

Energy Shocks, Employment Response, and Heterogeneous Credit Access

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Abstract

We study how firms adjust to an energy shock, and how access to credit affects their employment response. We use a natural experiment that generated spatially heterogeneous electricity-price spikes across Mexican municipalities; we link this to credit-registry data, employer-employee data, and balance-sheet data, and we complement this with an original survey on firms' responses to energy shocks. We establish three findings: (i) a one-standard-deviation increase in electricity prices raises employment at larger firms by 4.6 percent; (ii) this response is 40 percent weaker for firms with prior credit access, which instead draw on credit lines; and (iii) exposed firms shrink their asset base. Our survey evidence shows that firms shift production to off-peak hours and replace energy-intensive machinery. The aggregate employment response is reallocation: workers displaced from small, informal firms that exit are absorbed by larger survivors. We build a dynamic structural model of firms' labor and energy choices with a working-capital constraint and a job ladder across firms to quantify the role of credit access and compare policy instruments. A credit guarantee raises welfare far more than an energy subsidy of the same fiscal cost.

Keywords: Energy shocks; Labor Market; Credit access; Financial frictions.

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1 Introduction

How does a firm adjust its employment when energy becomes more expensive, and does access to credit amplify that adjustment? Evidence on the first question is mixed (Känzig, 2021; Allcott et al., 2016; Davis and Haltiwanger, 2001), and the second has not been studied in the context of energy shocks. As energy shocks have become more frequent and severe they became a first-order concern for governments. The European energy crisis, repeated threats to oil and gas shipments through the Strait of Hormuz, and extreme-weather events that knock out generation have each sent energy prices sharply higher in recent years, as geopolitical conflict and a changing climate destabilize global energy supply. Governments worldwide have committed approximately \$900 billion to emergency energy price support (International Energy Agency, 2023).

These questions are difficult to answer empirically. Energy price shocks typically coincide with inflation and recession, so their effect on employment cannot readily be separated from the macroeconomic conditions that accompany them. The second question raises a further difficulty: it requires observing, for the same firms, the price shock they faced, their employment, and their access to credit.

In this paper we overcome both difficulties by studying an energy shock that varied across municipalities within a single country at a single point in time, so that aggregate conditions are absorbed and the remaining variation is in energy costs alone, in a rich administrative setting that links credit-registry, employer-employee, and balance-sheet data, which we complement with primary data on firms' responses to energy shocks collected through a survey.

This paper finds that following an energy shock employment rises at large firms: a one-standard-deviation increase in electricity prices raises employment by 4.6 percent; hence labor and energy act as substitutes. Credit access significantly dampens this response: firms with access to credit before the shock draw on their credit lines and expand employment roughly 40 percent less than firms without it. Adjustment runs on two margins. We document for the first time that a firm's

access to credit is a first-order and previously overlooked determinant of its real adjustment to an energy shock, and of its employment in particular, and we trace how it propagates through the labor market. At the intensive margin, firms shift production to off-peak hours and replace energy-intensive machinery. At the extensive margin, the adjustment is reallocative rather than net job creation: firm exit rises by about 2.2 percent in more exposed municipalities and is concentrated among smaller, informal firms, whose displaced workers are largely absorbed by surviving large firms. We show that a modest or null aggregate employment response to an energy shock conceals large gross reallocation, so an energy shock changes which firms employ workers far more than it changes how many are employed. The shock also affects firms' balance sheets: over the following years, exposed firms carry persistently higher leverage and contract their total assets, fixed assets, and cash.

We answer the questions with three pieces of evidence: a natural experiment that raised energy prices sharply and unevenly across Mexican municipalities; an original survey of firms' adaptation to energy shocks that we designed and the Central Bank of Mexico fielded; and a dynamic structural model of firms' labor and energy choices under a working-capital constraint.

