then optimality implies a finite autocorrelation structure for these errors[6].

Interestingly, a recent literature shows that when more general loss functions are considered, efficient forecasts errors could present bias and autocorrelation. As a matter of fact, the presence of bias and autocorrelation in forecast errors might be the result of an optimal strategy when agents face asymmetric loss functions. See, for instance, Patton and Timmermann (2007), Elliott, Komunjer and Timmermann (2008), Capistrán (2007) and Capistrán and Timmermann (2008).

In empirical grounds it is usual to find articles evaluating the accuracy and efficiency of private and public forecasters. For instance, Joutz and Stekler (2000) take GDP and inflation forecasts from the Federal Reserve of the United States of America to find that they show systematic errors and similar properties and problems than private forecasts. In particular, they show that the Federal Reserve forecasts are not statistically better than simple ARIMA forecasts or those provided by surveys.

[5] Although most of the literature uses error measures drawn from statistics, McCulloch and Rossi (1990), Leitch and Tanner (1991) and West et al. (1993) use economic-based measures. This is the case of evaluations where the loss functions are associated with economic criteria such as profits or measures of welfare. This kind of evaluation goes beyond the scope of this paper. In addition, McCracken and West (2002) provide an interesting discussion about the variety of metrics available in the literature to evaluate forecasts.

[6] It is important to mention the contribution of Mincer and Zarnowitz (1969) in this regard. They propose simple methods to evaluate bias and forecast efficiency. Similarly, Granger and Ramanathan (1984) and Chong and Hendry (1986) propose encompassing test to evaluate if the information embedded in a particular series of forecasts is able to explain, at least in part, another forecasting method prediction errors.

More recently, Capistrán (2007) shows that the US Federal Reserve inflation forecasts under-predicted effective inflation in a given sample period, and that over predicted effective inflation in the rest of the sample. Furthermore, he also showed evidence indicating that the US Federal Reserve forecasts may have not used all the information available in private analyst forecasts.

Groen, Kapetanios and Price (2009) is another paper evaluating the forecasting performance of a central bank. As in our paper, they compare forecasts to different GDP vintages. They show that the Bank of England's inflation forecasts outperform a variety of time series benchmarks, whereas GDP growth rates forecasts are generally less accurate than traditional univariate and multivariate benchmarks. In particular they show that the traditional random walk model generates GDP forecasts that are more accurate then those of the Bank of England when prediction is made one quarter ahead. This result is robust to the different vintages used in the evaluation.

Another article evaluating forecasts by a central bank is due to Andersson et al. (2007). In this paper, the authors evaluate the relative performance of the Central Bank of Sweden's inflation forecasts. In general, they find that the Swedish Central Bank's forecasts are more accurate than forecasts provided by the National Institute of Economic Research, but the difference is not statistically significant. Moreover, their results suggest that the Swedish Central Bank performs quite well compared to Consensus Forecasts.

For the Euro zone, Bowls et al. (2007) analyze private analyst forecasts. Among other things, they find that private analyst have shown a tendency to underestimate effective inflation and to overestimate GDP growth. The sample period in their evaluation goes from the first quarter in 1999 to the last quarter in 2006.

In another article, Loungani (2001) evaluates GDP growth prediction errors from Consensus Forecasts in several developed and developing countries for the period 1989-1998. She finds

some evidence of inefficiency and bias. She also detects a high correlation between the forecasts of international institutions (World Bank, IMF and OECD).

More recently Loungani and Rodriguez (2008) focus on the speed of adjustment in the revisions of GDP growth private forecasts in 14 countries. They show that private analyst forecasts are smoother than optimal forecasts under quadratic loss. In other words, forecasts do not seem to incorporate news properly. They change slowly, which may be a very unpleasant feature at the brink of a recession.

Romer and Romer (2008) show, in a striking paper, that US monetary policymakers have no advantage over their staff to generate better forecasts. Furthermore, they show that policymakers are not using the available information optimally. They conclude that a simple citizen looking for good GDP and inflation forecast should disregard forecasts built by policymakers and use forecasts built by the Board of Governors staff. Ellison and Sargent (2009) explain that the striking results in Romer and Romer (2008) are consistent with US monetary policymakers being rational but caring about a worst-case scenario. In their view, US monetary policymakers may be seen as using efficiently the information provided by their staff in a context of model uncertainty, in which they have doubts about the specification and limitations of the models.

Some research in the topic of forecasts evaluation has also been carried out in Chile. Chumacero (2001), for instance, analyses private forecasters' estimates of GDP growth rates during the period 1986-1998. His results show that forecasters systematically underestimate the true growth rate of the economy.

More recently Bentancor and Pincheira (2008) shows that inflation forecasts from the SPF in Chile display a significant downward bias and excess of autocorrelation in the second half of their sample period. By correcting this autocorrelation in an out-of-sample exercise, the authors achieve significant reduction in MSPE and bias.

The paper by Albagli, Contreras, García, Magendzo and Valdés (2003) is probably the closest to ours. These authors evaluate the Central Bank of Chile inflation and GDP growth forecasts errors. They run a horse race between the Central Bank of Chile and private analysts. They also make a comparison against foreign central banks. They conclude that in the last years of their sample period (1991-2002) there has been an improvement in the accuracy of the Central Bank of Chile forecasts. They also show that GDP forecasts errors from the Inflation Report of the Central Bank of Chile are marginally larger than those of private analysts but that the performance of inflation forecasts from the Central Bank is significantly better than that of private analysts. They also mention that the performance of the Central Bank of Chile forecasts is similar to the performance of others Central Banks in the world.

This brief and selective review of the literature shows two interesting facts: most public and private forecasts display some degree of inefficiency when traditional metrics of predictive ability are used. Secondly, simple univariate and multivariate benchmarks may be competitive and even more accurate for some variables and horizons than forecasts produced by central banks or private analysts. In the following sections we will see how our evaluation of the Central Bank of Chile GDP growth forecasts fits in with the existing literature.

III Data and Methodology

We aim at evaluating annual real seasonally unadjusted GDP growth forecasts from the Central Bank of Chile over the sample period between 1991 and 2009. We obtained these forecasts from two sources: the Central Bank of Chile's Inflation Report and the Central Bank of Chile's report to the Congress. We use these two sources to get as many forecasts as we can. Reports to the Congress are available from 1991 to 2000. In these reports, released on September of each year, the Central Bank of Chile provided annual GDP growth rate forecasts for the current year as well as for the following year. Since 2001, the Central Bank of Chile publishes Inflation Reports three times a year, in January, May and September[7]. As in the previous Reports to the

[7] Since 2009 the usual policy of writing three Inflation Reports per year was changed to a policy of writing four Inflation Reports. These four reports are to be released in March, June, September and December.

Congress, the September issue of the Inflation Report includes annual GDP growth rate forecasts for the current and following years. We focus on these forecasts released on September to carry out our analysis. Focusing on the September report has two advantages. First, we include a larger number of observations by considering both forecasts from the report to the Congress and the Inflation Reports. Second, we can evaluate forecasts at two different horizons, the end of the current year, which we call one-step-ahead forecasts (OSA forecasts) and forecasts made for the end of the subsequent year, which we call two-step-ahead forecasts (TSA forecasts).

Since 2002, inflation reports contain two slightly different forecasts. These reports provide an explicit interval forecast and also an implicit point forecast that can be inferred from the domestic demand, exports and imports forecasts available in the reports. For the sake of simplicity we will consider two series of point forecasts, those corresponding to the center of the interval explicitly released, and those implicitly obtained from the domestic demand, imports and exports forecasts. These two series of forecasts are labeled Central Bank of Chile's forecasts 1 and 2 (CB1, CB2). These two series of forecasts are similar. They are displayed in table 1.

