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COVID-19 pension raids and sovereign risk

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A B S T R A C T

Chile was among the nations where the regulations allow individuals to make withdrawals from their retirement savings to cope with the COVID-19 pandemic. We analyze these quasi-natural experiments using the Autoregressive Distributed Lag Stationarity model and event study methodology spanning from March 2020 to April 2021. We find evidence that the first regulatory shock reduces the spread between the ten-year nominal sovereign bond yield and the annual interbank rate and amplify the impact of agent economic perceptions in the short term. These findings are useful for policymakers and investors regarding to adverse repercussions of this the policy on the economy going forward.

1. Introduction

Governments across the globe implemented a diverse range of measures to bolster household incomes in response to the COVID-19 lockdowns. These interventions included direct financial assistance to individuals, tax relief programs, loan initiatives, wage subsidies, and other support mechanisms. Chile implemented large pension withdrawals during the pandemic relative to other countries (Madeira, 2024). The nation permits withdrawals totaling over US$50 billion, equivalent to nearly 20 % of the Chilean GDP. The ramifications of these withdrawal policies will impact not only future pensions but also the local economy and its capital market.

Matters related to social security are the exclusive responsibility of the President of the Republic in Chile. However, Congress started the discussion about whether to allow people to use their pension fund savings to cope with the lack of resources during the COVID-19 pandemic. The proposal received extensive media exposure and citizen interest forcing the government to implement it. Pension funds are resources managed in private accounts, invested in the capital markets and people are not allowed to use it until retirement. Congress saw the opportunity to provide liquidity to households with the commitment to allow only one exceptional withdrawal. However, once the policy had been implemented, parliamentarianism found a way to continue exerting pressure through this policy and sought to increase its popularity by transforming illiquid assets into available resources for people. The perception of a conflict between state powers therefore arose and increased uncertainty in the local economy. The law allows pension system affiliates

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to take out 10 % of their own funds in each of three withdrawals, with an upper limit of 150 UF[1] (approx. $5560 dollars). The rapid implementation of the measure generated a sudden sale of different financial instruments by the PFA, especially fixed-income instruments from the local market. This quasi-natural experiment provides the opportunity to analyze the effects on the interest rate spread of fixed-income instruments traded on the local capital market.

The conflict between government and the Congress affects the country's political stability, which is positively linked to economic growth (Aisen & Veiga, 2013; Alesina et al., 1996; Uddin et al., 2017), direct foreign investment (Rashid et al., 2017), and better governance (Kaufmann, 2007). We sought to answer the question: Has the perception of increased political-economic instability due to the COVID-19 and the political disagreements between government and Congress in approving regulatory changes generated collateral effects on financial stability, particularly on sovereign bond rate spreads?

No infectious disease has hit financial markets as hard as the current COVID-19 pandemic. The effect has been particularly severe on service-oriented economies due to social distancing and government constraints on economic activity (Baker et al., 2020a). The World Bank (2022) points to a 3.3 % decline in real GDP growth worldwide in 2020, compared to the 1.3 % decrease in the subprime crisis in 2009. Harjoto et al. (2020) evidence that stock markets in emerging economies were affected by the number of deaths and cases, whereas developed economies were affected only by cases. In Addition, Ftiti et al. (2021) evidence that news about the number of cases and deaths increased stock market return volatility and reduced stock liquidity. We posit that withdrawals will lead to an increase in bond spreads. Furthermore, we hypothesize a negative correlation between economic perception and bond spreads. Additionally, we expect the market to anticipate the potential approval of the process, thereby causing an increase in the spread rate in the days leading up to the approval.

This study contributes to the existing body of research in two keyways. First, it expands our understanding of how sovereign bond spreads react to regulatory shocks in emerging economies, particularly those that trigger perceptions of economic and political instability. Second, we analyze and quantify the extent to which the market anticipates such events, reflected in changes to sovereign bond spreads.

To test our hypotheses, we used the event methodology to incorporate dummy variables that capture the regulatory policy approval and enactment. We also incorporated the COVID-19 mortality rate. In addition, we use global and local macroeconomic variables, local bond rate stress index, and the economic perception index to control for other factors that were not attributable to regulatory events.

Our empirical findings support our initial hypotheses. First, a negative relationship exists between the initial event and sovereign bond spreads. Secondly, the results provide evidence that the regulatory policy amplifies the impact of agent economic perceptions in the short term.

The rest of the paper is organized as follows. Section 2 provides the literature review. Section 3 reports the data and methodology. Section 4 shows the results and discussion. Finally, section 5 concludes.

2. Literature review

Extensive literature indicates that sovereign bond spreads in emerging economies are generated by global factors, domestic macroeconomic factors, as well as environmental, social, and governance factors (Edwards, 1986; Eichengreen & Mody, 2000). Edwards (1986) analyzes sovereign bond spreads in emerging markets using a five-year horizon and a pool of foreign bond instruments. He proposes a set of explanatory variables of the macroeconomic nature of the country and bond characteristics, showing a statistically significant relationship between risk premium and macroeconomic variables. This paper also discusses expectations that can impact the price of assets as well as those which are not fundamental. Eichengreen and Mody (2000) divided the effects on the spread into fundamentals and market sentiment. Thus, changes in market sentiment –which may not be related to fundamentals– strongly impact spreads in the short term.

As work has developed to explain sovereign bond spreads, new control variables have been included in the analysis. For example, Vayanos (2004) incorporated a time-varying liquidity premium and concluded that it is both an asset characteristic and a risk factor that explains the difference in bond returns in cross-sections. Ebner (2009) incorporated external market variables to countries (implicit volatility of the DAX German stock index over a period of 30 days, European Central Bank (ECB), ECB benchmark three-month interbank rate; liquidity, ECB benchmark exchange rate, Eurozone inflation) and time dummies to capture events determined by local macroeconomic variables, where market variables are better at explaining sovereign bond spread than fundamentals.

