

Energy, Environment and Economics Beyond the Flames: The Direct Physical Impacts of Wildfires on Firms in Chile and the Role of Ecosystem Service Dependencies

Albagli, Araya, Córdova, Gonzales, García-Trujillo,
Pérez & Toledo

Research Department
Central Bank of Chile

September 2026



LA CONFIANZA
ES CENTRAL



Disclaimer



The views expressed are those of the authors and do not necessarily represent the views of the Central Bank of Chile or its board members. This study was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service, Agustinas 1180. Santiago de Chile.



Aug 3, 2026: Monday again already?

43 thousand hectares were affected with different degrees of soil degradation (126 Central Parks)



THE WALL STREET JOURNAL.

DOW JONES | *News Corp.* ***** MONDAY, AUGUST 3, 2026 - VOL. CCLXXXVIII NO. 28 [WSJ.com](https://www.wsj.com) U.S. Edition

Last week: DJIA 52485.03 ▲ 537.78 1.04% NASDAQ 25373.85 ▲ 1.6% STOXX 600 649.19 ▲ 0.7% 10-YR. TREASURY ▼ 16/32, yield 4.743% OIL \$84.67 ▼ \$4.64 EURO \$1.1529 YEN 157.38

What's News

Business & Finance

- ◆ **Sony Pictures'** "Spider-Man: Brand New Day" opened to an estimated \$927 million in global box-office sales, making it the second-biggest film debut ever. [A1](#)
- ◆ **Math majors** and Ph.D.s are securing million-dollar pay deals from elite trading firms seeking to recruit the best and brightest amid fierce competition from AI companies. [A1](#)
- ◆ **Major American oil companies** have made little headway in tapping Venezuela's oil fields seven months after the U.S. deposed strongman Nicolás Maduro. [B1](#)
- ◆ **The first formal negotiations** intended to steer Venezuela toward democracy kicked off without the political opposition's most influential leader. [A2](#)
- ◆ **OPEC and its allies** pressed ahead with another increase in oil production, aiming to complete the group's return of voluntarily withheld bar-

Greece Fights Wildfires as Europe Crisis Spreads



DIRE BATTLE: Volunteers on Sunday worked to douse a wildfire near Porto Germeno, about 40 miles northwest of Athens. Two Greek firefighting helicopters collided on Sunday while battling a wind-driven fire, killing two crew members. [A9](#)

Gulf Allies Sway U.S. In Pivot To Talks With Iran

Trump calls off escalation of strikes after mediators offer new Hormuz plan

President Trump held off on a new attack on Iran as mediators made fresh progress on a plan to open the strategic Strait of Hormuz and some Persian Gulf states pressed the president to pursue dialogue with Tehran, people familiar with the matter said.

By Michael R. Gordon,
Alexander Ward
and Philip Wegmann

Trump's abrupt announcement on social media, posted early Sunday in the Middle East, that he had called off the

Figure: Burned area estimated from Landsat imagery

Chile 2024: 9,000+ hectares burned (about 27 Central Parks)

43 thousand hectares were affected with different degrees of soil degradation (126 Central Parks)

