

The present issue of Highlights reviews the following topics that have been recently analyzed at the Central Bank of Chile (CBCh):

- **Monetary surprises: Measurement and real effects**
- **A semi-structural model with banking sector for stress testing scenario design**
- **Liquidity of the Chilean corporate sector: Estimating available cash under stress scenarios**

Monetary Surprises: Measurement and real effects

It is critical for central bank decision making to quantify the magnitude and way monetary policy affects different economic variables of interest. However, obtaining an empirical estimate of these effects has a measurement problem: central banks act for a reason. In econometric terms, this translates into an "endogeneity problem" since monetary policy responds to economic variables simultaneously with the response of economic agents to central bank decisions. Thus, the determination of economic variables is influenced by monetary policy and vice versa. For example, if monetary policy responds by lowering the rate when activity or inflation is too low, a simple estimation leads to the misleading conclusion that an expansionary monetary policy implies low activity and low inflation.

One way to address this issue and thus obtain a reliable measure of the causal effect of monetary policy on economic variables is based on the use of "monetary policy surprises". Intuitively, economic agents only respond simultaneously to the part of the policy decision they foresee, while they react after decisions are taken to the "surprise" that the policy decision is not exactly what they expected. This delay in response breaks the simultaneity behind the endogeneity problem, allowing for the estimation of the causal effect.

In "[Monetary Surprises in Chile: Measure and Real Effects](#)", (CBCh working paper No. 921, August 2021) Central Bank of Chile economists [Andrés Fernández](#) y [Ernesto Pastén](#), and external co-authors derive and expose the pros and cons of alternative ways to obtain a series of monetary policy surprises for Chile. This series is used as

"Using the unanticipated component of monetary policy decisions in Chile, the effects of raising the monetary policy rate are estimated. The cost of financing increases, GDP and inflation contract, although the latter with a lag. The exchange rate depreciates consistently with the "information channel" of monetary policy"

an instrument in a Bayesian autoregressive vector, which captures the interdependence of economic variables, to estimate the causal effect of a contractionary monetary policy on GDP, inflation, inflation expectations, cost of financing and the exchange rate. For the construction of monetary policy surprises, the authors favor the use of the difference between monetary policy decisions and the median of expectations as surveyed by Bloomberg. This is so considering several technical advantages over alternative surveys of expectations or implicit measurements based on swap asset prices in narrow time windows around monetary policy decisions. The Bloomberg survey spans longer sample than alternatives. In addition, Bloomberg' survey is consistently conducted few days before monetary policy decisions despite the change in the calendar of meetings that occurred during its time span. Meanwhile, the records of swap asset prices, aside from covering a shorter time span, do not have a sufficient volume of transactions for reliable estimates.

The upper part of figure 1 shows the monetary policy surprises constructed based on the Bloomberg

survey. There are not been many surprise events, which is consistent with a policy framework intended to avoid market surprises. Since 2010, there have been five positive surprises (the MPR has been above the median of expectational responses) and seven negative surprises. For the estimation of the causal effect of monetary policy, the bottom panel of figure 1 shows impulse-response functions of a contractionary surprise measured as a 1 S.D. increase in the difference between the monetary policy instrument (MPR) and the median of MPR expectations. The sample used covers from 2001 to 2020 at monthly frequency. An impulse-response function is a way of estimating the causal effect of a variable (the "impulse") on the time path implied by the "response" of the respective variable of interest. The red line represents the estimate, while the light and dark blue bands represent confidence intervals at 5% and 15%, respectively.

The lower right panel of the figure shows that a contractionary surprise implies that monetary policy will continue to be contractionary, capturing the inertia with which policy decisions are taken. The consumer price index CPI reacts only after a year