Following the subprime crisis, researchers and practitioners identified different variables that affected financial stability and monitored the different markets that make up the economy, thus creating new indexes that help combat the lack of monitoring and control over systemic risk. However, the definition of financial stability lacks any single consensus due to its multidimensional nature. Financial stability can be associated with a financial system in a state that facilitates economic performance, dissipating financial imbalances produced endogenously or by unexpected adverse events (Allen & Wood, 2006). Thus, the inclusion of variables related to political risk, financial stress, and the creation of new indexes can explain the spread of sovereign bonds.

Baldacci et al. (2008) proposed a new political risk index[2] and incorporated fiscal vulnerability variables and found that both explain sovereign bond spread. Similarly, Balakrishnan et al. (2009) developed a financial[3] stress index for emerging economies and

[1] The Unidad de Fomento (UF), unit of account used in Chile, is constantly adjusted for inflation. It is a non-circulating currency. 1 UF = 28,668.36 Chilean pesos (CLP) and 1USD = 759.18 CLP on July 30, 2020 (date on which the law took effect).

[2] Based on the World Bank's Governance Index and the Heritage Foundation's Index of Economic Freedom.

[3] Markets included in the index: currencies; sovereign bonds; banks and equities.

analyzed how this stress propagates during the subprime crisis. Bellas et al. (2010) added a political risk index and the financial stress index developed by Balakrishnan et al. (2009) and concluded that short-term financial fragility is more important than fundamentals in explaining the sovereign bond spread as well as the global liquidity proxy measured by the VIX. Hollo et al. (2012) proposed a financial system stress index where they applied basic portfolio theory to aggregate five market-specific sub-indexes out of a total of 15 individual financial stress measures, considering that the cross-correlations of the sub-indexes vary over time. Garcia-de-Andoain and Kremer (2017) proposed a new stress indicator in the Eurozone bond market due to the ease with which contagion to other market segments could compromise the financial market.

Martínez et al. (2013) incorporated governance characteristics related to government effectiveness. They found a negative and statistically significant relationship between government effectiveness and bond spread. Bekaert et al. (2014) explain major spread in terms of global and local variables. They incorporated an indicator of bond market illiquidity and included measuring a new concept; political risk spread. This concept extracts information from the political risk ranking of the International Country Risk Guide, thus providing a quantitative measure of the probability of an adverse political event occurring in a given country. Huang et al. (2015) concluded that international political risk has a positive relationship with sovereign bond returns, mainly during political uncertainty. However, the effect is smaller in debtor countries with a stable political system and strong investor protection.

COVID-19 strongly affected different markets, e.g., increased illiquidity and volatility in the U.S. stock market (Baig et al., 2021), increased volatility of major stock indexes (David et al., 2021), increased volatility of stock returns in international stock markets due to restrictive government policies to cope with the pandemic (Zaremba et al., 2020), and the increased bid-offer spread of bonds in emerging markets (Gubareva, 2020). New tools were therefore proposed to capture the impact on financial markets and their components. Due to the concern regarding markets' financial stability, international organizations proposed new financial stress indicators. Such is the case of the IMF (2020), which introduced a new indicator to assess financial stress in local emerging economy bond and foreign exchange markets, with the methodology being based on Hollo et al. (2012) and Garcia-de-Andoain and Kremer (2017).

Evidence regarding the impact of COVID-19 on the sovereign bond market is still limited. Zaremba et al. (2021), Zaremba et al., 2020 found evidence that the growth of confirmed cases strongly impacts bond rate spreads, whereas government economic support policies reduced volatility. Sène et al. (2021) found a positive relationship between the spread of the sovereign bonds rate and the number of confirmed COVID cases. Additionally, aid announcements for emerging economies from international organizations –IMF, World Bank, and the Paris Club– temporarily calmed secondary markets.

Economic theory indicates that risk-averse investors should be compensated or provided with a premium if the assets they invest in are not safe, the higher the risk, the higher the return. The rapid spread of COVID-19 translated into greater uncertainty in all areas, thus increasing the risk faced by investors and the compensation demanded. The question remains as to how to measure that uncertainty. Baker et al. (2020b) identified three indicators that provide forward-looking information on real-time measures of uncertainty; newspaper-based economic uncertainty, stock market volatility (VIX), and a survey of business expectations.

The newspaper-based index was presented by Baker et al. (2016), who measured economic policy uncertainty in twelve countries, and concluded that it is associated with higher stock price volatility, reduced investment, and reduced employment in policy-sensitive sectors of the economy. Cerda et al. (2018) created a monthly news-based economic uncertainty index for emerging economies and concluded that increases in economic uncertainty negatively affect aggregate investment indicators, GDP, and employment. Subsequently, Becerra and Sagner (2020) proposed a daily index of economic uncertainty in emerging economies based on Twitter accounts (Twitter-based).

We can conclude that the variables explaining sovereign bond spreads depend on global and local fundamentals and non-fundamentals, including indices of governance perception, political and economic stability, news, pandemic management at the local level, etc. With potential rises in political instability and deterioration of the rule of law, our hypotheses to be tested are.

H_1: The regulatory shocks allowing people to use their own pension funds generate a decrease in the spread between the ten-year bond rate and the interbank rate.

H_2: The regulatory shocks permitting individuals to utilize their own pension funds further amplify the impact of agent economic perceptions in the short term.