Our natural experiment is Texas Winter Storm Uri, which in February 2021 caused a sudden collapse in cross-border natural gas flows from the United States to Mexico and a spike in wholesale electricity prices in Mexico. The freeze incapacitated much of Texas gas production (Federal Energy Regulatory Commission, 2021), and with roughly three-quarters of Mexican electricity generated from gas, oil, or coal (International Energy Agency, 2025), and most of that gas imported from the United States, the disruption passed almost directly into wholesale prices. Mexican municipalities differ in their reliance on gas-fired generation, so the spike varied sharply across space, producing a continuous, plausibly exogenous treatment: it was set off by a meteorological event abroad, and its spatial pattern reflects the inherited structure of the electricity grid rather than local economic conditions. We construct municipality-level price exposure from hourly nodal prices reported by the national electricity market operator, CENACE, and link it to firm-level data

matched across the monthly credit registry, formal employer-employee records, and yearly balance sheets. We estimate the response with a difference-in-differences design with a continuous treatment (Callaway et al., 2024), which compares firms in more and less exposed municipalities before and after the shock. Our sample is large, formal firms¹, which typically buy electricity on the wholesale market or under wholesale-indexed tariffs (Cámara de Diputados del H. Congreso de la Unión, 2014), so the nodal price changes we measure pass through to their energy costs.

We complement the administrative data with a purpose-built survey on firms’ adaptation to energy shocks. We designed the survey, and the Central Bank of Mexico fielded it on roughly 1,700 firms representative of our matched employer-employee and credit-registry sample. The survey lets us observe adjustment margins that administrative data cannot reveal. In the survey, among those firms that adopted no mitigating measure, 54 percent cite financial constraints as the reason. This is consistent with financial constraints being a recognized barrier to energy-efficiency investment (Gerarden et al., 2017; Allcott and Greenstone, 2012). The survey points to adjustment on the intensive margin, through changes to production.² Firms want to shift production to off-peak hours, when electricity is cheaper (Blonz, 2022; Schwarz et al., 2002), consistent with the reduced-form finding that the employment expansion is concentrated in lower-paid, less experienced workers and is strongest in energy-intensive sectors. They also want to replace energy-intensive machinery (Linn, 2008; Popp, 2002), in line with the contraction we observe in their fixed-asset base.

We develop and estimate a dynamic structural model of small and large firms, each with and

¹Formal firms are those registered with the tax and social-security authorities, as distinct from informal firms. We define a “large” firm as one employing at least 100 workers, the threshold that delimits our estimation sample. This cutoff corresponds to the official firm-size classification of INEGI, Mexico’s national statistics institute (Instituto Nacional de Estadística y Geografía), under which establishments qualify as large in commerce and services, and fall in the medium-to-large range in industry and manufacturing.

²These are firms’ intended responses to a hypothetical price increase fielded in 2026, not realized responses to the 2021 shock, so they establish the plausibility of the mechanisms rather than validating them causally. Eliciting intended responses to a hypothetical scenario is standard practice in firm surveys (Coibion et al., 2018), and is the appropriate design here: asking managers to recall how their firm adjusted to a shock five years earlier would introduce substantial recall error, which grows with the length of the recall period and is severe for the kind of operational detail we ask about (Bound et al., 2001).

without credit access, to quantify the role of credit access and assess which government policy best supports firms through an energy shock. To our knowledge, it is the first model to combine the elasticity of substitution between labor and energy with a credit friction to explain firms' employment response to an energy shock. In large firms, labor substitutes for powered capital, the combination of capital and energy use: when energy becomes more expensive, firms run their machines for fewer hours and reorganize production across shifts, and workers take over tasks the machines performed (Oberfield and Raval, 2021; Shapiro, 1996), consistent with our survey's results. In small firms, labor and energy are complements, in line with our reduced-form results. Firms face a working-capital constraint linking current expenditures to available liquidity (Midrigan and Xu, 2014; Strebulaev and Whited, 2012): a firm without credit access pays the energy bill out of its cash, and we measure the share of cash-poor firms from firms' balance sheets. Because energy use is tied to installed equipment, the bill rises with the price, the constraint binds, and constrained large firms substitute further toward labor, while small firms, for which labor and energy are complements, shed workers. Workers move between firms on a job ladder, and firms pay convex costs to adjust labor (Bloom, 2009) and learn slowly about the persistence of the price increase. At a common fiscal cost, a credit guarantee for firms without credit access raises welfare far more than an energy subsidy, which has almost no effect, as it is not targeted.