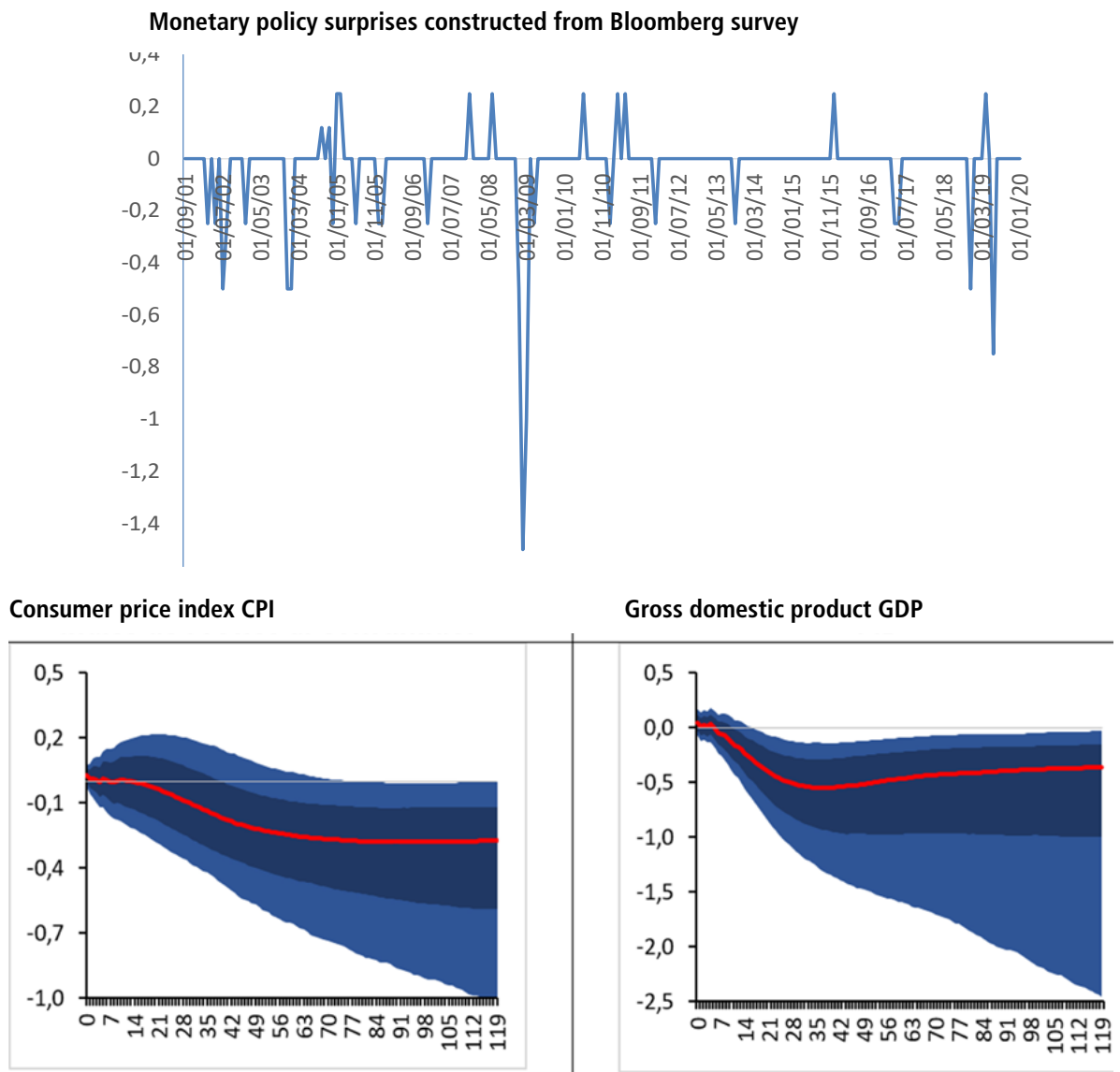
to converge to a lower level (i.e., inflation falls to later return to its long-run trend). Meanwhile, GDP falls more sharply and faster than inflation, to also converge to its long-run level. In turn, the nominal exchange rate depreciates. This is at odds with a standard model, while the responses of monetary policy, inflation and GDP are broadly consistent.