3. Methodology and data

Following Kripfganz and Schneider (2023), we employ the autoregressive distributed lag model (ARDL) to investigate the impact on the spread of sovereign bonds traded in the secondary market during the period March 1, 2020, to April 28, 2021. The following equation serves as the foundation for analyzing the potential effects:

$$Y_t = \alpha_0 + \alpha_1 {}^* t + \sum_{i=1}^{p} \varphi_i \ Y_{t-i} + \sum_{i=0}^{q} \beta_i {}^* X_{t-i} + \varepsilon_t \tag{3}$$

where Y_t is the spread between the nominal ten-year bond rate traded in the secondary market and the annualized interbank rate on day t. Linear trend $\alpha_1 {}^* t$, lag orders $p \in [1, p^*]$ and q $\in [0, p^*]$ with $p \geq 0, q \geq 1$ and explanatory variables,[4] X_t.

[4] For more details on the variables used and expected relationship, see Table 1.

This study utilizes lag-order selection criteria to identify the optimal number of lags for each variable. The selected lag lengths are presented in Table 2. Substitution of these values into Equation (3) allows us to employ the Akaike Information Criterion (AIC) to identify the optimal lag length for each variable within the model,[5] thereby achieving the best possible fit.

Once the optimal lag length is determined, we can estimate the long-term and short-term effects, as well as the error correction term, to analyze the cointegration of the variables. However, since our focus is on the short-term, we will focus on the following equation, which excludes the long-term variables:

$$\Delta Y_t = \sum_{i=1}^{p-1} \varphi_i \, \Delta Y_{t-i} + \sum_{i=0}^{q-1} \Delta X_{t-i} {}^{*} \beta_i + \gamma_t \tag{4}$$

This study employs event study methodology, we achieve this by incorporating dummy in equation (4) to assess the impact of regulatory changes on the variable of interest. A single dummy variable (W) captures the combined effect of all regulatory events, while three additional dummy variables (w1, w2, and w3) isolate the specific impact of each withdrawal event from pension funds.

Also, we include changes in country's rating risk in long term, dum_Rating_t. This variable takes a value of 1 if any of the major credit rating agencies (Moody's, Fitch, or S&P)[6] modifies the country's rating. Other studies have incorporated a country's rating either with dummy variables or by assigning numerical values to risk rating (Capelle-Blancard et al., 2019; Fender et al., 2012; Hilscher & Nosbusch, 2010; Margaretic & Pouget, 2018; Zaremba et al., 2021).

Other variables are the Cboe Volatility Index (VIX; Bellas et al., 2010; Bekaert et al., 2014; Zaremba et al., 2021; Sène et al., 2021; Andries et al., 2021), the U.S. 10-year bond rate and TED spread, both used in Hilscher and Nosbusch (2010), Wang et al. (2013), Wang and Yao (2014), Eichler (2014), Zaremba et al. (2021). Li (2021) and Augustin et al. (2021) use VIX and TED spread as control variables, while Csontó (2014) uses VIX and U.S. 10-year bonds. Only VIX is used by Bellas et al. (2010), Bekaert et al. (2014), Sène et al. (2021), and Andries et al. (2021). The expected relationships of the global factors, VIX and TED spread, are positive over the local bond spread. VIX can be considered as a forward-looking indicator of risk aversion, risk events associated with the credit market and investors' risk appetite. TED spread is a proxy for global sentiment and liquidity and the credit risk from interbank lending. U.S. we expect a negative relationship as treasuries bonds are a risk-averse proxy and, in situations of turbulence like the current one, investors move to safer instruments.

As regards local conditions, we consider the local stress index of sovereign bond rate (ISLTS) proposed by the IMF (2020) and used by the Central Bank of Chile (CB). Higher ISLTS levels mean tighter financial conditions in bond markets, such that our expected relationship is positive. The liquidity ratio measures access to credit based on central bank reserves. It is the ratio of central bank reserves to imports, for which we expect a negative relationship based on Capelle-Blancard et al. (2019). Zaremba et al. (2021) included the variation rate of central bank balance sheet assets as a proxy for monetary policy and for the CB providing liquidity to the financial system. They concluded that this variable decreased bond rate spread. This observation was also made by other studies such as Afonso and Jalles (2019), Sudo and Tanaka (2020), Urbschat and Watzka (2020), who found that an increase in assets by central banks generates a decrease in the spread of sovereign bonds. However, De Santis and Holm-Hadulla (2020) avoided the simultaneity bias between prices and purchases, showing that the assets purchased by central banks and other substitute assets increase short-term returns. Following Baker et al. (2020b), we incorporated an Index of Economic Uncertainty (IEU, Becerra & Sagner, 2020) and an Index of Economic Perception (IEP) to react to the spread of the COVID-19 crisis quickly. We expect an increase in the bond spread at higher IEU levels. The IEP is a composite index, calculated from the combination of answers to five questions that measure the perception of the current personal economic situation, the country's current economic situation, the country's long-term future economic situation, and the household consumption expectation. We have only considered the composite indexes (IEP), where its maximum value (100) indicates better prospects, and therefore, lower bond spreads.

We included the difference between lending and borrowing rates −30 to 89 days– used in the financial system (DRLB). We incorporate it as a proxy for monetary policy, such that increases in the DRLB would generate less willingness to issue or contract debt due to the increase in the premium required for these instruments. However, in uncertain conditions, investors take refuge in safer options, such as bonds issued by the central bank. Thus, the expected relationship is uncertain. We also add variables from the stock market, daily return of the local stock index (IPSA) (Fender et al., 2012; Martinez et al., 2013), and daily volatility of the stock index (Fender et al., 2012) following the model proposed by Parkinson (1980), where H_t and L_t are the highest and lowest values on day t. Variance can be measured as $\sigma_t^2 = \frac{1}{4 \ln 2} {}^{*} (ln(H_t|L_t))^2$. We use past annual inflation (Aizenman et al., 2013; Capelle-Blancard et al., 2019; Kennedy & Palerm, 2014; Martinez et al., 2013), because higher inflation levels require higher compensation in the bond rate. It is worth remembering that these bonds are in nominal terms, and do not have inflation included in their returns.