We contribute to two strands of literature. The first studies energy shocks and their impact on the labor market, and offers mixed evidence on the impact magnitude and direction. A firm can substitute toward labor or contract its scale, and estimates of the elasticity of substitution between the two span complementarity to substitution (Bretschger and Jo, 2024; Berndt and Wood, 1975). Energy and oil price shocks have long been tied to recessions and unemployment, but the estimated employment magnitudes are debated and often modest, at the macro level (Bachmann et al., 2024; Känzig, 2021; Blanchard and Galí, 2010; Kilian, 2009, 2008) and at the firm level (Fontagné et al., 2023; Cox et al., 2014), which the literature attributes to firms adjusting on other margins (Hassler et al., 2021; Marin and Vona, 2021; Allcott et al., 2016). Firms are known to answer higher energy

prices by replacing energy-intensive equipment (Linn, 2008; Popp, 2002), and cost-saving investments of this kind often go unmade, with financial constraints among the reasons (Gerarden et al., 2017; Allcott and Greenstone, 2012). Our contribution is to show that the modest aggregate employment effect reported at the macro level masks a deep reallocation: the shock moves workers from the firms that exit toward the larger firms that absorb them (Foster et al., 2008; Melitz, 2003; Caballero and Hammour, 1994), so gross flows move far more than net employment.

The second is the literature on financial frictions, and specifically whether those frictions act as amplifiers of cost shocks in the labor market. Under the Modigliani-Miller benchmark a firm's real decisions are independent of its financial position (Modigliani and Miller, 1958), while with financial frictions the credit a firm can draw determines how much of the shock it must absorb through real adjustment (Catherine et al., 2022; Crouzet, 2018; Gopinath et al., 2017; Bernanke et al., 1999). Credit access is known to shape how shocks pass through to firms' real decisions (Chodorow-Reich et al., 2022; Ottonello and Winberry, 2020; Bahaj et al., 2020; Huber, 2018; Berton et al., 2018; Giroud and Mueller, 2017; Chodorow-Reich, 2014; Khwaja and Mian, 2008), including the relative-price and exchange-rate shocks that most resemble an energy shock (Li et al., 2025; Manova, 2013), and financial constraints amplify how firms' investment and borrowing respond to energy prices (Møller and Ketelsen, 2025; Anaya Longaric et al., 2025; Amaglobeli et al., 2024). Merging the energy-shock and financial-frictions literatures, our paper is the first to show that financial frictions govern the employment response to an energy shock, as they do for other input-cost shocks. While an energy shock is an input-cost shock, it differs from other such shocks in that the same price increase reaches firms and their customers at once, raising costs while compressing the demand into which they would be passed, and in that the spike itself creates uncertainty about where prices will settle, which leads firms to postpone investments they cannot reverse (Elder and Serletis, 2010; Kilian, 2008).

The paper proceeds as follows. Section 2 describes the Mexican energy sector and the Winter

Storm Uri shock. Section 3 presents the data. Section 4 develops the empirical strategy around the Winter Storm Uri shock and presents the main results and robustness checks. Section 5 examines the mechanisms, with survey evidence on how firms adjust production and administrative evidence on firm exit and the reallocation of employment. Section 6 presents the structural model and compares policy instruments. Section 7 concludes.