To further explore the nominal exchange rate

response, we estimate impulse-response functions (not reported here) of inflation expectations and the cost of financing measured as the difference between the interest rate paid on Chilean sovereign bonds relative to the U.S. Both variables tend to rise when responding to a contractionary surprise. Overall, the response of these variables underscores the relevance of the "information channel" of monetary policy: A surprise, beyond its direct effect on agents'

decisions, reveals information about the central bank's assessment of the state of the economy and the future monetary policy trajectory. Both factors exert an influence on economic variables, sometimes reinforcing the direct effect, as is the case of inflation and GDP, but at other times reversing it, as with the nominal exchange rate. The paper reviews international literature that shows that this effect is not exclusive to the Chilean case but a common

Figure 1: Estimation of impulse-responses to a 10bp monetary policy surprise



A semi-structural model with banking sector for stress testing scenario design

The difficulty of developing stress test scenarios (i.e., recessions and/or recoveries) and designing economic policy experiments in semi-structural models without financial variables is well known in at least two dimensions. First, over the analytical horizon of these models, variables converge relatively quickly to their equilibrium levels, so these models fail to generate strong and persistent fluctuations in, for example, aggregate demand. Second, financial shocks are introduced indirectly into the models without considering the feedback effects between the real sector and the financial sector.

The paper *“A semi-structural model with banking sector for stress testing scenario design”* CBCh working paper No. 922, August 2021), by Central Bank of Chile economists Juan Sebastián Becerra, José Gabriel Carreño, and [Juan Francisco Martínez](#), proposes a simple tool to cooperate in the construction of stress scenarios for the Chilean economy. The model developed by the authors extends the semi-structural models currently used by the CBCh by nesting a set of equations for the main financial variables that will allow observing the direct and feedback effects between the real and the financial sector. The model is estimated by using Bayesian techniques from the first quarter of 2001 to the fourth

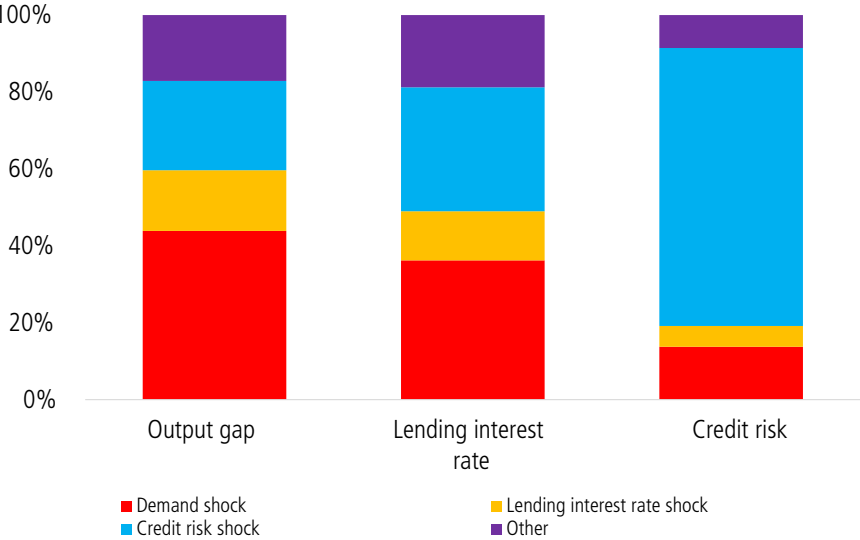
“The model developed by the authors extends the semi-structural models currently used by the CBCh by nesting a set of equations for the main financial variables that will allow observing the direct and feedback effects between the real sector and the financial sector”

quarter of 2019. The estimation period includes the structural breakdown caused by the global financial crisis and the policy measures adopted. As mentioned above, an important contribution of this paper is that it includes a set of relationships that explicitly consider feedback between the real and the financial sector. This differs, for example, from Martínez et al. (2017) who design stress test scenarios using the Monetary Policy Report as a basis. In such scenarios, they assume ex ante levels of output contraction and its subsequent convergence without quantifying feedback effects between the real sector and the financial sector. On the other hand, this paper complements previous studies by projecting the fall in output, decomposing it into its main components and quantifying the feedback from and to the financial variables. Thus, the authors decompose the 6.6pp output fall in Martínez et al. (2017) and determine that 4.5pp corresponds to the

real sector (75%) and 1.65pp (25%) to financial feedback.

In addition, this study helps to understand the importance of the process of risk allocation by the financial sector. Indeed, the risk captured by provisions expenditure is significant in the feedback from the financial sector to the real sector. In particular, figure 1 shows that fluctuations in the output gap are mainly driven by demand shocks (44%), followed by credit risk shocks (23%), lending interest rate shocks (16%) and others (17%). A similar situation occurs when decomposing the lending rate, which is mainly driven by demand (36%), credit risk (32%) and, to a lesser extent, the lending rate shock (13%). Finally, in the case of credit risk, almost all variations are explained by credit risk shocks (73%).