Also used were daily growth in deaths due to COVID-19 (DGRDCOV, Andries et al., 2021), daily infection rate, or the number of new infections (Sène et al., 2021; Zaremba et al., 2021). We expected that as the DGRDCOV becomes higher, policies to cope with the pandemic will be considered fruitless, therefore bringing higher levels of uncertainty, local volatility, and increasing the return required over government bonds. Government Response Index[7] (GRindex) includes Containment and Health Index (Chindex), related

[5] Based on equation (3), the optimization process identified the following optimal lag structure for each variable in the equation: SpreadLn (2), VIX (4), Rate10yus (3), TEDRATE (2), IEP (1), Liq (1), VCBA (4), Volipsa (1), Infl (1), DGRDCOV (1).

[6] Information extracted from the communications of the risk rating agencies, where Fitch changes its long-term risk rating on October 15th, 2020, from A to A-, and S&P changes it from A+ to A on March 24th, 2021.

[7] Oxford COVID-19 Government Response Tracker.

Table 1
Description of variables and expected relationship with the sovereign bond rate spread.

Variables	Description	Source	Expected Relationship
VIX	Cboe Volatility Index	https://www.cboe.com/tradable_products/vix/vix_historical_data/	+
TEDRATE	Difference between three-month LIBOR U.S. and T-bill interest rates	Federal Reserve Bank of St.Louis	+
Rate10yus	10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data.	Federal Reserve Bank of St.Louis	–
ISLTS	Local bond rate stress index	Central Bank of Chile	+
IEU	Economic uncertainty index	Central Bank of Chile	+
IEP	Economic perception index, data interpolated from monthly to daily frequency.	Data provided by the Central Bank of Chile	–
Liq	Liquidity ratio, the ratio between central bank reserves and imports. Data interpolated from monthly to daily frequency.	Calculated based on data from the Central Bank of Chile.	–
VCBA	Change in assets on the central bank's balance sheet. Data interpolated from monthly to daily frequency	Calculated based on data from the Central Bank of Chile.	–
DRLB	Difference between deposit and placement rates of the financial system for 30–89 days	Calculated based on data from the Central Bank of Chile.	+/−
Return	Stock index (IPSA) return, natural logarithm of the quotient of the IPSA price index of day t and t-1.	Calculated based on daily of highs and lows of the IPSA, Economática	–
Volipsa	Daily volatility of the Selective Stock Price Index (IPSA). Calculated with the model proposed by Parkinson (1980). Where H_t y L_t are the highest and lowest values on the day t the variance can be measured as $\sigma_t^2 = \frac{1}{4\,ln\,2}*(ln(H_t\vert L_t))^2$.	Calculated based on daily highs and lows of the IPSA, Economática	+
Infl	Annual inflation, calculated based on the value of the daily UF as an IPCt $=(\text{UF}_t/\text{UF}_{t-364}-1)$	Calculated based on data from the Central Bank of Chile.	+
DGRDCOV	Daily local death rate for confirmed cases of COVID-19 $(deaths_t - deaths_{t-1})/deaths_{t-1}$	Oxford COVID-19 Government Response Tracker	+
GRindex	Government Response Index	Oxford COVID-19 Government Response Tracker	+/−
Sindex	Stringency Index, information on social distancing policies	Oxford COVID-19 Government Response Tracker	+/−
Chindex	Containment and Health Index, public awareness campaigns and contact tracing policies.	Oxford COVID-19 Government Response Tracker	+/−

Source: Own elaboration

Table 2
Lag-order selection criteria.

VARIABLES	Max lags	VARIABLES	Max lags
Spreadln	2	TEDRATE	4
W	1	Rate10yus	4
w1	1	ISLTS	4
w2	1	IEU	4
w3	1	IEP	4
GRindex	1	Liq	4
Sindex	1	VCBA	4
Chindex	1	DRLB	1
DGRDCOV	4	Return	2
dum_rating	1	Volipsa	3
VIX	4	Infl	4

Variables: natural logarithm of spread between the nominal ten-year bond rate traded in the secondary market and the annualized interbank rate on day t (Ln(spread); Cboe Volatility Index (VIX); Difference between three-month LIBOR US and T-bill interest rates (TEDRATE); 10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data (Rate10yus); Local bond rate stress index (ISLTS); Economic perception index, data interpolated from monthly to daily frequency (IEP); Economic uncertainty index (IEU); Liquidity ratio, the ratio between central bank reserves and imports, data interpolated from monthly to daily frequency (Liq); Change in assets on the central bank's balance sheet, data interpolated from monthly to daily frequency (VCBA); Difference between deposit and placement rates of the financial system for 30–89 days (DRLB); Stock index return, natural logarithm of the quotient of the IPSA price index of day t and t-1 (Return); Daily volatility of the Selective Stock Price Index, calculated with the model proposed by Parkinson (1980) (Volipsa); Annual inflation, calculated based on the value of the daily UF (Infl); Daily local death rate for confirmed cases of COVID-19 (DGRDCOV); Goverment Response Index (GRindex)); Stringency Index, information on social distancing policies (Sindex); Containment and Health Index, public awareness campaigns and contact tracing policies (Chindex).
Source: Own elaboration.

to public awareness campaigns, and contact tracing policies, Stringency Index (Sindex), information on social distancing policies and Economic Support to Household Index (ESindex), and representing household assistance programs, Zaremba et al., 2021. In these cases, we consider two effects: on the one hand, the drastic measures to stop the pandemic as soon as possible (either total closure of borders, quarantine, economic aid, school closures, social distancing, etc.) and, on the other, economic policies impacting bond rates. Measures to control the spread of COVID have a high cost for the government, resulting in debt and less tax revenue. Therefore, the long-term bond returns demanded by investors increase as the government has less capacity to pay. Finally, ε_t is the error term.