2 Setting

2.1 *The Mexican Energy Sector*

Mexico's electricity system is unusually exposed to shocks originating outside its borders. Generation depends heavily on natural gas, and Mexico imports roughly 70 percent of the gas it consumes, almost all of it piped from the United States (Joseph and Rivera Rivota, 2023), so disruptions to U.S. supply pass quickly into domestic energy costs. The system is also prone to frequent blackouts and sharp price volatility, and these vulnerabilities fall hardest on energy-intensive sectors, which adjust most to energy cost shocks (Fontagné et al., 2024; Mensah, 2024) and are also among the most productive (Dechezleprêtre et al., 2025).

The generation mix is dominated by fossil fuels (as can be seen in Figures A1 and A2 in Appendix B): roughly three-quarters of electricity is produced from natural gas, oil, or coal (International Energy Agency, 2025), with natural gas the single largest source, so wholesale electricity prices track the price of gas closely. The sector is dominated by the state-owned Federal Electricity Commission (Comisión Federal de Electricidad, CFE). Over our sample period, the 2014 Electricity Industry Law reserved transmission and distribution to the state as strategic areas (Cámara de Diputados del H. Congreso de la Unión, 2014), which the Constitution exempts from the prohibition on monopolies (Cámara de Diputados del H. Congreso de la Unión, 2013), while generation and retail supply operated under a free-competition regime in which, however, the CFE remained the country's dominant generator. Policy has entrenched this fossil dependence. Since 2018, suc-

cessive reforms have curtailed support for private renewables, halted long-term clean-energy auctions, and reinforced CFE's role in generation (Fuentes, 2025). Together with limited expansion of the grid, these measures have kept the generation mix, and hence electricity prices, tied to fossil fuels and exposed to gas-market shocks.

Since the 2013-2014 energy reform, wholesale power has been traded in the *Mercado Eléctrico Mayorista* (MEM), where prices are set separately at each node of the grid and therefore vary by location (Cámara de Diputados del H. Congreso de la Unión, 2014). Consumers whose demand exceeds one megawatt can register with the regulator as *Usuarios Calificados* (qualified users) and buy directly in the wholesale market at prices linked to these nodal marginal prices; smaller users are served by CFE under regulated basic-supply tariffs (Comisión Reguladora de Energía, 2016; Cámara de Diputados del H. Congreso de la Unión, 2014). This distinction is central to our design: because qualified users buy at wholesale-linked prices, movements in nodal prices pass through directly and immediately to their energy costs.³ Firms on regulated basic-supply tariffs are not insulated, since the generation-cost component of these tariffs is recomputed monthly against CFE's wholesale procurement cost and so tracks market conditions with a small lag (Comisión Reguladora de Energía, 2017). We therefore focus on the firms most likely to face wholesale-linked prices, or, where they remain on regulated tariffs, to be reached through this pass-through. For these firms the shock is both measurable in the data and economically meaningful.

This dependence on fossil fuels is not spatially uniform, and the resulting variation is central to our empirical strategy. Using plant-level data obtained through a Freedom of Information request to Mexico's Secretaría de Energía, we map the location, technology, and capacity of generation plants (Figure A3 in Appendix B), revealing a pronounced geographic clustering of gas-fired capacity alongside limited spatial diversification of renewables. Municipalities differ sharply in their reliance on gas-fired generation (Figure A4 in Appendix B): those closer to the pipelines that carry

³Although electricity coverage contracts exist, such hedging is rare: in our conversations with suppliers, fewer than one percent of firms held arrangements offsetting a wholesale price rise, consistent with broader (non-Mexican) evidence that only about 10 percent of nonfinancial firms hedge commodity prices (Bartram et al., 2009).

imported gas (shown in Figure A5) depend most heavily on it, while others rely on oil-fired or other non-renewable sources. This spatial heterogeneity in local energy dependence is a key input into our empirical strategy.