Table 1
Central Bank of Chile GDP Annual Growth Rate Forecasts

	CB1		CB2	
	1 Step Ahead	2 Steps Ahead	1 Step Ahead	2 Steps Ahead
1991	5.0%	5.0%	5.0%	5.0%
1992	7.5%	5.0%	7.5%	5.0%
1993	5.6%	5.5%	5.6%	5.5%
1994	4.0%	4.5%	4.0%	4.5%
1995	7.0%	5.3%	7.0%	5.3%
1996	6.8%	6.0%	6.8%	6.0%
1997	5.8%	5.8%	5.8%	5.8%
1998	5.0%	6.8%	5.0%	6.8%
1999	0.1%	3.8%	0.1%	3.8%
2000	5.6%	5.0%	5.6%	5.0%
2001	3.7%	5.7%	3.7%	5.7%
2002	2.3%	5.0%	2.2%	5.0%
2003	3.3%	4.0%	3.1%	4.0%
2004	5.3%	4.5%	5.1%	4.5%
2005	6.3%	5.0%	6.1%	5.3%
2006	5.0%	5.8%	4.7%	5.7%
2007	6.0%	5.8%	6.0%	5.6%
2008	4.8%	5.5%	4.7%	5.5%
2009	-1.8%	4.0%	-1.7%	3.8%
2010		5.0%		5.0%

Note: 1 step ahead forecasts are released on September of the current year.

2 step ahead forecasts are released on September of the previous year.

We compare the Central Bank of Chile's GDP growth forecasts with different benchmarks. We use predictions for the current and subsequent year collected from the September issue of Consensus Forecasts for the 2001-2009 period. We also use the information in the Survey of Professional Forecasters (SPF) carried out periodically by the Central Bank of Chile. Forecasts for the current year can be deduced from their quarterly forecasts for the period 2000-2002. We gave the SPF a little advantage over the Central Bank, by looking at the survey carried out in October, which actually has GDP predictions for the last two quarters of the corresponding year. From 2003 until now, the survey provides explicit forecasts for the current and subsequent year[8]. Finally, we take advantage of the real time database of quarterly GDP containing, for a given date, the most recent quarterly GDP series available at that moment. We use this database to generate real time forecasts using a number of univariate time series models. In particular we consider the following models: AR(1), AR(2), a driftless random walk for the level of quarterly GDP, a drfitless random walk for the quarterly growth GDP rate, one version of the "airline model" proposed by Box and Jenkins (1970), and the average of all these forecasts[9]. We also combined models for data in different frequencies. To do so, we use forecasts for the current year (one-step-ahead forecasts) from the Central Bank of Chile, from a random walk process in levels and from a version of the "airline model". Then we plug each of these forecasts as an additional observation to the available annual series and then we estimate an ARMA(1,1) with annual GDP growth rates observations. With this last model we generate two-step-ahead forecasts which are also used as a benchmark for the two-step-ahead-forecasts released by the Central Bank of Chile.

We use Root Mean Squared Prediction Error (RMSPE) as a measure of predictive accuracy. This measure corresponds to the squared root of the Mean Squared Prediction Error (MSPE), which is defined as follows:

$$MSPE(e) = E(e^2)$$

[8] From Consensus we use the average of all the surveyed analysts. In the case of the Survey of Professional Forecasters, the Central Bank of Chile releases only the median of the predictions.

[9] We consider the following version of the "airline model": $g_t = g_{t-1}+\varepsilon_t+\theta\varepsilon_{t-4}$, where g_t represents the accumulated GDP growth in the last four quarters and ε_t represents a white noise.

where e denotes the prediction error, defined as the actual value minus the predicted value.

While RMSPE is one of the leading metrics to evaluate predictions in the forecasting literature, some other metrics may be equally useful. In particular, we will also show results using Mean Absolute Prediction Errors (MAPE), which is defined as follows:

$$MAPE(e) = E|e|$$

where e denotes the prediction error defined as before.

We work with quasi-finals errors as well as with first vintage errors. Quasi-final errors are defined as the last version of actual GDP growth in a given reference year, minus the forecast. First vintage errors are defined as the first released GDP growth observation minus the forecast. As we already mentioned in the introduction, GDP growth figures undergo several rounds of revisions, so typically the first release is different from the quasi-final release, and sometimes this difference is sizeable as it is shown in table A1 in the appendix.

We also mentioned in the introduction that our analysis faces the challenge of an extremely small sample size with missing observations. The reason for the missing observations problem relies on the fact that during the sample period four different reference years for the actual calculation of real GDP were used. This is not a simple problem. GDP growth figures expressed in a given reference year are not easily translated into a different reference year. This is because different reference years may be using a different methodology to measure sectoral GDP and in general they use different weights to weight up the different sectors of the Chilean economy. Tables 2-3 next illustrates this problem showing the annual GDP growth rates figures in each of the four reference years covering our sample period.

Table 2
GDP Annual Growth Rates for Chile
Quasi-final Release

Year	Reference Year			
	1977	1986	1996	2003
1991	6.0%	8.0%		
1992	10.4%	12.3%		
1993		7.0%		
1994		5.7%		
1995		10.6%		
1996		7.4%		
1997		7.4%	6.6%	
1998		3.9%	3.2%	
1999		-1.1%	-0.8%	
2000		5.4%	4.5%	
2001			3.4%	
2002			2.2%	
2003			3.9%	
2004			6.2%	6.0%
2005			6.3%	5.6%
2006				4.6%
2007				NYA
2008				NYA
2009				NYA

Notes:

1. NYA stands for Not Yet Available.
2. Quasi-final releases correspond to the last vintage for a given reference year.

Table 3
GDP Annual Growth Rates for Chile
First Vintage

Year	Reference Year			
	1977	1986	1996	2003
1991	6.0%	6.1%		
1992	10.4%	10.3%		
1993		6.0%		
1994		4.2%		
1995		8.5%		
1996		7.2%		
1997		7.1%	6.6%	
1998		3.4%	3.2%	
1999		-1.1%	-1.0%	
2000		5.4%	4.4%	
2001			2.8%	
2002			2.1%	
2003			3.3%	
2004			6.1%	6.0%
2005			6.3%	5.7%
2006				4.0%
2007				5.1%
2008				3.2%
2009				

There are a few years in which the Central Bank of Chile actually computed annual GDP growth rates using two different reference years. Sometimes the difference in the figures is small, but sometimes is fairly large. These differences suggest that comparing forecasts built upon information of a given reference year, with figures expressed in another reference year may be misleading, because those errors would correspond to the sum of the forecasts errors plus the error due to the change in reference year. Unfortunately, sometimes the Central Bank of Chile released figures expressed in only one reference year. Every time that reference year is different to the reference year on which forecasts were originally built we treat those forecasts errors as missing observations. We do this to avoid an unfair evaluation of forecast ability when errors may be affected by changes in reference years[10]. Tables 4-5 next show forecasts errors from the Central Bank of Chile. We find missing observations in the following years 1993, 2001, 2002, 2006 and 2007.

Due to the very small sample we are working with, we will use critical values from a t(n-1) distribution when showing results of the Giacomini and White (2006) test (which actually coincides in this setting with the test by Diebold and Mariano;1995 and West;1996). Harvey, Leybourne and Newbold (1997) show via simulations that these critical values improve the size of the test in small samples.

[10] The missing observations problem arises when a change in the reference year is about to take place but the future methodology for computing GDP is not yet released. In these occasions, we assume forecasters provide GDP forecasts expressed in the "old" reference year. According to our records, the methodology associated to the 1986 reference year was released in October 1992. Therefore, we assume that by September of that year the new methodology was unknown for private and public forecasters, which implies that one and two-step-ahead forecasts were made in the 1977 reference year. Because there is no GDP growth observations for the year 1993 expressed in the 1977 reference year, we have a missing observation for the two-step-ahead forecast error in the year 1993. Similarly, the methodology associated with the 1996 reference year was released in September 2001. We make the assumption that forecasts built in that month were based on the "old" reference year. Because there are no GDP growth observations for the years 2001 ad 2002 expressed in the 1986 reference year, we have missing observations for the two-step-ahead forecast error in the years 2001 and 2002 and for the one-step-ahead forecast error in 2001. Finally, the last reference year was released in November 2006. We assume that forecasts generated by September 2006 were made in the 1996 reference year which explains the missing observations in Tables 4-5 corresponding to years 2006 and 2007.

Table 4
Central Bank of Chile GDP Annual Growth Rate Forecast Errors
Quasi-final Release

	CB1		CB2	
	1 Step Ahead	2 Steps Ahead	1 Step Ahead	2 Steps Ahead
1991	100	100	100	100
1992	290	540	290	540
1993	140	MO	140	MO
1994	170	120	170	120
1995	360	530	360	530
1996	60	140	60	140
1997	160	160	160	160
1998	-110	-290	-110	-290
1999	-120	-490	-120	-490
2000	-20	40	-20	40
2001	MO	MO	MO	MO
2002	-10	MO	0	MO
2003	60	-10	80	-10
2004	90	170	110	170
2005	0	130	20	100
2006	MO	MO	MO	MO
2007	NYA	MO	NYA	MO
2008	NYA	NYA	NYA	NYA
2009	NYA	NYA	NYA	NYA
Average full sample	84	95	89	93
Average 2001-2009	35	97	53	87

Notes:

1. NYA stands for Not Yet Available.
2. Quasi-final releases correspond to the last vintage for a given reference year.
3. MO stands for Missing Observations.