Figure 1: Unconditional variance decomposition

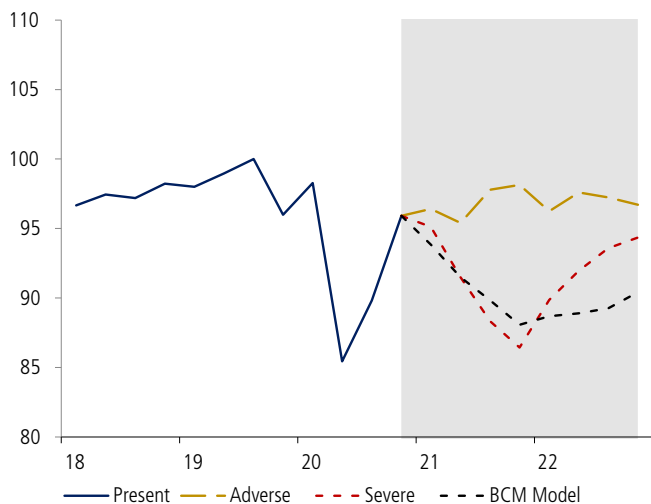


Finally, the authors develop stress scenarios for economic activity and compare them with those currently used at the CBCh. Figure 2 shows the trajectory of annual GDP growth under the adverse and severe scenarios presented in the Financial Stability Report and the scenarios constructed in this paper. The severe scenario considers a sharp

contraction in economic activity, similar to that of the global financial crisis, and a reduction in trend growth, like that observed after the Asian crisis. The adverse scenario consists of a sequence of shocks in which the path of activity is adjusted to the 5th percentile of the projections in the Monetary Policy Report. In this paper, the authors construct a scenario

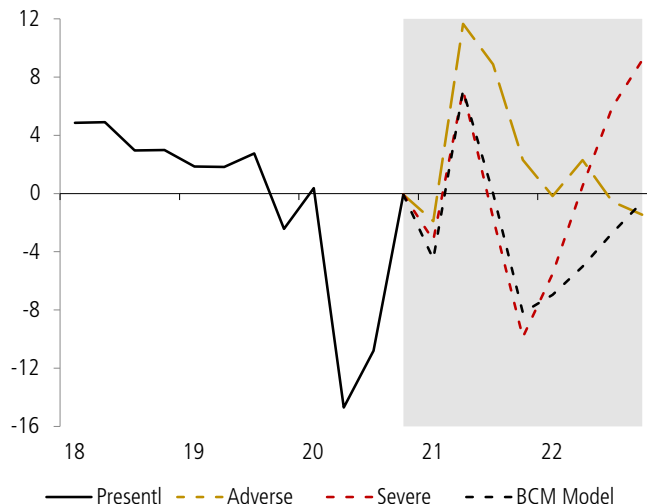
assuming a shock of 2 standard deviations to the output gap that manages to capture a dynamic to the adverse scenario of the stress tests. A slower reversion to the mean is also observed after hitting the 8% trough compared to the severe scenario.

Figure 2.1
Real GDP (*)
(quarterly data; index, 100 = Q3.2019)



(*) De-seasonalized data.
Source: Central Bank of Chile.

Figure 2.2
Annual GDP growth (*)
(quarterly data; percent)



(*) De-seasonalized data.
Source: Central Bank of Chile.

Liquidity of the Chilean corporate sector: Estimating available cash under stress scenarios

The economic downturn caused by the Covid-19 sanitary emergency has affected companies both in Chile and around the world. Unlike the 2008-2009 global financial crisis, this time the effect has been observed in the supply and demand of goods and services, exposes the real economy to a level of vulnerability that is capable of deteriorating financial conditions in terms of both solvency and liquidity. This is no different for firms in the Chilean corporate sector, which have seen their financial indicators plummet due to lower sales and increased credit constraints during this period. In this context, liquidity—understood as a firm’s ability to obtain immediate cash—becomes a critical variable. This is so because insufficient short-term cash generation can turn into a solvency problem and, in the event of non-payment, affect third parties such as banks, suppliers and bondholders.