2.2 *The Winter Storm Uri Shock*

In February 2021, Winter Storm Uri, an Arctic outbreak, brought extreme cold to Texas and the South-Central United States. The freeze incapacitated large parts of the U.S. gas supply system (Federal Energy Regulatory Commission, 2021): severe freeze-offs sharply reduced Texas gas production, and as Texas curtailed exports to prioritize its own power generators, cross-border gas flows to Mexico collapsed (Joseph and Rivera Rivota, 2023). Many Mexican power plants shifted from natural gas to oil, and given the sector’s heavy reliance on fossil fuels, the disruption passed almost directly into a sudden, plausibly exogenous spike in wholesale electricity prices.

Figure 1 plots the monthly average wholesale electricity price across CENACE nodes; Figure 2 plots the price of the eight-month forward Henry Hub natural gas futures contract.⁴ Both series rise around Uri and do not return to pre-shock levels within the sample period, illustrating the tight linkage between Mexican electricity prices and U.S. natural gas markets. The forward gas price rises more gradually than the spot electricity price, as one would expect of a market repricing gas over the medium term. That the forward price rose too indicates that firms expected the higher energy costs to persist rather than reverse, which matters because firms adjust their real decisions far more to cost shocks they perceive as persistent; the accompanying rise in energy-price uncertainty further shapes investment and hiring (Yoon and Ratti, 2011; Elder and Serletis, 2010; Bloom, 2009).

⁴Henry Hub is a major pipeline junction near Erath, Louisiana, and the pricing point for NYMEX/CME natural gas futures. It is widely used as the benchmark price for natural gas in North America.

3 Data and Descriptive Statistics

3.1 Data

We assemble a firm-level panel that links Mexican firms’ employment, finances, and balance sheets to local energy prices, drawing on several administrative and proprietary datasets. Employment outcomes come from the employer-employee records of the *Instituto Mexicano del Seguro Social* (IMSS), which cover the formal labor market and report wages, employment, and worker mobility. Financial outcomes come from the monthly *R04C-Cartera de Crédito* registry, which records every credit product (loans, credit lines, credit cards, and other instruments) granted by banks operating in Mexico, letting us track firms’ access to external finance over time. Balance-sheet information is drawn from *Orbis*, which covers roughly 2.4 million Mexican firms and reports financial statements, ownership structure, and industry classifications.

Energy data come from the *Centro Nacional de Control de Energía* (CENACE), which reports hourly electricity prices, demand, and generation at the node level; we map each node to the municipalities it serves to build municipal measures of energy costs over time.⁵ To capture firms’ expectations and self-reported constraints, we use the *Encuesta Mensual de Opinión Empresarial sobre la Actividad Económica Regional* (EMAER), which provides qualitative and quantitative indicators of business activity and perceived obstacles to production and investment. We also draw on a dedicated survey module on energy shocks, run as a special edition of EMAER, that we designed in collaboration with the Central Bank of Mexico and matched to our administrative data, which we describe in detail in Section 5.

Because these firm-level sources cover only the formal sector, we complement them with INEGI’s *Censos Económicos* (Instituto Nacional de Estadística y Geografía, 2024), which enumerate the universe of Mexican firms, formal and informal, at the municipality level.

⁵Nodes are assigned to municipalities geographically, and where a municipality is served by more than one node its price is the average of the prices at those nodes over the relevant window. The measure used throughout is the change in the municipal price over the thirty days following the shock relative to the corresponding pre-shock window, winsorized at the top and bottom of the distribution.