Table 5
Central Bank of Chile GDP Annual Growth Rate Forecast Errors
First Vintage

	CB1		CB2	
	1 Step Ahead	2 Steps Ahead	1 Step Ahead	2 Steps Ahead
1991	100	100	100	100
1992	290	540	290	540
1993	40	MO	40	MO
1994	20	-30	20	-30
1995	150	320	150	320
1996	40	120	40	120
1997	130	130	130	130
1998	-160	-340	-160	-340
1999	-120	-490	-120	-490
2000	-20	40	-20	40
2001	MO	MO	MO	MO
2002	-20	MO	-10	MO
2003	0	-70	20	-70
2004	80	160	100	160
2005	0	130	20	100
2006	MO	MO	MO	MO
2007	-90	MO	-90	MO
2008	-160	-230	-150	-230
2009	NYA	NYA	NYA	NYA
Average full sample	-8	-24	-2	-26
Average 2001-2009	-32	-3	-18	-10

Notes:

1. NYA stands for Not Yet Available.
2. MO stands for Missing Observations.

IV. Main Results

In this section we present the main results of our analysis. First we show comparisons of RMSPE. Second, we show results concerning efficiency of the forecasts. In the third subsection we provide additional results regarding the behavior of the forecasts under consideration. Finally in the fourth section we show simple results regarding the coverage of the interval forecasts.

1. Forecast Accuracy.

We first compare the accuracy of the Central Bank of Chile forecasts with the accuracy of forecasts from Consensus Forecasts and the Survey of Professional Forecasters. Tables 6-7 show our RMSPE results.

Table 6
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison Against Consensus Forecasts

	Quasi-final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	54	124	82	158	41	126
CB2	69	114	83	153	52	116
Consensus	67	137	67	152	51	133
Sample Size	4	3	6	4	4	3

Table 7
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with the Survey of Professional Forecasters

	Quasi-final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	49	151	76	178	38	146
CB2	62	139	77	172	48	133
SPF	67	169	70	180	56	163
Sample Size	5	2	7	3	5	2

Table 6 shows RMSPE for the Central Bank and Consensus Forecasts. Figures in the first three rows are expressed in basis points. The last row shows the number of observations in the analysis. It is remarkable how low this number is, which makes us to be very cautious when analyzing our results.

We focus on two targets: quasi-final GDP growth releases and first GDP growth vintages. The first two columns in table 6 indicate that when forecasts are compared to quasi-final GDP releases, forecasts from the Central Bank of Chile labeled as CB1 have been more accurate than Consensus' forecasts at both horizons. Central Bank of Chile's forecasts labeled as CB2 have been slightly less accurate than Consensus when predictions are made one-step-ahead. For the two-step–ahead forecasts, the Central Bank of Chile forecasts CB2 have been also more accurate than those of Consensus. The third and fourth column in table 6 show results when forecasts are compared to the first vintage of GDP growth. Now, forecasts from the Central Bank of Chile CB1 and CB2 are less accurate than those of Consensus no matter what predictive horizon we consider.

The last two columns in table 6 shows results for first vintages when the sample is restricted to the same years included in columns 1 and 2. The reason why we include these columns will be clearer in the following paragraph. In these two columns forecasts from the CBCh are more accurate than Consensus' forecasts. In summary, in this horse race between the CBCh and Consensus forecasts there is no clear winner. Depending on the vintage under consideration, the forecast horizon and the sample period, we can either have the CBCh or Consensus Forecasts as a winner. Furthermore, maybe the most interesting result is that differences in RMSPE between the CBCh's forecasts and Consensus' forecasts are rather small.

We are also interested in determining whether forecasts are more accurate when compared with quasi-final releases or first vintages. With this in mind we could proceed by comparing the results in the first two columns with those in the third and fourth columns in Table 6. Nevertheless, results from these columns are not directly comparable. The reason for this is that there are more vintages than quasi-final releases, so more observations are included in the computation of the first vintage RMSPE. To overcome this problem, Table 6 includes two additional columns (5 and 6) presenting RMSPE using first vintages but restricting the sample to the same years included in the results displayed in columns 1 and 2. This enables us to make a fair comparison between quasi-final and first vintage RMSPE using exactly the same sample

period. This is important, because in small samples, the addition of one extra observation in only one of the two statistics we are computing may introduce an unpleasant noise.

When comparing results in column 1 with those in column and 5 and those in column 2 with the results in column 6, we find a clear pattern for one-step-ahead forecasts: predictions seem more accurate when compared to first vintages. For two-step-ahead forecasts there is no clear pattern. Besides, differences in RMSPE at this forecasting horizon are very small.

Table 7 has the same structure showed in table 6 but now RMSPE are reported for the Central Bank of Chile's forecasts and for the SPF's forecasts. Notice that RMSPE shown for the Central Bank of Chile's forecasts need not to be the same to those in table 6. This is because the sample period is slightly different in both tables. Differing from the previous analysis, now we see that two-step-ahead forecasts from the CBCh are more accurate than two-step-ahead forecasts from the SPF. This result is robust to the sample period and the vintage under consideration. For one-step-ahead forecasts we have mixed results: the first column indicates that one-step-ahead forecasts from the Central Bank of Chile have been more accurate than those of the SPF when forecasts are compared with quasi-final releases. When predictions are compared to first vintages, column 3 shows that one-step-ahead forecasts from the Central Bank of Chile have been outperformed by those of the SPF. Finally, column 5 shows that comparing forecasts with first vintages during the same years used in column 1 produces the same output as in table 6: The Central Bank of Chile does a better job than the SPF. Therefore, in this horse race between the CBCh and SPF's forecasts, the CBCh is a clear winner for predictions two-step-ahead. There is no clear winner, however, when considering one-step-ahead forecasts. Again we see that differences in RMSPE between forecasts from the CBCh and the SPF are rather small.

Table 7 also displays a clear pattern regarding the accuracy of forecasts when compared to first and quasi-final vintages: predictions are more accurate when compared to first vintages. (see table 7 columns 1,5 and 2,6).

To complement our analysis, we also compare the Central Bank of Chile's forecasts with forecasts from simple time-series models. We use several specifications of ARMA(p,q) models estimated with recursive windows over a real time sample at quarterly frequency. Tables 8-9 show RMSPE results using the same structure previously shown in Table 6.

Table 8
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Time Series Models, Full Sample Period

	Quasi-Final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	156	291	117	262	115	265
CB2	157	290	117	261	116	264
R. Walk Level	130	674	121	607	91	628
R. Walk Growth Rate	165	461	134	436	140	446
Airline Model*	154	390	119	366	117	375
AR(1)	156	378	135	364	139	372
AR(2)	208	337	134	347	137	355
Average	163	448	119	354	125	435
Sample Size	14	12	16	13	14	12

Table 9
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Time Series Models, Period 2001-2008

	Quasi-Final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	54	124	82	158	41	126
CB2	69	114	83	153	52	116
R. Walk Level	38	524	147	458	55	509
R. Walk Growth Rate	81	249	71	245	61	228
Airline Model*	90	271	98	251	70	257
AR(1)	93	262	84	247	77	248
AR(2)	108	285	97	263	91	274
Average	90	315	90	272	72	301
Sample Size	4	3	6	4	4	3

The most remarkable result in tables 8-9 is the overwhelming good performance of the Central Bank of Chile two-step-ahead forecasts compared to forecasts from time-series models. At times ARMA forecasts display RMSPE that are about twice as big as those from the Central Bank of Chile. We will go back to this point later.