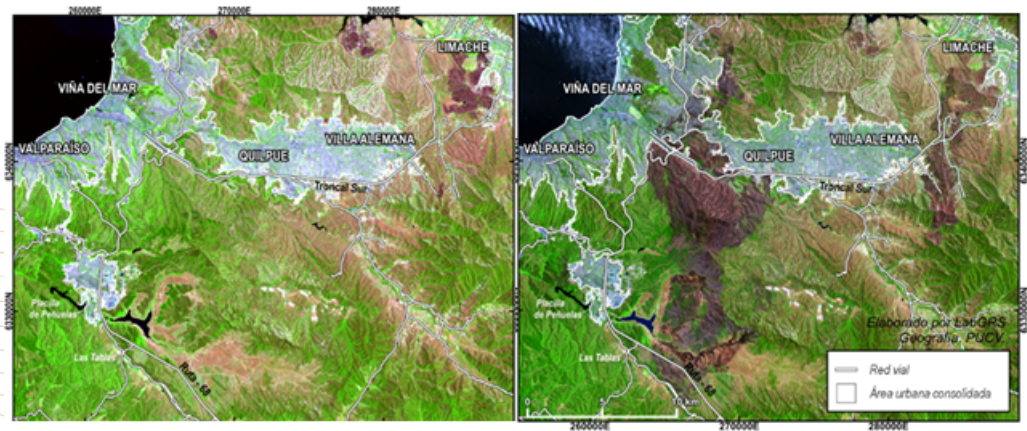


Figure: Burned area estimated from Landsat imagery

Chile faces growing exposure to physical climate risks



This threatens households, firms, and public infrastructure

- **Acute hazards:** heat waves, wildfires
- **Chronic hazards:** long-term water scarcity, rising temperatures
- These hazards affect firms:
 - ▷ Directly: damaging assets and disrupting production
 - ▷ Indirectly: supply-chain disruptions, labor market impacts, financial stress

2024 Summer Heat Waves

Chile suffered a strong heat wave shortly before the major wildfires of early February in the Valparaíso Region, which contributed to ignition and rapid-propagation conditions.



International wildfire risk has entered a new order of magnitude



This is a global, structural trend — not an isolated Chilean episode

- The January 2025 Palisades and Eaton fires in Los Angeles produced combined insured losses of about US\$40 billion, the costliest wildfire event on record.
- Swiss Re Institute (sigma, March 2026): global insured natural-catastrophe losses reached US\$107 billion in 2025; wildfire is the fastest-growing peril, with insured losses rising roughly 12% per year — faster than exposure growth alone would predict.
- UNDRR's 2025 Global Assessment Report: wildfires caused an estimated US\$106 billion in economic losses and US\$74 billion in insured losses globally between 2014–2023, *before* accounting for the 2025 California fires.
- Implication: firm- and financial-sector-level evidence on wildfire transmission channels, like the one this paper provides for Chile, is directly relevant to a fast-growing global risk category.

Sources: Swiss Re Institute, *Natural catastrophes in 2025* (Mar 2026); UNDRR, *The invisible costs of wildfire disasters in 2025*.



Chile was undergoing a prolonged mega-drought that had started in 2010

- Briones and solorza (2026) Wildfires and floods leave long-lasting economic scars in Chile, as financial constraints hinder reconstruction and delay recovery for several years after the shock.
- Luna Mallea (2026) Wildfire impacts propagate through supply chains, with indirect losses often exceeding direct damages to exposed firms. Trade credit acts as a climate resilience mechanism by providing liquidity that helps firms absorb and recover from disruptions
- Banerjee et al. (2025) find that Chile can advance toward carbon neutrality through FOLU policies that protect forests and reduce wildfire losses, while simultaneously increasing GDP, creating jobs, improving water security, and strengthening resilience to climate risks. sequestration and avoiding emissions from forest loss.
- Gonzales et al. (2024) show that climate-driven stressors such as rising temperatures and drought intensify wildfire severity, and quantify losses to plantations, native forests, and carbon-sequestration capacity (US\$1,046 million in plantation losses; over US\$21 billion in CO₂-related damages).



Contribution: from burnt hectares to biodiversity-adjusted economic risk



The paper's central value-added relative to the existing literature

- Prior work on Chilean wildfires (e.g., Gonzales et al., 2024) values losses to natural capital itself — plantations, forests, carbon stocks — but stops at the ecological accounting stage.
- **This paper's contribution:** it links firm-level financial and real outcomes to sector-specific ecosystem-service *dependency* scores (ENCORE), moving the unit of analysis from “hectares burned” to “which firms are more exposed, and why.”
- It is, to our knowledge, **the first systematic use of an ecosystem-service dependency lens** — rather than a purely geographic fire-exposure lens — to explain *heterogeneity* in firm-level wildfire impacts in Chile.
- **Ecological vulnerability**, not just physical proximity to fire, predicts economic severity: sectors with an ENCORE damage index above 0.1 experienced roughly a 15% sales decline, versus about 10% for the full treated sample.
- **The methodology** — combining administrative microdata, geospatial fire perimeters, and ENCORE dependency scores — is replicable by other central banks, and directly speaks to the jurisdiction-level limitations of ENCORE flagged by the FSB (2024).