In addition, there are some variables in previous literature that explain the spread rate in sovereign bonds not been used in this study due to the possibility of endogeneity (Hilscher & Nosbusch, 2010). These include external debt/GDP ratio, reserves/GDP, and the terms of trade.

Fig. 1 shows the logarithm's behavior of the difference between the 10-year nominal bonds of the Central Bank of Chile and the annualized interbank rate, ln (spread), from March 2020 to April 2021, highlighting the dates of the different legislative processes[8] for the three approved withdrawals. The dates considered in these processes are from the so-called "Bill to the Executive" as the end of the legislative process and the final presidential approval. The dates of the legislative processes considered are i) July 23 to July 30, 2020, ii) December 03 to December 15, 2020, and iii) April 23 to April 28, 2021, respectively.

Table 3 contains the descriptive statistics of the variables, number observations, average, median, standard deviation, maximum and minimum values, percentile 25 and percentile 75. Table 4 shows the Pearson's correlations between the study variables, although we found no evidence of strong correlations (above 0.7) for most variables. However, the correlations between VIX -Volipsa, VIX-TEDRATE, TEDRATE-Inflation and TEDRATE-DGRDCOV are among 0.7 and 0.8, in other cases ISLTS-IEU, Liquidity-Rate10yus and GRindex and its components exceeds values of 0.8. These values were expected since the pandemic is partially responsible for the increased instability and volatility of the markets at a global and local level. Furthermore, a unit root analysis was conducted for each time series included in the investigation. This analysis employed Augmented Dickey-Fuller (ADF) tests. The results of these tests suggest that the variables exhibit stationarity (see Table 5), either in their original levels or after differencing once.

4. Results and discussion

Table 6 does not reveal a statistically significant association between withdrawals (W, w1, w2, and w3) and bond spreads in the secondary market for either Model (1) or Model (3). In Model (2) and Model (4) we incorporated a variable with the interaction between withdrawals (W, w1, w2, and w3) and the index of economic perception (IEP) like a transmission channel between the expectations and the bonds spreads. This interaction in not statically significant in model (2), however in model (4) we find evidence of two variables of interest, in first withdrawal (w1) is negative and statistically significant at 10 %, in contrast cases, the interaction between w1 and the index of economic perception (IEP) is positive and statistically significant at 1 %.

Conversely, the primary factors influencing the bond spread appear to be, the first lag and second lag of the first difference in the natural logarithm of the bond spread (L.DSpreadln and L2.DSpreadln), the first difference in 10-year U.S. Treasury bond returns (D. Rate10usy), the second lag of the first difference in 10-year U.S. Treasury bond returns (L2D.Rate10usy), the second lag of the difference between three-month LIBOR U.S. and T-bill interest rates (L2.TEDRATE), first difference in Index of Economic Perception (D. IEP) and the second, third and fourth lag of the change in assets on the central bank's balance sheet (L2D.VCBA L3D.VCBA and L4D. VCBA).

Our analysis reveals that only withdrawal 1 exerted a statistically significant influence on the bond spread, leading to a decrease. This finding suggests that the regulatory policy has adverse consequences for the economy in the long term, as it diminishes savings available for funding future investments. Additionally, we did not find any significant relationship between the downgraded long-term risk rating of this emerging economy and the spread rate of the bonds traded in the secondary market in any of the proposed specifications.

The interaction between withdrawals and the IEP is positive and significant only for the first withdrawal in explaining the spread in rates. This result provides evidence that only the initial regulatory shock amplifies the impact of agent economic perceptions in the short term.

Based on the results obtained, we can support our hypotheses H_2 and partially our hypotheses H_1. The results demonstrate a statistically significant negative impact of initial withdrawals on the spread rate of secondary market bonds (long-term effect) and amplify the economic activity in the short-term.

Among the global factors considered, the first difference in 10-year U.S. Treasury bond returns (D.Rate10usy) and the second lag of the first difference (L2D.Rate10usy) have average coefficients of 0.204 and −0.091, respectively. These coefficients are statistically significant at the 1 % and 10 % levels, respectively. These coefficients are statistically significant at the 1 % and 10 % levels, implying a strong influence. In economic terms, a 1 % increase in the change of the 10-year Treasury yield is associated with a 20.4 % increase in the bond spread and its second lag is linked to a 9.1 % decrease in the spread.

The change in the difference between three-month LIBOR U.S. and T-bill interest rates (D.TEDRATE) is statistically significant at the 10 % level in all proposed models, with an average value of 0.155. In economic terms, a one-percent increase in the lagged change of the difference between three-month LIBOR U.S. and T-bill interest rates (L2 (D.TEDRATE)) is associated with a 15.5 % increase in the bond spread. The variation of the country's current economic perception index (*D.IEP*) presents a positive relationship and is

[8] For more information on the Chilean legal process, visit https://www.bcn.cl/formacioncivica/detalle_guia?h=10221.3/45763.