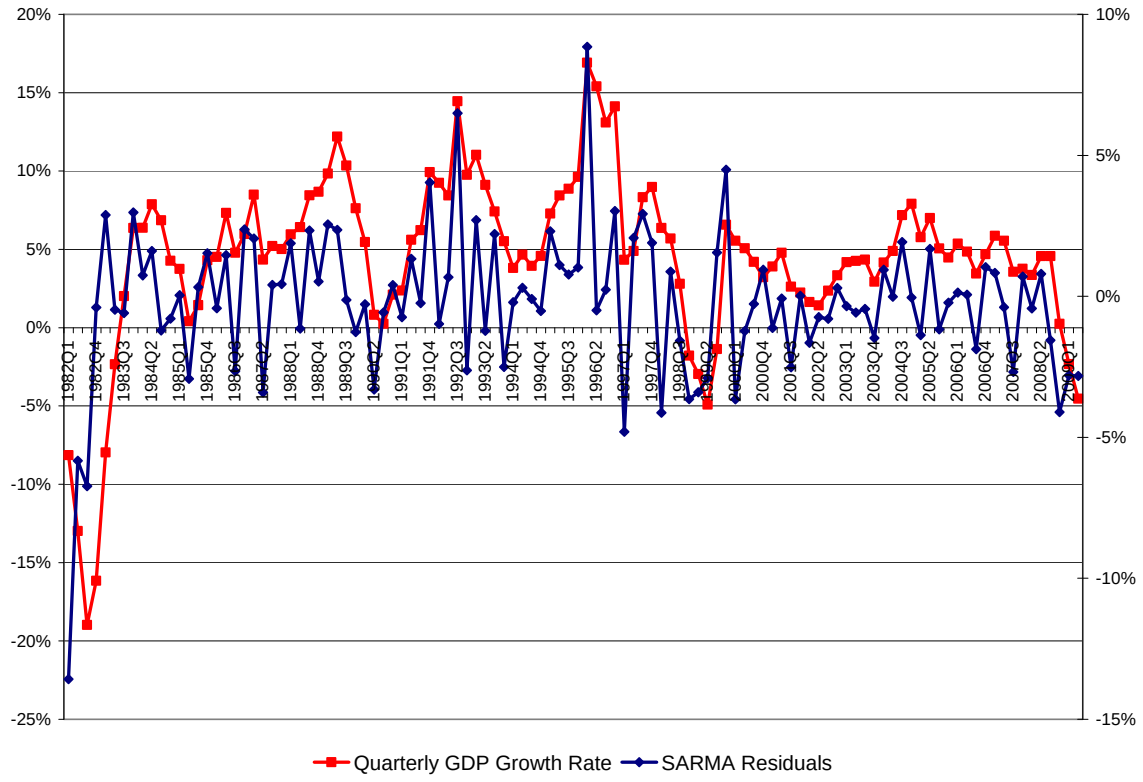
One-step-ahead forecasts from time series models are more competitive than their two-step-ahead counterparts. The first two columns in table 8 indicate that when forecasts are compared to quasi-final GDP releases, one-step-ahead forecasts from the Central Bank of Chile are outperformed by a random walk in levels and by the variation of the airline model we are

working with. The third and fourth columns in table 8 show results when forecasts are compared to GDP growth first vintages. Now, one-step-ahead forecasts from the Central Bank of Chile are slightly more accurate than the best one-step-ahead forecasts of the time series models. Column 5 indicates that the CBCh is only outperformed by the best time-series strategy when the sample is restricted to the same years used in column 1 and predictions are compared to first vintages.

We also notice that in all cases but one, forecasts are more accurate when compared to first vintages than when compared to quasi-final releases (see columns 1,5 and 2,6 in table 8).

Table 9 is similar to table 8. The only difference relies in the sample period. Table 9 shows results when the sample is restricted to the period 2001-2008. We do this because of the structural change in the volatility of GDP growth already reported in the literature (see Calani, Fuentes and García (2009) and Betancour, De Gregorio and Medina (2006)). Figure 1 shows quarterly GDP growth rates for the Chilean Economy, as well of the residuals of a SARMA(1,0,1)x(0,0,1) process for the same variable. This figure shows clearly that from some point near to 2001, the Chilean economy experienced a reduction in GDP growth volatility. To give some numbers, the standard deviation of GDP growth rates fell from 6.3% in the period 1982Q1-1999Q4 to 2.4% in the period 2001Q1-2009Q2. This reduction holds true even if we do not consider the first observations which could be considered as outliers given the magnitude of the 1982 crisis. When we discard observations corresponding to years 1982-1984, the reduction in volatility is still significant, falling from 4.2% to 2.4% in the last period.

Figure 1
Quarterly GDP Growth Rates and Residuals of SARMA Specification



Results in table 9 confirm the excellent relative performance of the Central Bank of Chile GDP growth two-step-ahead forecasts. On the other hand, we get mixed results for the Central Bank of Chile one-step-ahead forecasts: sometimes they are the best but sometimes they are outperformed by the best time-series forecasts. Finally, in all cases but one RMSPE are much lower in table 9 than in table 8, indicating a strong reduction in the size of forecasts errors. It is important to remark that this reduction holds true for all forecasts: CB1, CB2 and those from time series models. It is clearly very difficult to correctly identify the sources behind this increment in forecast accuracy, so we leave this problem for future research[11].

We also carry out an additional exercise aimed at producing better two-step-ahead forecasts than those from ARMA(p,q) models. We take one-step-ahead forecasts from two time series models and from the Central Bank of Chile (CB1), and we consider them as an additional true observation of annual GDP growth. Then we estimate an ARMA(1,1) model at annual

frequencies to generate a two-step ahead forecast according to our terminology. RMSPE of this exercise are shown in tables 10-11.

Table 10
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Concatenation Methods, Full Sample Period

	Quasi-final Release	First Vintage	First Vintage in Restricted Sample
	2-Step-Ahead	2-Step-Ahead	2-Step-Ahead
CB1	302	271	275
CB2	301	270	274
CB1-ARMA(1,1)	315	299	299
R. Walk Level-ARMA(1,1)	272	294	292
Airline Model*-ARMA(1,1)	341	315	316
Sample Size	11	12	11

Table 11
Root MSPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Concatenation Methods, Period 2001-2008

	Final Release	First Vintage	First Vintage in Restricted Sample
	2-Step-Ahead	2-Step-Ahead	2-Step-Ahead
CB1	124	158	126
CB2	114	153	116
CB1-ARMA(1,1)	70	165	91
R. Walk Level-ARMA(1,1)	119	208	151
Airline Model*-ARMA(1,1)	75	170	89
Sample Size	3	4	3

The good news arising from tables 10-11 is that these concatenating strategies generate relatively accurate forecasts that are competitive with those of the Central Bank of Chile and private analysts. Anyway, Central Bank of Chile forecasts outperform these concatenating strategies when forecasts are compared with first vintages in the longest available sample. This result, however, is overturned in different sub samples when compared with either first vintages or quasi-final releases, so its robustness is still questionable.

Beyond these mixed results, differences in root mean squared prediction errors are in general either small or moderate and with no statistical significance[12]. Table A2 in the appendix show the magnitude in the difference of RMSPE for selected forecasting methods. Just in one

[11] See Betancour, De Gregorio and Medina (2006) for possible explanations of the Chilean moderation.
[12] 54 basis points is the biggest difference in RMSPE. The second biggest difference is 31 basis points.

occasion there is a statistically significant difference and it favors forecasts produced by the Central Bank of Chile. It is worth mentioning that in another occasion the difference is almost significant at the 10% significance level favoring the CBCh as well.

Tables A3-A8 in the appendix are the analogs of tables 6-11 but now constructed using Mean Absolute Prediction Errors. These tables show in general similar results to those obtained from tables 6-11, but at least one interesting fact is worth of mention: MAPE are lower than RMSPE. This is because a quadratic form imposes a higher penalty to large errors. For instance, in terms of an absolute loss function, two errors of fifty basis points are the same as two errors of 5 and 95 basis points (MAPE of fifty basis points). In the case of a quadratic loss function these two sets of errors yield different outcomes (50 and 67.3 respectively).

2. Efficiency

The last two rows in tables 4-5 show average Central Bank of Chile forecast errors. Given the fact that all the averages in table 4 are positive, and that all the averages in table 5 are negative, it is tempting to conclude that on average the Central Bank of Chile has under predicted GDP growth when forecasts are compared with quasi-final releases and has over predicted GDP growth when compared with first vintages. Nevertheless, neither of these averages is statistically different from zero nor stable along time. Furthermore, we think it is more relevant to emphasize the autocorrelation of one-step-ahead forecasts errors. Tables 4-5 shows persistence in the sign of forecasts errors which means that they look like a sequence of nonnegative errors followed by another sequence of positive errors. In other words, once the Bank under predicts GDP growth it is likely to repeat that under prediction in the following year. In fact, the estimated probability of making a mistake in the same direction next year is 82% when considering a comparison with first vintages. Two-step ahead forecast errors show much lower autocorrelation. In fact the probability of making an error next year in the same direction is 52%, much similar to a fair coin toss, although the number of observations is really low to make a reliable case.