Spatial variation in exposure to the wildfires

- Difference-in-differences (DiD) design covering 2022–2025.
- Treated firms: active 2023 geocoded addresses falling within the burnt perimeter.
- Control firms: same municipalities, outside the fire-affected area, to preserve similar institutional and demand conditions.

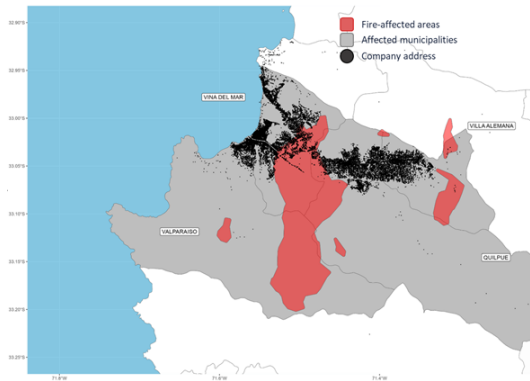


Figure: Burned area estimated from Landsat imagery

- **Geolocation:** SII Historical Address Register (active in 2023), latitude/longitude per address.
- **Urban fire perimeter:** NASA EIS FEDS (VIIRS 375m), snapshot February 6, 2024.
- **Economic outcomes:** SII Form 29 monthly VAT sales (2022–2025); employment from administrative records.
- **Financial outcomes:** CMF Sistema de Deudores (2022–2025): monthly bank debt, arrears, creditor composition.
- **Sectors/financing:** CBCh CAE/ISIC directory to harmonize sectoral codes.
- **Nature-related risk characterization:** ENCORE database, mapping sector-level dependencies on ecosystem services and impacts on biodiversity, aligned to ISIC codes.

ENCORE: what it is and why it fits this study



Definition

- Exploring **N**atural **C**apital **O**pportunities, **R**isks and **E**xposure.
- Developed by UNEP-WCMC, Global Canopy, and the Global Canopy Programme (GCP); maintained as an open-access nature-risk tool.
- Links natural-capital accounting to economic and financial risk models — the same bridge the NGFS (2023, 2026) asks central banks to build.

Two building blocks

- *Dependencies*: how much a GICS sub-sector relies on each of 21 ecosystem services (water flow regulation, soil erosion control, hazard protection, etc.)
- *Impacts*: how a sub-sector's activity presses on 8 natural assets (biomass, soil, water, species)



Real and Financial consequences: specification



$$Y_{i,t} = \alpha_i + \tau_t + \sum_{h=-m}^n \beta (\text{Treat}_i \times \text{Post}_{t-h}) + \psi' X_{i,t} + \epsilon_{i,t}$$

where $Y_{i,t}$ denotes economic or financial outcomes for firm i at month t ; α_i are firm fixed effects, τ_t month-year fixed effects, and $X_{i,t}$ control variables. Standard errors are clustered at the firm level. An event-study design replaces Post_t with monthly leads and lags to examine dynamic adjustment and pre-trend validity.



Matched control sample: strengthening the design



- Starting from the full panel of 67,503 firms, we retain control firms most similar to treated firms on:
 - ① Average monthly sales in the pre-event period (Jan 2023–Jan 2024)
 - ② Economic sector (CAE-170 classification)
- **“Triplets”**: for each treated firm, we select two control firms in the same CAE-170 sector with the smallest absolute distance in pre-event sales.

Why this matters

These variables capture both firm-size-related financial capacity and sector-specific operating conditions, crucial for credible comparisons.