“Ante un escenario de completa caída de ingresos, cerca del 90% de las empresas contarían con 6 o más meses de caja para poder solventar sus gastos en diciembre de 2020, en comparación con el 82% promedio durante el primer semestre de la pandemia”.

In view of this situation, in the working paper [“Liquidez del sector corporativo chileno: estimación de disponibilidad de caja bajo escenarios de estrés”](#) (CBCh working paper No. 926, October 2021) by Central Bank of Chile economists Jorge Fernández, Fernando Pino, and María Ignacia Valencia, present an estimate of available cash at firms in the corporate sector that complements the view of traditional financial indicators considering adverse scenarios in terms of cash generation. Simply put, the paper quantifies

the number of months that will take firms to exhaust their cash in meeting their costs and debts in the face of various unfavorable situations. This measurement is summarized in a new indicator labelled “months of cash.” In particular, they use information from 50 representative companies of the corporate sector, which report their financial statements to the

Financial Market Commission (FMC), three adverse income scenarios are simulated in order

to estimate how many months it would take to deplete the available cash. In addition, in order to incorporate information about the situation of the firms within the country, the historical cost/sales ratio is calculated by economic sector of said companies, including their differences in terms of proportion of fixed costs and asymmetric reaction to increases or decreases in their revenues. For example, firms in the Retail sector would adjust their costs more in the face of a drop in income relative to firms in Services, Food industry, or Construction. This would reflect the presence of higher fixed costs for the latter group of industries. Likewise, the relationship between a fall or a rise in sales and a reduction or increase in costs differs across sectors, because firms typically reduce their expenses more quickly when confronting a period of poor sales. These results are factored into the estimation of the future evolution of costs to improve the simulation of scenarios for the firms in the Chilean corporate sector.

El modelo se puede adaptar para realizar una comparación con otros indicadores utilizados internacionalmente; por ejemplo, se incluye una adecuación del ejercicio realizado por Benerjee

et al. (2020). Dicho estudio calcula el porcentaje de empresas que son capaces de cubrir sus gastos operacionales ante diferentes escenarios de renovación de deuda.

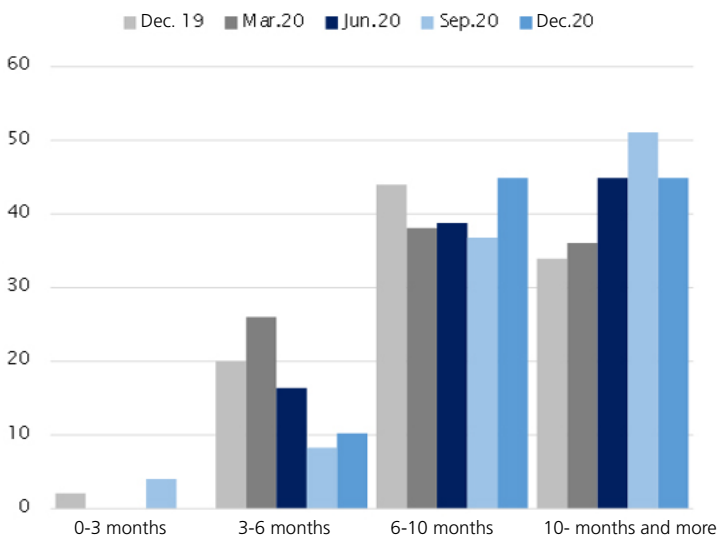
The model can be adapted to make a comparison with other indicators used abroad; for example, an adaptation of the exercise performed by Benerjee et al. (2020) is included here. Said study calculates the proportion of firms that are capable of covering their operating expenses in a variety of debt rollover scenarios.

The main finding of the estimations is an improvement of the liquidity capacity since the onset of the sanitary crisis, which is relatively homogeneous at the economic sector level. In particular, in a scenario of a total loss of income, nearly 90% of firms would have six or more months of cash on hand to cover their expenses as of December 2020, compared with an average of 82% during the first six months of the pandemic (figure 1). Also, the homogeneous increase in the cash level by economic sector during this period is proof of how this shock affected the entire Chilean corporate sector (figure 2). This points to a relative improvement in the

liquidity situation of these companies. Meanwhile, in a cross-country comparison, Chile ranks in the lower part of the distribution of firms with liquidity stress—close to Japan—, so it would maintain a larger cash reserve relative to the other countries in the study, even with comparable countries in terms of GDP or export matrix such as South Korea, South Africa, or Turkey.