Table 12 below complements this analysis showing the first order autocorrelation coefficient for one-step-ahead errors, and the second order autocorrelation coefficient in the case of two step-ahead forecast errors. Our results confirm the presence of autocorrelation in one-step-ahead forecasts errors in the sense that in three out of four evaluations, the autocorrelation coefficient is statistically significant at the 90% confidence level. This is traditionally considered an indication of inefficiency. This is found despite the fact that we are working with an extremely small sample including missing observations. We recall that missing observations is a serious problem that may generate a bias towards not detecting existing autocorrelation, so we think this result is important. Interestingly, at longer horizons no evidence of autocorrelation is found.

Table 12
Central Bank of Chile Growth Rate Forecasts Errors
Autocorrelation Analysis, Full Sample

	Coefficient	Std. Error	t-Statistic	P-Value.
CB1 Quasi-final Release OSA	0.37	0.22	1.82	0.10
CB1 First Vintage OSA	0.34	0.17	1.97	0.07
CB2 Quasi-final Release OSA	0.36	0.23	1.64	0.13
CB2 First Vintage OSA	0.34	0.18	1.93	0.08
CB1 Quasi-final Release TSA	0.13	0.20	0.64	0.55
CB1 First Vintage TSA	-0.13	0.15	-0.86	0.43
CB2 Quasi-final Release TSA	0.14	0.21	0.68	0.52
CB2 First Vintage TSA	-0.12	0.15	-0.79	0.46

Note: OSA stands for One-Step-Ahead
TSA stands for Two-Step-Ahead
P-Value computed according to a t(n-2) distribution.

3. Are the forecasts really different?

As we mentioned in earlier sections, working with a small sample with missing observations is a serious problem when applying traditional inference methods. This problem may be by-passed, at least partially, if we focus on analyzing the forecasts rather than forecasts errors. Forecasts do not suffer from missing observations and also we can count with forecasts made for years 2009 and 2010, increasing the number of observations we can work with.

We explore the relationship between forecasts in two dimensions. First, we look for optimistic and pessimistic agents. Second, we take a look at the correlation between these forecasts.

Table 13
Central Bank of Chile Growth Rate Forecasts Minus Benchmark Forecasts
2001-2010

	CB1 OSA	CB2 OSA	CB1 TSA	CB2 TSA
Consensus OSA	17***	6		
SPF OSA	13**	3		
TS OSA	39***	11		
Consensus TSA			34***	32***
SPF TSA			37**	34**
TS TSA			(65***)	(67***)

Note: OSA stands for One-Step-Ahead
TSA stands for Two-Step-Ahead
Information from the Survey of Professional Forecasters corresponds to the period 2000-2010.

Table 13 shows the difference between forecasts from the Central Bank of Chile and three different benchmarks: those from Consensus, from the SPF and the average of a number of time series models. We consider the period 2001-2010. Interestingly, all figures comparing forecasts from the Central Bank of Chile and private analysts are positive, indicating that the Central Bank of Chile has a relatively optimistic view regarding the Chilean growth process. This is true, irrespective of the horizon and forecast of the Central Bank we consider. Besides, this difference is statistically significant in 6 out of the 8 relevant comparisons. From the economic point of view, some of the figures in table 13 are negligible, but some others might be relevant in terms of monetary policy.

Interest rate setting implications of this difference are interesting as well. Let us recall that a traditional equation characterizing the decisions of a Central Bank is called "Taylor rule". A traditional version of this rule usually incorporates a contemporary output-gap term. This term suggests a raise in interest rates whenever current output is higher than potential output and a decrease in interest rates whenever current output is below potential output. Nevertheless, current output gap is never observed. This happens because potential output is by definition an unobservable variable, and because output observations are released with some lag. Under these conditions, central banks need to build nowcasts of current output gap. If there is no

difference in the views of the Central Bank of Chile and private analysts regarding potential output, and short term GDP forecasts are proper proxies of GDP nowcasts, then it is reasonable to expect, based on a Taylor rule type of equation, that private analysts would have rather set lower monetary policy rates than those that have actually been set by the Central Bank of Chile.

It is important to remark that this optimistic relative behavior of the Central Bank of Chile needs not to be a problem in terms of forecasts accuracy. This is because we are not talking about bias in the forecasts. In principle there is no way we can label this optimistic behavior as good or bad news in terms of accuracy.

Finally let us take a look at the correlation of forecasts. Table 14 shows the correlation between one-step-ahead GDP growth forecasts from the Central Bank, a random walk model in levels, in growth and for an average of a number of time series predictions. Table 15 includes also correlations between all these forecasts and those from Consensus and the SPF for the period 2001-2009.

Table 14
Correlation of One-Step-Ahead Forecasts
1991-2009

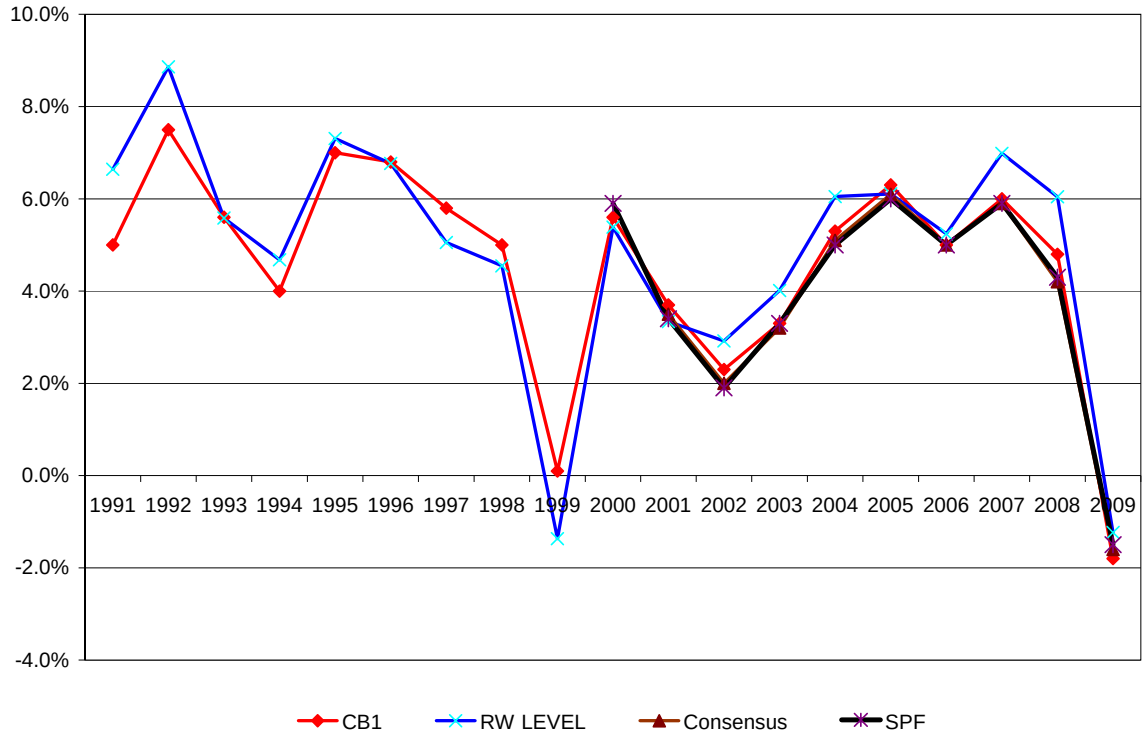
	CB1	CB2	TS Average	RW Level	RW Growth
CB1	1.000	0.999	0.997	0.978	0.997
CB2	0.999	1.000	0.997	0.978	0.995
TS Average	0.997	0.997	1.000	0.976	0.997
RW Level	0.978	0.978	0.976	1.000	0.966
RW Growth	0.997	0.995	0.997	0.966	1.000

Table 15
Correlation of One-Step-Ahead Forecasts
2001-2009

	CB1	CB2	TS Average	RW Level	RW Growth	Consensus	SPF
CB1	1.000	0.999	0.997	0.978	0.997	0.997	0.996
CB2	0.999	1.000	0.997	0.978	0.995	0.995	0.995
TS Average	0.997	0.997	1.000	0.976	0.997	0.992	0.992
RW Level	0.978	0.978	0.976	1.000	0.966	0.969	0.973
RW Growth	0.997	0.995	0.997	0.966	1.000	0.995	0.993
Consensus	0.997	0.995	0.992	0.969	0.995	1.000	0.999
SPF	0.996	0.995	0.992	0.973	0.993	0.999	1.000

Results are striking. The lowest correlation is 0.966 and most of them are around 0.99. These results suggest that one-step-ahead forecasts are very similar. Figure 2 confirms this conclusion.