Results for monthly sales: heterogeneity in ecological vulnerability and scale



Economic Activity	ENCORE index	Treated firms	Av. monthly sales (US\$M)
Commerce, Restaurants, Hotels	0.12	273	6.04
Manufacturing	0.18	99	4.36
Financial Services	—	53	2.47
Transport	0.12	100	2.43
Personal Services	0.12	79	0.31
Business Services	0.02	119	0.27
Construction	0.34	87	0.10
Real Estate & Housing Services	0.09	30	0.05

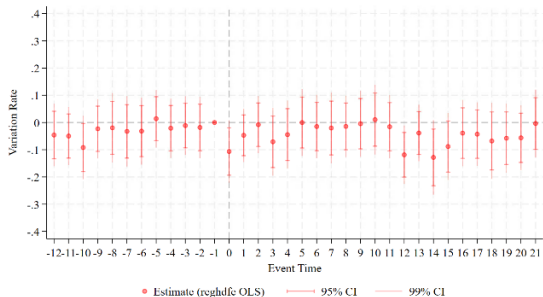
Agriculture has the highest ecosystem-dependency score (0.78) despite comparatively small sales, while Commerce and Manufacturing dominate economic scale with low ENCORE scores — underscoring that dependency and size are largely independent dimensions of risk.



Ecosystem-dependent sectors suffered significantly larger revenue declines

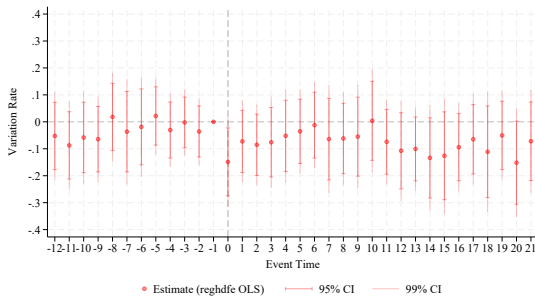


Post-fire sales declined by approximately 10% in the full treated sample and by around 15% among firms with an ENCORE damage index above 0.1, providing the paper's main quantitative evidence that greater dependence on biodiversity and ecosystem services amplifies economic losses beyond direct physical exposure.



Num. firms: 2290 | Treated: 856 | Control: 1432

(a) Event-Study Regression Coefficients

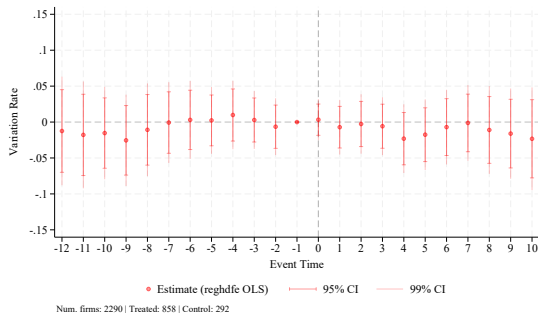


Num. firms: 1692 | Treated: 392 | Control: 670

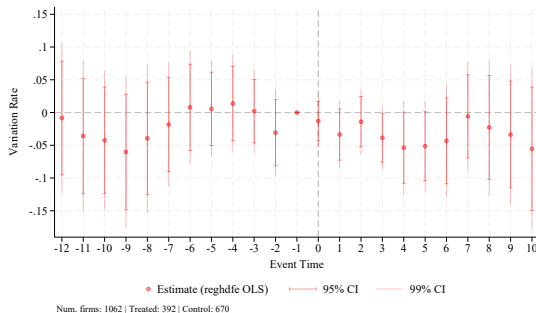
(b) Event-Study Regression Coefficients – ENCORE index > 0.1

Employment adjustments materialize after fixed contractual costs are absorbed

Employment declines lag behind sales, consistent with labor adjustment costs, and are more persistent among firms with high ENCORE dependency.