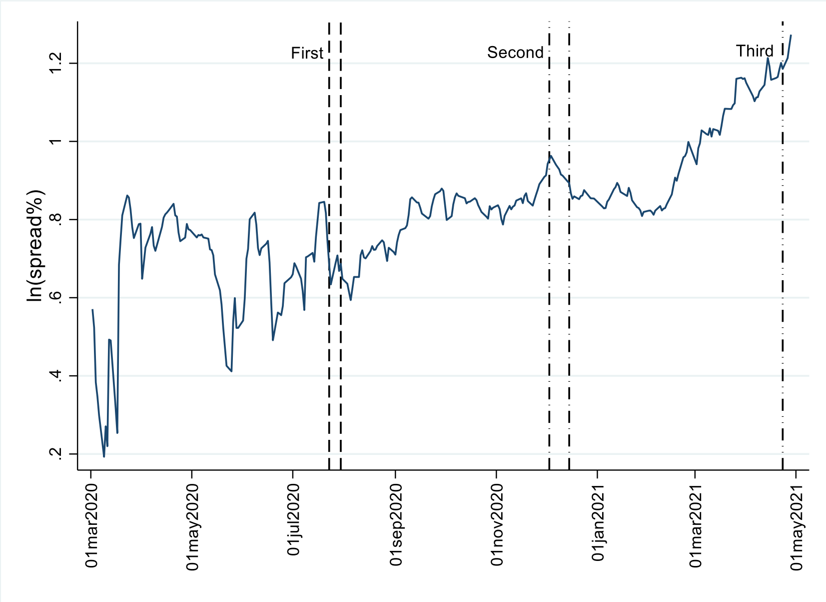

Fig. 1. Logarithm's behavior of the difference between the 10-year nominal bonds of the Central Bank and the annualized interbank rate.
Source: Own elaboration.

Table 3
Summary variables, descriptive statistics.

Variables	N	Min	Max	SD	p25	Median	p75
Ln (spread)	290	0.193	1.273	0.179	0.722	0.823	0.873
VIX	285	16.25	82.690	11.222	22.28	25.84	31.46
TEDRATE	279	0.1	1.420	0.3	0.13	0.15	0.18
Rate10yus	291	0.508	1.742	0.337	0.672	0.803	1.084
ISLTS	291	0.124	0.365	0.052	0.2	0.247	0.271
IEU	291	185.88	428.274	54.498	271.23	318.956	344.821
IEP	291	20.324	31.974	3.698	22.208	26.676	29.676
Liq	291	5.852	9.722	0.978	7.173	8.044	8.626
VCBA	291	−0.75	1.281	0.432	−0.037	0.059	0.41
DRLB	291	0.02	0.760	0.097	0.17	0.23	0.3
Return	291	−0.152	0.076	0.021	−0.009	0.001	0.011
Volipsa	291	0.002	0.093	0.01	0.007	0.01	0.014
Infl	291	2.313	3.836	0.426	2.624	2.793	3.161
DGRDCOV	275	0	0.500	0.066	0.002	0.005	0.014
GRindex	291	0	87.550	16.428	68.49	78.39	80.16
Sindex	291	0	87.500	15.425	76.39	79.17	81.94
Chindex	291	0	85.770	15.262	72.92	75.3	77.68
ESindex	291	0	100.000	31.892	50	100	100

Variables: natural logarithm of spread between the nominal ten-year bond rate traded in the secondary market and the annualized interbank rate on day t (Ln(spread); Cboe Volatility Index (VIX); Difference between three-month LIBOR US and T-bill interest rates (TEDRATE); 10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data (Rate10yus); Local bond rate stress index (ISLTS); Economic perception index, data interpolated from monthly to daily frequency (IEP); Economic uncertainty index (IEU); Liquidity ratio, the ratio between central bank reserves and imports, data interpolated from monthly to daily frequency (Liq); Change in assets on the central bank's balance sheet, data interpolated from monthly to daily frequency (VCBA); Difference between deposit and placement rates of the financial system for 30–89 days (DRLB); Stock index return, natural logarithm of the quotient of the IPSA price index of day t and t-1 (Return); Daily volatility of the Selective Stock Price Index, calculated with the model proposed by Parkinson (1980) (Volipsa); Annual inflation, calculated based on the value of the daily UF (Infl); Daily local death rate for confirmed cases of COVID-19 (DGRDCOV); Goverment Response Index (GRindex)); Stringency Index, information on social distancing policies (Sindex); Containment and Health Index, public awareness campaigns and contact tracing policies (Chindex).

statistically significant at 1 % in all models proposed. We can associate this unexpected relationship to the fact that the index is composed of five questions that measure the perception of the current personal economic situation, the country's current economic situation, the country's long-term future economic situation, and the household consumption expectation. Thus, we may be mixing short-, medium-, and long-term perspectives, and with these monetary aids, the perception of a better future may dominate the

Table 4
Pearson's correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) VIX	1.000																
(2) TEDRATE	0.769*	1.000															
(3) Rate10yus	−0.353*	−0.195*	1.000														
(4) ISLTS	0.501*	0.591*	−0.647*	1.000													
(5) IEU	0.115	0.307*	−0.653*	0.818*	1.000												
(6) IEP	−0.408*	−0.465*	0.349*	−0.421*	−0.478*	1.000											
(7) Liq	0.479*	0.280*	−0.819*	0.613*	0.523*	−0.624*	1.000										
(8) VCBA	−0.215*	0.114	−0.231*	0.223*	0.532*	−0.332*	0.117*	1.000									
(9) DRLB	−0.056	−0.028	−0.144*	0.054	0.089	−0.045	0.115*	0.077	1.000								
(10) Return	−0.191*	0.044	0.024	0.109	0.109	−0.007	−0.012	0.038	0.051	1.000							
(11) Volipsa	0.762*	0.575*	−0.152*	0.337*	0.028	−0.282*	0.292*	−0.232*	−0.078	−0.268*	1.000						
(12) Infl	0.629*	0.744*	−0.126*	0.545*	0.307*	−0.646*	0.441*	0.225*	−0.077	0.016	0.483*	1.000					
(13) DGRDCOV	0.665*	0.718*	−0.221*	0.509*	0.331*	−0.471*	0.363*	0.028	0.079	0.320*	0.566*	0.579*	1.000				
(14) GRindex	−0.712*	−0.474*	0.249*	−0.155*	0.102	0.305*	−0.414*	0.238*	0.147*	0.126*	−0.514*	−0.568*	−0.648*	1.000			
(15) Sindex	−0.530*	−0.304*	0.021	0.068	0.297*	0.087	−0.168*	0.301*	0.190*	0.132*	−0.356*	−0.438*	−0.365*	0.943*	1.000		
(16) Chindex	−0.648*	−0.382*	0.198*	−0.057	0.198*	0.165*	−0.323*	0.311*	0.161*	0.132*	−0.453*	−0.449*	−0.559*	0.985*	0.972*	1.000	
(17) ESindex	−0.769*	−0.682*	0.364*	−0.448*	−0.244*	0.706*	−0.625*	−0.059	0.066	0.075	−0.600*	−0.839*	−0.650*	0.820*	0.630*	0.710*	1.000