Figure 2
Several Annual GDP Growth One-Step-Ahead Forecasts



Actually, forecasts from Consensus, the SPF and the Central Bank of Chile look almost the same. It is also intriguing that all these forecasts follow quite close the behavior of a random walk in levels. This is especially evident when considering the forecasts first difference. Just to emphasize this, let us mention that the direction in which forecasts move it is exactly the same for all forecasts. This means that if one particular agent has a forecast that is higher that the

forecast he or she had in the previous year, then, most likely, the rest of the forecasts will similarly move up compared with the previous year forecast.

Two-step-ahead forecast show a different picture. Correlations are lower, and sometimes much lower, indicating that two-step-ahead-forecasts seem to be significantly different. In particular Central Bank of Chile forecasts are only mildly correlated with time-series forecasts. On the opposite side of the coin, we still see an important correlation of the CBCh's forecasts with those of private analyst. This is confirmed in Figure 3 which shows the evolution of a number of two-step-ahead forecasts including those of the Central Bank of Chile, Consensus and the SPF. Regarding the direction in which forecasts move, again it is exactly the same between consensus and CB2, and similar but not equal to that predicted by the SPF. Time series forecasts are quite similar in their direction to those of the Central Bank of Chile during the first half of the sample, but in the second half this link is a little weaker.

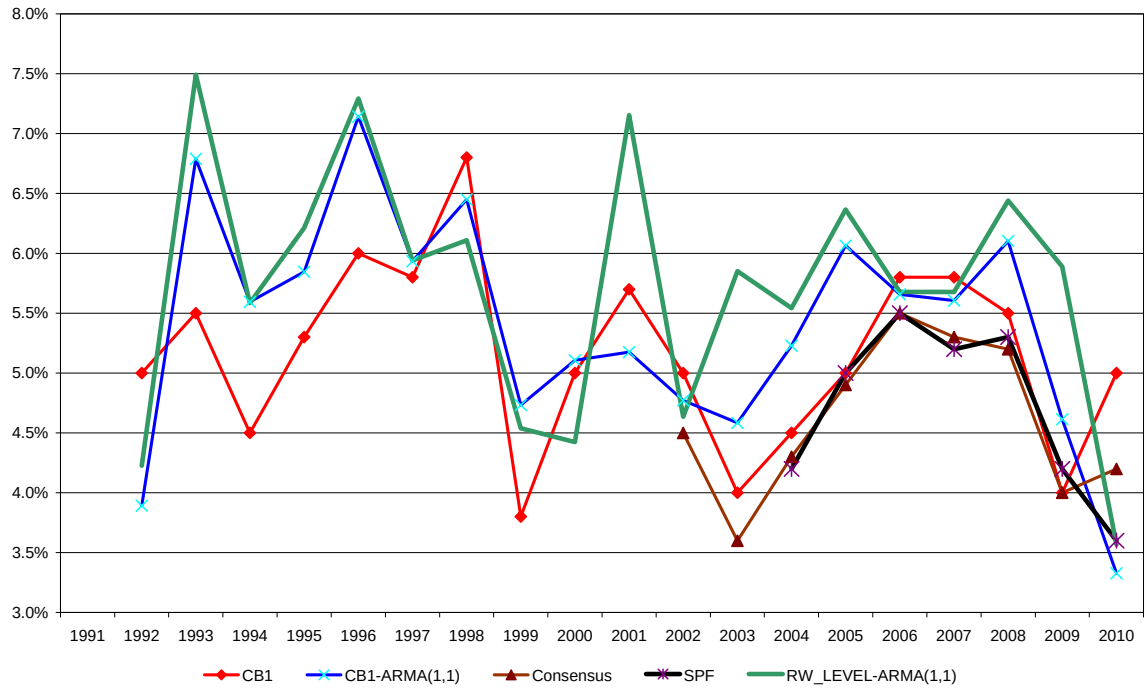
Table 16
Correlation of Two-Step-Ahead Forecasts
Full Sample

	(1)	(2)	(3)	(4)	(5)
(1) CB1	1.000	0.992	0.591	0.412	0.555
(2) CB2	0.992	1.000	0.608	0.420	0.569
(3) CB1-ARMA(1,1)	0.591	0.608	1.000	0.813	0.824
(4) R. Walk Level-ARMA(1,1)	0.412	0.420	0.813	1.000	0.850
(5) Airline Model*-ARMA(1,1)	0.555	0.569	0.824	0.850	1.000

Table 17
Correlation of Two-Step-Ahead Forecasts
2001-2009

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) CB1	1.000	0.980	0.454	0.180	0.555	0.937	0.722
(2) CB2	0.980	1.000	0.493	0.204	0.585	0.922	0.710
(3) CB1-ARMA(1,1)	0.454	0.493	1.000	0.725	0.817	0.710	0.883
(4) R. Walk Level-ARMA(1,1)	0.180	0.204	0.725	1.000	0.892	0.294	0.721
(5) Airline Model*-ARMA(1,1)	0.555	0.585	0.817	0.892	1.000	0.708	0.884
(6) Consensus	0.937	0.922	0.710	0.294	0.708	1.000	0.934
(7) SPF	0.722	0.710	0.883	0.721	0.884	0.934	1.000

Figure 3
Several Annual GDP Growth Two-Step-Ahead Forecasts



4. Coverage of Interval Forecasts

As we already mentioned, since 2002, inflation reports contain two slightly different forecasts. These reports provide an explicit interval forecast and also an implicit point forecast that can be inferred from the domestic demand, exports and imports forecasts available in the reports. In this subsection we show the intervals displayed in the inflation reports and also their empirical coverage, which is nothing but the percentage of times that actual releases are contained within these intervals. Tables 18-19 show coverage results when forecasts are compared with quasi-final and first GDP growth releases. Successful forecasts have been remarked in shaded cells. In the last row of each table we show coverage results. Coverage is defined as the ratio between the number of successful interval forecasts and the total number of forecasts. An interval forecast is successful when the actual observation belongs to the respective interval. For coverage calculation we rule out years in which the CBCh made predictions based upon a given reference year and actual GDP growth observations were released in a different reference year, for the same reasons explained in previous sections. Results in the tables show that coverage is 0.5 for one-step-ahead forecasts and either 0.33 or 0 for two-steps-ahead forecasts,

depending on the actual vintage we are comparing with. Even though we are not using other models to derive a sort of "benchmark coverage", our coverage results seem rather low.

Table 18
Coverage of Interval Forecasts
Quasi-final releases 2002-2006

	Interval Forecasts		Quasi-Final GDP Growth Vintage Reference Year	
	1-Step-Ahead	2-Steps-Ahead	1996	2003
2002	**[2.0, 2.5]**		2.2%	
2003	**[3.0, 3.5]**	**[3.5, 4.5]**	3.9%	
2004	**[5.0, 5.5]**	**[4.0, 5.0]**	6.2%	
2005	**[6.0, 6.5]**	**[4.5, 5.5]**	6.3%	
2006	**[4.75, 5.25]**	**[5.25, 6.25]**		4.6%
Rate of Success	**0.5**	**0.33**		

Table 19
Coverage of Interval Forecasts
First Vintages 2002-2008

	Interval Forecasts		First GDP Growth Vintage Reference Year	
	1-Step-Ahead	2-Steps-Ahead	1996	2003
2002	**[2.0, 2.5]**		2.1%	
2003	**[3.0, 3.5]**	**[3.5, 4.5]**	3.3%	
2004	**[5.0, 5.5]**	**[4.0, 5.0]**	6.1%	
2005	**[6.0, 6.5]**	**[4.5, 5.5]**	6.3%	
2006	**[4.75, 5.25]**	**[5.25, 6.25]**		4.0%
2007	**[5.75, 6.25]**	**[5.25, 6.25]**		5.1%
2008	**[4.5, 5.0]**	**[5.0, 6.0]**		3.2%
Rate of Success	**0.5**	**0**		

V. Summary and Conclusions

In this article we evaluate the Central Bank of Chile's annual GDP growth forecasts during the period 1991-2009. We compare the Central Bank of Chile' forecasts with those from the Survey of Professional Forecasters, Consensus Forecasts, and also with those obtained using simple time-series models. We evaluate a number of different forecast properties, including forecast accuracy and efficiency. In particular we place our attention on Root Mean Squared Prediction Errors and autocorrelation of forecast errors. We compare the accuracy of the CBCh's forecasts

using both first vintages and revised GDP growth data. We also analyze whether the forecasts by the CBCh are optimistic or pessimistic when compared with private analysts' forecasts. Furthermore, we analyze if forecasts have been more accurate in the recent years or in the distant past. Finally we analyze the empirical coverage of the forecasting intervals reported by the CBCh. Our main results follow next.