3.2 Descriptive Statistics

Our sample comprises firms that differ widely in size, sector, and financial position. Employment ranges from 100 to over 55,000 workers, with a median of about 200 (Table 1; Figure 3 plots the full size distribution). Manufacturing is the single largest sector, followed by services and by wholesale and retail trade (Table 2). Firms also differ widely in their financial position: among firms with a banking relationship, the median firm owes roughly 6.5 million pesos to banks, at an interest rate of about 11 percent, and draws down close to 60 percent of its available credit lines (Table 3).⁶

To place our sample in the context of the broader economy, Table 4 and Figures 4-5 describe how firms and economic activity are distributed across Mexican municipalities, drawing on the universe of formal and informal firms recorded in INEGI’s Censos Económicos 2024. Activity is highly concentrated: the fifteen municipalities with the most firms each host tens of thousands, led by Puebla and Guadalajara and by the metropolitan municipalities of Mexico City, Monterrey, and the Bajío. Geographically, firms (Figure 4) and employment (Figure 6) are present throughout the country but thicken across the central belt and the industrial North, whereas labor compensation (Figure 7) and revenue (Figure 5) are more spatially concentrated, reflecting the clustering of higher-value activity in the largest urban and manufacturing centers (Appendix Table A1 aggregates the same distribution by state).

4 Empirical Strategy

This section outlines our empirical strategy for identifying the causal effect of a sudden and unexpected increase in energy prices on Mexican firms.

⁶These magnitudes are in line with Mexican credit-market benchmarks. The median debt is well above Banco de México’s reported average for small and medium enterprises, about 1.8 million pesos, while the median interest rate sits just below the corresponding small- and medium-enterprise average of roughly 12 percent, consistent with larger firms borrowing on more favorable terms (Banco de México, 2021). A credit-line utilization near 60 percent is typical of committed corporate credit lines.

4.1 Empirical Specification

We exploit the electricity-price spike that Winter Storm Uri set off in February 2021, described in Section 2. We first estimate the average response to the shock, then ask whether it varies with credit access and with firms' energy exposure. The baseline is a Poisson Pseudo Maximum Likelihood (PPML) estimator of the average employment or wage bill response:

$$\mathbb{E}[Y_{imt}] = \exp\left(\alpha + \beta_1(\Delta P_m \times \text{Post}_t) + \mu_i + \delta_{s \times t} + \delta_{r \times t}\right) \quad (1)$$

To test whether this response depends on credit access, we interact the shock with the firm's pre-shock credit access and replace the state-by-year-month effects with municipality-by-year-month effects ($\delta_{m \times t}$):

$$\mathbb{E}[Y_{imt}] = \exp\left(\alpha + \beta_2(\text{Post}_t \times \text{Credit}_i) + \beta_3(\Delta P_m \times \text{Post}_t \times \text{Credit}_i) + \mu_i + \delta_{s \times t} + \delta_{m \times t}\right) \quad (2)$$

Finally, to test whether the response also scales with firms' energy exposure, we add to equation (2) the triple interaction of the price shock with the pre-shock energy intensity of a firm's sector, so that the three interactions are estimated in a single saturated regression:

$$\begin{aligned} \mathbb{E}[Y_{imt}] = \exp\left(\alpha + \beta_2(\text{Post}_t \times \text{Credit}_i) + \beta_3(\Delta P_m \times \text{Post}_t \times \text{Credit}_i) \right. \\ \left. + \beta_4(\Delta P_m \times \text{Post}_t \times \text{EnergyUse}_i) + \mu_i + \delta_{s \times t} + \delta_{m \times t} \right) \end{aligned} \quad (3)$$

where Y_{imt} denotes the employment or wage bill for firm i located in municipality m at time t . ΔP_m measures how strongly each municipality was exposed to the shock, that is, the size of its local electricity price increase. We construct it from CENACE nodal marginal prices at the hourly level, geo-mapping each node to a single municipality and computing, for each municipality, the demeaned percentage change in the local marginal price around the shock date over a symmetric event window, 30 days in our baseline. This exposure is fixed, a single time-invariant value per municipality, so it captures only cross-sectional differences in the intensity of the price shock. Because the firms in our sample face wholesale-linked or wholesale-indexed prices (Section 2), these nodal price changes pass through to their energy costs and provide a credible proxy for the

shock they face. Post_t is an indicator equal to one in the period following February 2021 and zero otherwise.