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Variables: Cboe Volatility Index (VIX); Difference between three-month LIBOR US and T-bill interest rates (TEDRATE); 10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data (Rate10yus); Local bond rate stress index (ISLTS); Economic perception index, data interpolated from monthly to daily frequency (IEP); Economic uncertainty index (IEU); Liquidity ratio, the ratio between central bank reserves and imports, data interpolated from monthly to daily frequency (Liq); Change in assets on the central bank's balance sheet, data interpolated from monthly to daily frequency (VCBA); Difference between deposit and placement rates of the financial system for 30–89 days (DRLB); Stock index return, natural logarithm of the quotient of the IPSA price index of day t and t-1 (Return); Daily volatility of the Selective Stock Price Index, calculated with the model proposed by Parkinson (1980) (Volipsa); Annual inflation, calculated based on the value of the daily UF (Infl); Daily local death rate for confirmed cases of COVID-19 (DGRDCOV); Goverment Response Index (GRindex)); Stringency Index, information on social distancing policies (Sindex); Containment and Health Index, public awareness campaigns and contact tracing policies (Chindex).
Source: Own elaboration

Table 5
Augmented Dicky-Fuller test to unit root, trend and lags.

Variable	pvalue Augmented Dicky-Fuller	Stationary ADF	Transformation First difference Stationary ADF
ln (spread)	0.006	Y	
VIX	0.074	N	
TEDRATE	0.102	N	Y
Rate10yus	0.083	N	Y
ISLTS	0.000	Y	
IEP	0.180	N	Y
IEU	0.110	N	Y
Liq	0.056	N	Y
VCBA	0.010	Y	
DRLB	0.000	Y	
Infl	0.859	N	Y
Return	0.000	Y	
Volipsa	0.010	Y	
DGRDCOV	0.000	Y	

Variables: Cboe Volatility Index (VIX); Difference between three-month LIBOR US and T-bill interest rates (TEDRATE); 10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data (Rate10yus); Local bond rate stress index (ISLTS); Economic perception index, data interpolated from monthly to daily frequency (IEP); Economic uncertainty index (IEU); Liquidity ratio, the ratio between central bank reserves and imports, data interpolated from monthly to daily frequency (Liq); Change in assets on the central bank's balance sheet, data interpolated from monthly to daily frequency (VCBA); Difference between deposit and placement rates of the financial system for 30–89 days (DRLB); Stock index return, natural logarithm of the quotient of the IPSA price index of day t and t-1 (Return); Daily volatility of the Selective Stock Price Index, calculated with the model proposed by Parkinson (1980) (Volipsa); Annual inflation, calculated based on the value of the daily UF (Infl); Daily local death rate for confirmed cases of COVID-19 (DGRDCOV); Goverment Response Index (GRindex).
Source: Own elaboration

relationship.

According to Haas and Neely (2020) major central banks around the globe responded to the pandemic with the same tools used for the subprime crisis. This involved cutting rates, buying assets, creating lending programs, and modifying financial regulations. Therefore, the emerging economy evaluated in this study is no different from this trend. Our analysis incorporates the change in the central bank's (CB's) asset holdings and their four lags. Lags 2, 3, and 4 exhibit statistical significance at the 10 %, 1 %, and 10 % levels, respectively. The relationship with the spread rate changes with the inclusion of lags, demonstrating a negative, positive, and negative association, respectively. We interpret these findings as follows. When the CB engages in asset purchases, it creates buying pressure on those instruments, leading to an increase in their returns (negative association with the spread). However, as these measures are continued, the market may anticipate their persistence and the initial buying pressure subsides (positive association). Ultimately, if the measures are exhausted or the CB slows its buying pace, the spread rate of government bonds in the long term tends to decrease (negative association).

In contrast to the findings of Andries et al. (2021) and Zaremba et al. (2021), the daily death rate in Chile due to COVID-19 (DGRDCOV) does not exert a statistically significant influence on this relationship.

5. Conclusions

Chile has undertaken substantial pension withdrawals during the pandemic compared to other nations (Madeira, 2024). The country allows for withdrawals amounting to over US$50 billion, representing approximately 20 % of the Chilean GDP. The implications of these withdrawal policies will extend beyond future pension obligations (Fuentes et al., 2023) to encompass effects on its capital market. We analyzed the impact on the spread between the nominal government bond 10-year rate and the interbank rate due to withdrawal regulatory shocks. For this, we identified a quasi-natural experiment in an emerging economy where legislative initiatives were generated by Congress that allowed money withdrawals from the pension funds. These legislative processes were fast, involved high media exposure, public attention, and saw differences between the legislative and executive branches.