First, our comparison of the CBCh's forecasts with those of private analysts indicates that in terms of forecast accuracy they are similar. In fact table A2 in the appendix shows that there is no statistical significance in the difference of RMSPE between one-step-ahead forecasts. The same table shows one statistically significant result favoring the Central Bank of Chile two-step-ahead forecasts, but this result is not robust to the vintage we use to compute forecast errors. Despite these findings, probably the most important conclusion is that differences in accuracy are rather small or moderate.

Second, our analysis indicates that the CBCh's forecasts are comparable to those coming from the best time-series strategies we used. It is intriguing, however, that in some of our comparisons, simple models as the random walk in levels tends to outperform the CBCh's one-step-ahead forecasts, in a very similar result to that shown by Kapetanios et al (2009). Even when used in a concatenation strategy, some simple time-series models are able to outperform the CBCh's two-step-ahead forecasts. Nevertheless, we cannot identify one single superior time-series model consistently outperforming the CBCh in our different comparisons. In other words, the best time-series forecasts usually come from different models in the different exercises we carried out. For this reason it is difficult to claim superiority of time-series forecasts over forecasts from the CBCh.

Third, we also see that the CBCh, Consensus and the SPF's one-step-ahead forecasts are more accurate when compared to first vintages than to quasi-final releases. Since 2001, the difference between the comparison with first vintages and quasi-final releases ranges between 11 and 17 basis points for one-step-ahead forecasts (favoring first vintages). In the case of two-step-ahead forecasts this clear pattern also holds true for Consensus and the SPF, but not for the CBCh.

Fourth, despite the fact that forecasts from the CBCh are competitive when compared with private analysts and time series models, they display inefficiency in the form of excess of autocorrelation. This happens mainly in one-step-ahead-forecasts. At longer horizons forecasts seems efficient from this point of view. It is worth mentioning that this finding is consistent with a bulk of literature reporting different sources of inefficiency in private as well as public forecasts.

Fifth, since 2001, forecasts from the CBCh and also from the majority of time series models have been on average, more accurate than in the first section of the sample (1991-2000). This is coincident with the reduction in GDP growth volatility reported in previous articles. We tend to think that this reduction of volatility is one of the basic pillars associated with the increase in forecast accuracy. The reasons explaining the growth volatility reduction, however, are beyond the scope of this article.

Sixth, CBCh's forecasts have been, on average, more optimistic than those of Consensus and the SPF. In particular, since 2001, one of the CBCh series of forecasts (CB1) has been 17 basis points higher than that of Consensus, for one-step-ahead forecasts, and 34 basis points higher in two-step-head forecasts. Whereas this optimism has moderate size, it is systematic and statistically significant.

Seventh, when analyzing how different several one-step-ahead forecasts are, we realize that most of them are alike. As a matter of fact, correlations are always above 0.96 and the information they contain regarding the direction of change in GDP growth is basically the same. Regarding two-step-ahead forecasts, we detect important differences between private analysts and time series forecasts. Nevertheless, private forecasts are still highly correlated to those of the Central Bank of Chile.

Finally, we also report coverage results for the CBCh interval forecasts. Despite the small number of observations, some results are striking. For instance, irrespective of the vintage

against which we compare the CBCh forecasts, only half of the times quasi-final GDP growth has fallen within the forecasting interval. For two-step-ahead forecasts the coverage is lower. It is a third when compared to quasi-final releases and zero when compared to first vintages.

In summary, and with the big caveat of having a really low number of observations, our results suggest that the CBCh's forecasts are similar to those of Consensus and the SPF. Despite these findings, our efficiency analysis, in addition to the fact that in some periods the forecasts produced by the Central Bank of Chile have been outperformed by alternative forecasts, opens the question about the room for improvement in the accuracy of the Central Bank of Chile forecasts. While the room for improvement may actually exist, according to the different benchmarks we consider in this article, this room seems to be small for point forecasts but larger for interval forecasts.

Finally, let us conclude mentioning that the tendency of greater accuracy of the CBCh's one-step-ahead forecasts when GDP is measured with first vintages poses the question about the final target of the CBCh's forecast. Should the Bank target first vintages, final revisions or both? From the point of view of building credibility, the target should be closer to first vintages that are the first numbers released to the public. On the other hand, if we think that quasi-final revisions are a better estimate of the effective GDP growth of the economy, then the target should be quasi-final revisions because they represent a better appraisal of the "true" state of the economy. From this point of view, a subject for future research should be the construction of more accurate forecasts, especially for quasi-final releases, or the construction of a unique series of GDP growth forecasts displaying robust accuracy when forecasts are compared to first and quasi-final releases.

Appendix

Table A1
GDP Annual Growth Rates and Revisions

Año	GDP Growth First Vintage	GDP Growth Quasi-Final Release	Revision
1991	6.1%	8.0%	1.9%
1992	10.3%	12.3%	2.0%
1993	6.0%	7.0%	1.0%
1994	4.2%	5.7%	1.5%
1995	8.5%	10.6%	2.1%
1996	7.2%	7.4%	0.2%
1997	7.1%	7.4%	0.3%
1998	3.4%	3.9%	0.5%
1999	-1.1%	-1.1%	0.0%
2000	5.4%	5.4%	0.0%
2001	2.8%	3.4%	0.6%
2002	2.1%	2.2%	0.1%
2003	3.3%	3.9%	0.6%
2004	6.1%	6.2%	0.1%
2005	6.3%	6.3%	0.0%
2006	4.0%	4.6%	0.6%
2007	5.1%		
2008	3.2%		
AVERAGE	5.0%	5.8%	0.7%
CORRELATION	0.98		

Notes:

3. Different tones of gray represent different reference years. The darkest represents figures expressed in the 2003 reference year. The lightest represents figures expressed in the 1986 reference year. The middle zone shows figures expressed in the 1996 reference year.
4. Quasi-final releases correspond to the last vintage for a given reference year.

Table A2
Inference on Predictive Ability, Longest Available Sample

	Quasi-final Release		First Vintage	
	1 Step Ahead	2 Steps Ahead	1 Step Ahead	2 Steps Ahead
CB1-Consensus	-13	**-13***	15	6
CB2-Consensus	2	-23	16	1
CB1-EEE	-18	-18	6	-2
CB2-EEE	-5	-30	7	-8
CB1-Random Walk	26	30	-4	-23
CB2-Random Walk	27	29	-4	-24

Notes:

1. *: Represents statistical significance of the Diebold-Mariano-West test, at the 10% significance level.
2. A negative figure favors forecasts produced by the Central Bank of Chile.
3. We carry out inference comparing Mean Squared Prediction Errors. Nevertheless, to make the interpretation easier, we show in this table the difference in Root Mean Squared Prediction Errors.
3. For the two-step-ahead comparisons against the random walk, we used the concatenating strategy using the random walk and an ARMA(1,1) model.