Credit_i is a fixed, pre-shock indicator of a firm's access to formal bank credit, built from the R04C credit registry described above. It equals one if firm i has at least one outstanding credit product on record, a loan, a credit line, or other bank credit, in each of the five months preceding the shock, and zero otherwise. Section 4.2 replaces the indicator with continuous measures of credit availability pre-shock, and Section 4.5 reports the interaction under alternative windows of three, six and nine months. We impose the relationship continuously over the five months before February 2021 so that the classification predates any anticipation of the shock; because it is pre-determined, Credit_i is time-invariant and cannot be affected by the shock itself. The triple interaction $\Delta P_m \times \text{Post}_t \times \text{Credit}_i$ therefore captures whether credit access moderates firms' response to the energy price shock. A natural concern is that credit access is correlated with firm size. However, firms with and without credit access in our sample are similar in size and wages (Appendix Table A2), and the effect of credit access does not vary with firm size: when we interact it with firm size, the difference is small and statistically insignificant (Appendix Table A3). Finally, EnergyUse_i is the pre-shock energy intensity of firm i 's sector. We do not observe energy use at the firm level, so we proxy it with energy intensity at the sector level, taken from European sector-level energy-use accounts (Eurostat, 2024), and assign each firm the energy intensity of its sector.⁷

All specifications include firm fixed effects (μ_i), which absorb time-invariant firm heterogeneity; sector-by-year-month fixed effects ($\delta_{s \times t}$), where t denotes a year-month throughout, which control for sector-specific shocks that evolve over time, including sector-specific seasonality; and state-by-year-month fixed effects ($\delta_{r \times t}$), which absorb any regional shock common to a state in a

⁷Using European sector intensities as a proxy assumes that the ranking of sectors by energy intensity is broadly comparable across countries, which reflects the common technological basis of energy use in production. This is especially plausible for the firms in our sample, which operate with far more capital and more productive, frontier-oriented technology than informal firms (La Porta and Shleifer, 2014).

given month. Exposure ΔP_m therefore identifies β_1 from differences across municipalities within the same state and month. Equations (2) and (3) replace the state-by-year-month effects with municipality-by-year-month effects ($\delta_{m \times t}$). Standard errors are clustered at the municipality level, the level at which the price shock varies (Abadie et al., 2023). The estimation sample is a balanced monthly panel of firms observed throughout the sample window.⁸

The municipality-by-year-month fixed effects in equations (2) and (3) absorb all time-varying municipality-level confounders, that is, any shock, policy, or local economic trend that varies across municipalities and coincides with the post-Uri period. Because ΔP_m is time-invariant at the municipality level, these fixed effects absorb the main price effect $\beta_1(\Delta P_m \times \text{Post}_t)$, as they do the main effect of Post_t : the credit specification does not identify β_1 but isolates the credit channel, estimating β_2 and β_3 purely from within-municipality, within-month variation across firms in credit access, free of any municipality-level confounder.⁹ We recover β_1 from the baseline in equation (1) and trace its dynamics in the event studies below. We further verify that the results are robust to replacing the municipality-by-year-month fixed effects with a coarser distance-to-border interaction, which isolates energy price transmission from border-specific trade or supply-chain disruptions (Section 4.5).

The cross-municipality variation in ΔP_m is plausibly exogenous. Figure 8 displays the municipal-level change in wholesale electricity prices 30 days after the shock. The increase is widespread but concentrated in the North, particularly the North-East and Mexico City, reflecting these regions' greater reliance on natural gas. The geography of the shock does not simply track where economic activity is located: across municipalities, the size of the price increase is only weakly correlated with the local number of firms and level of employment, in logs (correlations of about 0.12

⁸Because the shock also affects firm exit, conditioning on firms observed throughout the window selects on survival, a post-treatment outcome. In our sample this selection is unlikely to be consequential: splitting the exit response by firm size (Table 5), exposure leaves exit unchanged among medium firms and reduces it among large firms, so the balanced panel does not disproportionately drop the most exposed firms. The increase in exit is concentrated among micro firms, which lie outside our sample, and we treat the extensive margin separately.