Using the Autoregressive Distributed Lag Stationarity model and event study methodology we find evidence just the first withdrawal has a negative impact over the spread rate and amplify the impact of agent economic perceptions in the short term. Furthermore, these findings partially support the hypothesis that regulatory shocks, which permit individuals to utilize their pension funds, contribute to a decrease in the spread between the ten-year bond rate and the interbank rate.

Additionally, we found a relationship between the Central Bank balance sheet assets variation and the spread rate. We found the spread rate is changed interleaved, experimenting an increase short-term effect -consistent with De Santis and Holm-Hadulla (2020)- and a net long-term effect decreased it (Afonso & Jalles, 2019; Sudo & Tanaka, 2020; Urbschat & Watzka, 2020). The variables associated with the pandemic, such as the daily death rate do not evidence impact the bond spread as expected, at least in short-term.

Future research in this domain could delve into the implications of yield fluctuations on bonds concerning the performance of pension funds and their subsequent effects on future pension benefits. The Chilean congress continues to deliberate on strategies to enhance the well-being of retirees in the coming years.

Table 6
Short run effects and bond spread.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES		Ln (Spread)				
LD.Spreadln	0.357***	0.361***	0.353***	0.373***	0.336***	0.354***
	(0.075)	(0.074)	(0.075)	(0.076)	(0.075)	(0.076)
L2D.spreadln	−0.136**	−0.133*	−0.136**	−0.123*	−0.136**	−0.123*
	(0.068)	(0.068)	(0.068)	(0.069)	(0.067)	(0.068)
W	−0.006	−0.014	−0.011			
	(0.007)	(0.009)	(0.008)			
w1			−0.005	−0.018*	−0.048**	−0.018*
			(0.012)	(0.010)	(0.020)	(0.010)
w2			−0.012	−0.013	0.001	−0.013
			(0.011)	(0.011)	(0.020)	(0.011)
w3			0.002	0.006	0.001	0.006
			(0.015)	(0.012)	(0.022)	(0.012)
W*IPE			0.056			
			(0.036)			
w1*IPE				0.188*		0.183*
				(0.102)		(0.101)
w2*IPE				0.608		0.667
				(0.809)		(0.803)
w3*IPE				0.038		0.020
				(0.063)		(0.058)
D.Rate10yus	0.201***	0.203***	0.207***	0.209***	0.208***	0.198***
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
LD. Rate10yus	0.057	0.058	0.058	0.061	0.063	0.057
	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)	(0.051)
L2D.Rate10yus	−0.093*	−0.093*	−0.089*	−0.089*	−0.087*	−0.090*
	(0.051)	(0.052)	(0.051)	(0.052)	(0.051)	(0.051)
L2D.TEDRATE	0.151*	0.152*	0.155*	0.154*	0.155*	0.166*
	(0.085)	(0.086)	(0.085)	(0.086)	(0.085)	(0.086)
D.IEP	0.043***	0.044***	0.045***	0.046***	0.037**	0.031**
	(0.015)	(0.015)	(0.015)	(0.016)	(0.014)	(0.015)
L2D. VCBA	−0.096*	−0.096*	−0.095*	−0.095*	−0.094*	−0.096*
	(0.055)	(0.056)	(0.055)	(0.056)	(0.055)	(0.055)
L3D. VCBA	0.154***	0.154***	0.150**	0.150**	0.147**	0.148**
	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)
L4D. VCBA	−0.116*	−0.116*	−0.115*	−0.113*	−0.114*	−0.108*
	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)
D.Liq					−0.085*	−0.080*
					(0.046)	(0.048)
Constant	−0.004	−0.004	−0.004	−0.003	−0.003	−0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Other controls	YES	YES	YES	YES	YES	YES
Observations	213	213	213	213	213	213
R-squared	0.336	0.345	0.338	0.354	0.35	0.36
R-squared Adj.	0.24	0.25	0.24	0.24	0.25	0.24
VIF mean	1.55	1.59	1.54	2.1	1.54	2.1
DW (Ho: no serial correlation) d-statistic	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected
	1.93	1.95	1.94	1.95	1.95	1.97
Breusch–Godfrey LM test for autocorrelation Prob > Chi2	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected
White (Ho: Homoskedasticity)	0.45	0.3	0.37	0.3	0.23	0.2
Prob > Chi2	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected	No Rejected
	0.47	0.47	0.47	0.47	0.47	0.47

Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Variables: dummy regulatory shock (W); dummies regulatory shocks separated (w1, w2, and w3); dummy change in long-term credit rating by the rating agencies (dum_rating); Economic perception index, data interpolated from monthly to daily frequency (IEP); interaction between dummy regulatory shock (W) and Index economic perception (W*IEP); interaction between dummy regulatory shock separated (w1, w2, and w3) and Index economic perception (w1*IEP, w2*IEP, w3*IEP); Difference between three-month LIBOR US and T-bill interest rates (TEDRATE) and its lags in differences; 10-year U.S. Treasury bond returns, monthly data interpolated to daily frequency data (Rate10yus)) and its lags in differences; Change in assets on the central bank's balance sheet, data interpolated from monthly to daily frequency (VCBA) its lags in differences.
Other controls: Cboe Volatility Index (VIX) with its lags in differences; Liquidity ratio, the ratio between central bank reserves and imports, data interpolated from monthly to daily frequency (Liq); Daily volatility of the Selective Stock Price Index, calculated with the model proposed by Parkinson (1980) (Volipsa); Daily local death rate for confirmed cases of COVID-19 (DGRDCOV); Annual inflation, calculated based on the value of the daily UF (Infl).

CRediT authorship contribution statement

Jaime Bastías: Data, Methodology, Software, Writing – review & editing. **José L. Ruiz:** Methodology, Conceptualization, Validation, Writing – review & editing.

Data availability

Data will be made available on request.

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