(a) Event-Study Regression Coefficients



(b) Event-Study Regression Coefficients – ENCORE index > 0.1

Why this matters now: an international policy window



- NGFS's April 2026 "Nature Package" and the forthcoming Compendium of Nature-related Implementation Practices (October 2026) shift the focus from concepts to implementation. This paper answers that call through a practical country-level application of nature-related risk assessment.
- With wildfire insured losses growing about 12% a year globally (Swiss Re, 2026) and Chile experiencing a second major wildfire event within two years, firm-level, ecosystem-service-adjusted risk assessment is becoming operationally relevant, not just academically interesting.
- A natural next step is to test whether the sales and financial patterns identified for the 2024 Valparaíso fires replicate in the ongoing 2026 Ñuble–Biobío event, once administrative data become available.





Conclusions



There is value in integrating administrative, geospatial, and biodiversity-risk data



ENCORE provides a richer and more granular understanding of disaster impacts

- Jointly analyzing economic and financial effects reveals the multi-dimensional nature of post-disaster firm impacts: sales shocks materialize immediately, employment responses follow with delay, and financial pressures evolve over time.
- Considering these dimensions together, alongside sector-level ecosystem-service dependency, allows for a more comprehensive understanding of firm resilience and the channels through which shocks propagate.
- The recurrence of large-scale wildfires in Chile (2024, 2026) and the acceleration of global wildfire losses reinforce the policy relevance of this line of research.





Thank you!



Energy, Environment and Economics Beyond the Flames: The Direct Physical Impacts of Wildfires on Firms in Chile and the Role of Ecosystem Service Dependencies

Albagli, Araya, Córdova, Gonzales, García-Trujillo,
Pérez & Toledo

Research Department
Central Bank of Chile

September 2026



LA CONFIANZA
ES CENTRAL



References I



- Briones, L., Solorza, M. (2025). Natural disasters and slow recoveries: New evidence from Chile (Working Paper No. 1062). Central Bank of Chile.
<https://www.bcentral.cl/documents/33528/133326/Documento+de+Trabajo+1062.pdf>
- Banerjee, O., Cicowiez, M., García-Trujillo, G., Bagstad, K. J., Dudek, S., Johnson, J. A., Albagli, E., Gonzalez, M., Yung, M. A. (2025). Land use strategies for achieving Chile's nationally determined contributions. *Environmental Research: Ecology*, 4(3), 035002. <https://doi.org/10.1088/2752-664X/adf22>
- CR2 (2015). *Report to the Nation: The 2010–2015 Mega Drought: A Lesson for the Future*. Center for Climate and Resilience Research.
- Gonzales, L., Lara, I., and Vial, J. (2024). Forest fires in Chile: Evaluation of the economic and environmental impact on natural capital. *International Journal of Biological and Natural Sciences*, 4(1).
- Luna Mallea, R. F. (2026). Essays on the economic effects of climate change risks (Doctoral dissertation, Rutgers University-School of Graduate Studies).
- NGFS (2023). *Nature-related Financial Risks: A Conceptual Framework to Guide Action by Central Banks and Supervisors*. Network for Greening the Financial System.



References II



- NGFS (2026). *Nature Package: Note on the Supervision of Nature-related Financial Risks*. Network for Greening the Financial System.
- SENAPRED (2024). *Incendios forestales: Viña del Mar – Quilpué – Valparaíso*. Servicio Nacional de Prevención y Respuesta ante Desastres.
- SENAPRED / CONAF (2026). *Incendios forestales en Ñuble, Biobío y La Araucanía: reportes de situación*. UN Chile Situation Reports 1–3.
- Financial Stability Board (2024). *The Availability of Data with Which to Monitor and Assess Nature-related Financial Risks*.
- Swiss Re Institute (2026). *Natural Catastrophes in 2025: The Persistent Rise of Wildfire and Storm Risk*. sigma report.
- UNDRR (2025). *The Invisible Costs of Wildfire Disasters in 2025*. United Nations Office for Disaster Risk Reduction, Global Assessment Report on Disaster Risk Reduction.