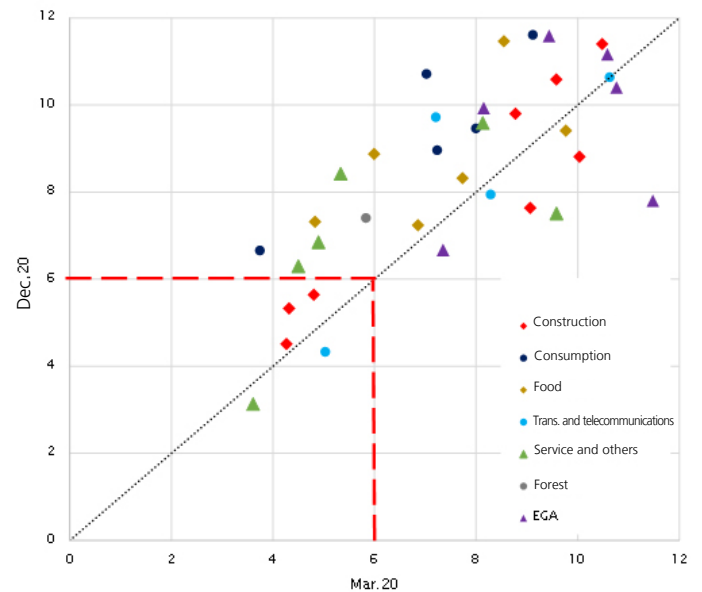
In conclusion, the results of the “months of cash” indicator provide valuable information regarding the resilience of the Chilean corporate sector. The advantage of this indicator over others lies in the possibility of identifying through a threshold which and how many companies are below a risk limit in terms of liquidity, providing a tool for monitoring financial risks. Given that the indicator is measured in adverse scenarios, it allows for greater detail about the situation of these companies. Moreover, this measurement incorporates firm-specific and economic-sector-specific elements for Chile, allowing to improve the results for an international comparison with Benerjee et al. (2020). Thus, their reporting and monitoring has been included in the Financial Stability Report of the Central Bank of Chile, within the context of the sanitary crisis.

Figure 1: Distribution of months' worth of liquidity: No-income scenario ^{(1) (2)}



(1) Consolidated data
 (2) Sample of 50 firms in the Chilean corporate sector, in different economic areas.
 (3) Only firms with less than 12 months' worth of liquidity are plotted.
 (4) Source: own calculations using FMC data.

Figure 2: Estimated months' worth of liquidity by economic sector ⁽¹⁾⁽³⁾
 (percent of firms)



Publications in academic journals by research staff of the Central Bank of Chile, January – December 2021

Alfaro, R. y A. Sagner “S&P 500 under a Structural Macro-Financial Model” *Economic Analysis Review*.

Alegría, A. R., Alfaro y F. Córdova (2021). “The effect of warnings published in a financial stability report on loan-to-value ratios”, *Latin American Journal of Central Banking* 2(4).

Arriagada, C., P. Coble, B. Lewis y T. Li. *Post-investment aftercare explained: A guide for FDI practitioners and policymakers on How to Grow and Retain Investors*. Publisher: Routledge - Taylor & Francis Group. Londres, UK, por aparecer.

Berstein, S. y M. Morales “The role of a longevity insurance for defined contribution pension systems”, *Mathematics and Economics*.

Bush, G., T. Gómez, A. Jara, D. Moreno, K. Styrin y Y. Ushakova. “Macroprudential policy and the inward transmission of monetary policy: The case of Chile, Mexico, and Russia”. *Review of International Economics*, vol. 29.

Cabezas, L. y A. Jara. “Demanda por circulante: hechos estilizados y sustitución por medios de pago electrónicos” *Revista Cepal*, por aparecer.

Carlomagno, G. y A. Espasa. “Discovering specific common trends in a large set of disaggregates: Statistical procedures, their properties, and an empirical application”. *Oxford Bulletin of Economics and Statistics*, por aparecer.