Table A3
MAPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison Against Consensus Forecasts

	Quasi-final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	40	103	58	148	25	120
CB2	53	93	65	140	38	110
Consensus	55	120	53	138	35	117
Sample Size	4	3	6	4	4	3

Notes:

1. MAPE stands for "Mean Absolute Prediction Error".

Table A4
MAPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with the Survey of Professional Forecasters

	Quasi-final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	36	150	53	173	24	145
CB2	46	135	59	163	34	130
SPF	58	165	57	177	42	160
Sample Size	5	2	7	3	5	2

Notes:

1. MAPE stands for "Mean Absolute Prediction Error".

Table A5
MAPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Time Series Models, Full Sample Period

	Quasi-Final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	121	227	89	208	84	206
CB2	124	224	91	205	87	203
R. Walk Level	93	619	92	550	71	575
R. Walk Growth Rate	140	377	112	364	115	370
Airline Model*	123	300	96	276	90	280
AR(1)	129	314	111	299	113	303
AR(2)	161	274	107	272	108	276
Average	138	316	103	352	106	307
Sample Size	14	12	16	13	14	12

Notes:
1. MAPE stands for "Mean Absolute Prediction Error".

Table A6
MAPE oh the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Time Series Models, Period 2001-2008

	Quasi-final Release		First Vintage		First Vintage in Restricted Sample	
	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead	1-Step-Ahead	2-Step-Ahead
CB1	40	103	58	148	25	120
CB2	53	93	65	140	38	110
R. Walk Level	29	510	109	428	44	487
R. Walk Growth Rate	70	230	63	227	50	207
Airline Model*	84	261	88	237	64	238
AR(1)	80	252	71	232	60	228
AR(2)	93	264	82	236	73	241
Average	71	303	83	272	58	280
Sample Size	4	3	6	4	4	3

Notes:
1. MAPE stands for "Mean Absolute Prediction Error".

Table A7
MAPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Concatenation Methods, Full Sample Period

	Quasi-final Release	First Vintage	First Vintage in Restricted Sample
	2-Step-Ahead	2-Step-Ahead	2-Step-Ahead
CB1	238	217	215
CB2	235	214	213
CB1-ARMA(1,1)	215	219	212
R. Walk Level-ARMA(1,1)	216	224	215
Airline Model*-ARMA(1,1)	234	241	235
Sample Size	11	12	11

Notes:
1. MAPE stands for "Mean Absolute Prediction Error".

Table A8
MAPE of the Central Bank of Chile GDP Annual Growth Rate Forecasts
Comparison with Concatenation Methods, Period 2001-2008

	Quasi-final R.	First Vintage	First Vintage in Restricted Sample
	2-Step-Ahead	2-Step-Ahead	2-Step-Ahead
CB1	103	148	120
CB2	93	140	110
CB1-ARMA(1,1)	63	132	80
R. Walk Level-ARMA(1,1)	89	160	106
Airline Model*-ARMA(1,1)	66	138	82
Sample Size	3	4	3

Notes:
1. MAPE stands for "Mean Absolute Prediction Error".

References

Albagli, E., Contreras, G., García, P., Magendzo, I. and R. Valdés (2003): "Errores de Proyección en Perspectiva," Working Paper No. 199, Central Bank of Chile.

Andersson, M., Karlsson, G. and J. Svensson (2007): "The Riksbank's Forecasting Performance" Riksbank Research Paper No. 218.

Bentancor and Pincheira (2010): "Predicción de errores de proyección de inflación en Chile" EL TRIMESTRE ECONÓMICO, vol. LXXVII (1), núm. 305, enero-marzo de 2010, pp. 129-154.

Betancour C., J. De Gregorio and J.P. Medina (2006): "The "Great Moderation" and the Monetary Transmission Mechanism in Chile" BIS Papers N° 35.

Bowls C, Friz R, Genre V, Kenny G, Meyler A. and Rautanen T. (2007): "The ECB Survey of Professional Forecasters: A Review After Eight Years' Experience". Occasional Paper Series N0 59/April 2007.

Box, George and Jenkins, Gwilym (1970): Time series analysis: Forecasting and control, San Francisco: Holden-Day

Calani M. Fuentes R and A. García (2009): "Has Chile´s Output Growth Volatility Really Declined? When? Why?" Manuscript Universidad Católica de Chile.

Capistrán C (2007): "Bias in Federal Reserve Inflation Forecasts: Is the Federal Reserve Irrational or Just Cautious?" Banco de México Working Papers N° 2006-14.

Capistrán C. and A. Timmermann (2008): "Disagreement and Biases in Inflation Expectations" Manuscript Rady School of Management UC San Diego.

Chumacero, R.A. (2001): "Empirical Analysis of Systematic Errors in Chilean GDP Forecast," *Journal of Forecasting* 20(1): 37-45.

Chumacero, R. y F. Gallego (2002). "Trends and Cycles in Real-Time" Estudios de Economía 29(2): 211-229.

Chong, Y.Y. and Hendry, D.F. (1986): "Econometric evaluation of linear macroeconomic models". *Review of Economic Studies* **53**, pp. 671–690.

Harvey, Leybourne and Newbold (1997): "Testing the equality of prediction mean squared errors". *International Journal of Forecasting* **13**, pp. 281–291.

Diebold F. and R. Mariano (1995): "Comparing Predictive Accuracy," *Journal of Business and Economic Statistics* 13: 253-263.

Elliott G. Komunjer and A. Timmermann (2008): "Biases in Macroeconomic Forecasts: Irrationality or Asymmetric Loss". *Journal of European Economic Association, 2008, 6(1), 122-157.*

Elliott G, and A. Timmermann (2008): "Economic Forecasting". *Journal of Economic Literature, 2008, 46:1, 3-56.*

Ellison M, and T. Sargent (2009): "A Defence of the FOMC". *Discussion Paper Series N°7510 CEPR/EABC N ° 47/2009*

Granger and Ramanathan (1984): "Improved Methods of Combining Forecast," *Journal of Forecasting* 3: 197-204.

Giacomini, R. and H. White (2006): "Tests of Conditional Predictive Ability," *Econometrica*. Vol 74 N° 6.

Groen J, Kapetanios G. & S. Price (2009) "A real time evaluation of Bank of England forecasts of inflation and growth". *International Journal of Forecasting* 25 (2009) 74-80.

Joutz F. and H. Stekler (2000): "An Evaluation of the Predictions of the Federal Reserve" *International Journal of Forecasting* 16(3): 17- 38.

Leitch and Tanner (1991): "Economic Forecast Evaluation: Profits versus Conventional Error Measures," *American Economic Review* 81: 580-590.

Loungani and Rodriguez (2008): "Economic Forecasts: Too Smooth by Far?" *World Economics* Vol. 9, No. 2, April-June 2008.

Loungani, P. (2001): "How Accurate are Private Sector Forecast? Cross-Country Evidence from Consensus Forecast of Output Growth," *International Journal of Forecasting* 17(3): 419-432.

McCracken M. and K. West (2002): "Inference about Predictive Ability," En M. Clements and D. Hendry (Eds): *Companion to Economic Forecasting*, Oxford: Blackwell.

McCulloch and Rossi (1990): "Posterior, Predictive and Utility-Based Approaches to Testing the Arbitrage Pricing Theory," *Journal of Financial Economics* 28:7-38.

Mincer and Zarnowitz (1969): "The Evaluation of Economic Forecast." en J. Mince (Ed.): *Economic Forecast and Expectations*. New York NBER.

Morandé F. y Tejada M. (2008): "Fuentes de Incertidumbre en la Conducción de la Política Monetaria en Chile," *Journal of the Chilean Economy* 11(3): 45- 74.

Patton A. and A. Timmermann (2007): "Properties of Optimal Forecasts under Asymmetric Loss and Nonlinearity". *Journal of Econometrics, 2007, 140, 884-918* .

Pedersen, M. (2009), "Extracting GDP Signals from the Monthly Indicator of Economic Activity. Evidence from Chilean Real-Time Data", manuscript, Central Bank of Chile.

Pincheira, P. and H. Rubio (2009), " El Escaso Poder Predictivo de Algunas Simples Curvas de Phillips en Chile: Una Evaluación en Tiempo Real", manuscript, Central Bank of Chile.

Romer, C.D. and D.H. Romer. (2008), "The FOMC versus the Staff: Where Can Monetary Policy Makers Add Value?", *American Economic Review: Papers and Proceedings 2008, 98:2, 230-235.*

West, K. (1996): "Asymptotic Inference about Predictive Ability," *Econometrica* 64:1067-1084.

West, Edison and Cho (1993): "A Utility-Based Comparison of Some Models of Exchange Rate Volatility," *Journal of International Economics* 35: 23-45.

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