Carvalho, C., N. Pasca, L. Souza y E. Zilberman. “Macroeconomic effects of credit deepening in Latin America”. *Journal of Money, Credit and Banking*, por aparecer.

Coble, P. y P. Pincheira “Forecasting building permits with Google Trends”. *Empirical Economics*.

Didier, T., F. Huneus, M. Larrain y S.L. Schmukler “Financing firms in hibernation during the Covid-19 pandemic”. *Journal of Financial Stability* 53.

Fornero, A., F. Gallego, F. González y M. Tapia. “Railroads, specialization and population growth in small open economies: evidence from the first globalization”. *Journal of Population Economics*, por aparecer.

García-Santana, M., J. Pijoan-Mas y L. Villacorta (2021). “Investment demand and structural change”, *Econometrica* 89(6).

Kirchner, M. y M. Rieth. “Sovereign default risk, macroeconomic fluctuations and monetary-fiscal stabilization”. *IMF Economic Review*, por aparecer.

Lopez-Martin, B. y D. Perez-Reyna (2021) “Contracts, firm dynamics and aggregate productivity”. *Journal of Economic Dynamics and Control* 130.

Lu, W., F. Zhiyu Feng, y C. Zhu. “Financial integration, savings gluts, and asset price booms”. *The B.E. Journal of Theoretical Economics*, por aparecer.

Madeira, C. “The impact of the Covid public policies on the Chilean households”. *Applied Economics Letters* 28(18).

Madeira, C. “The potential impact of financial portability measures on mortgage refinancing: Evidence from Chile”. *Journal of International Money and Finance* 117.

Madeira, C. “The long term impact of Chilean policy reforms on savings and pensions”. *Journal of the Economics of Ageing* 19.

Martínez, J. F. y D. Oda “Characterization of the Chilean financial cycle, early warning indicators and implications for macro-prudential policies” *Latin America Journal of Central Banking* (disponible on-line)

Morales-Resendiz, R., J. Ponce, P. Picardo, A. Velasco, B. Chen, L. Sanz, G. Guiborg, B. Segendorff, J. L. Vasquez, J. Arroyo, I. Aguirre, N. Haynes, N. Panton, M. Griffiths, C. Pieterz, y A. Hodge “Implementing a retail CBDC: Lessons learned and key insights”. *Latin America Journal of Central Banking*

Paraje, G., A. Colchero, J.M. Wlasiuk, A.M. Sota y B.M. Popkin “The effects of the Chilean food policy package on aggregate employment and real wages”. *Food Policy*.

Latest working papers of the Central Bank of Chile

DTBC #	Title	Author(s)	Date
934	The Labor Earnings Gap, Heterogeneous Wage Phillips Curves, and Monetary Policy	Mario Giarda	December 2021
933	The impact of climate change on economic output in Chile: past and future	Karla Hernández, Carlos Madeira	December 2021
932	Risk modeling with option-implied correlations and score-driven dynamics	Marco Piña, Rodrigo Herrera	December 2021
931	Nowcasting Chilean household consumption with electronic payment data	Marcus Cobb	December 2021
930	Sentimiento en el Informe de Estabilidad Financiera del Banco Central de Chile	Juan Sebastián Becerra, Alejandra Cruces	December 2021
929	Inequality, Nominal Rigidities, and Aggregate Demand	Sebastian Diz, Mario Giarda, Damián Romero	November 2021
928	Rational Sentiments and Financial Frictions	Paymon Khorrami, Fernando Mendo	October 2021
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925	Procyclical fiscal policy and asset market incompleteness	Andrés Fernández, Daniel Guzman, Ruy E. Lama, Carlos A. Vegh	September 2021
924	Reserve Accumulation and Capital Flows: Theory and Evidence from Non-Advanced Economies	Juan Pablo Ugarte	September 2021
923	Estimates of the US Shadow-Rate	Rodrigo Alfaro, Marco Piña	September 2021
922	A semi-structural model with banking sector for stress testing scenario desing	Juan Sebastián Becerra, José Carreño, Juan Francisco Martínez	August 2021
921	Monetary Policy Surprises in Chile: Measurement & Real Effects	Boragan Aruoba, Andrés Fernández, Daniel Guzmán, Ernesto Pastén, Felipe Saffie	August 2021
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