⁹Pre-shock credit access is not randomly assigned, so we interpret β_3 as the differential response of firms with prior credit access rather than as the effect of exogenously relaxing a financial constraint.

and 0.20; Appendix Table A4), strengthening our identification. This spatial pattern is durable: Figure A6 shows the same exposure 60 and 120 days after the shock.

Three features of the price shock further support the identification strategy. First, the shock was sizable and persistent: node-level regressions with node fixed effects show that prices were approximately 55 percent higher post-Uri on average, with the short-run increase (+40 percent) growing into a +62 percent medium-run effect (Table 6). Second, the shock had substantial cross-sectional variation: grouping nodes into deciles by their post-Uri price change, the average change ranges from 36 percent (D1) to 64 percent (D10). Third, although nodes with lower pre-Uri prices experienced larger increases, daily prices evolved in parallel across shock deciles in the 60 days before Uri (Figure 9), supporting the identifying assumption.

Two caveats bear on the pass-through assumption, though we can address both. First, some large firms may hold fixed-price contracts or hedging arrangements that insulate them from spot price movements. To the extent that such contracts are uncorrelated with our treatment variable (the cross-municipal price change), this introduces classical measurement error and attenuates our estimates toward zero, making our findings conservative; and such hedging is in any case rare in our setting (Section 2). Second, we observe neither firm-level tariff status nor energy expenditures, so the size cutoff proxies for qualified-user status and we cannot estimate a first-stage regression of energy costs on wholesale prices; but because larger firms face wholesale-linked or wholesale-indexed prices (Section 2), wholesale price changes remain a credible proxy for their energy-cost shock.

We estimate this specification by PPML rather than log-linear OLS. Employment and the wage bill are strictly positive, so zeros are not a concern for these outcomes; we use PPML here mainly for consistency with the financial outcomes examined below, several of which are non-negative and contain zeros. PPML yields coefficients interpretable directly as semi-elasticities (Santos Silva and Tenreyro, 2006). Reassuringly, estimating the same specifications by log-linear OLS delivers

similar results.

4.2 *Employment Results*

Table 7 reports the effect of a one standard-deviation increase in energy prices on employment and the wage bill. Columns (1) and (3) give the average price effect (β_1) from the baseline specification: firms in more exposed municipalities expand both employment (a 4.6 percent increase) and the wage bill (3.9 percent), and this average effect is traced over time in the event-study figures (Figures 10 and 11). Columns (2) and (4) add the credit-access interaction (β_3) in the saturated specification with municipality-by-month fixed effects, which absorb β_1 . The interaction is negative for both employment (-4.5 percent) and the wage bill (-2.5 percent): access to bank credit dampens the labor-market response, especially along the employment margin. On employment the interaction nearly offsets the average effect, so the employment response is concentrated among firms without credit access. Figure 12 traces this over time, plotting the employment event study separately by credit access: the two groups track each other before the shock and diverge afterward. Credit thus shapes firms' adaptation paths and their energy-labor cross-price elasticities, with better-financed firms less inclined to substitute labor for energy and keeping their workforce closer to its pre-shock level.¹⁰

Our third specification asks whether the employment response scales with firms' energy exposure, a direct test of the labor-energy substitution channel. Estimating equation (3), the $\Delta P_m \times \text{Post}_t \times \text{EnergyUse}_i$ interaction is positive and strongly significant for both employment and the wage bill (Table 8), so the expansion is concentrated among the most energy-intensive firms, precisely those for which the shock most raises the cost of energy relative to labor. This dose-response reinforces the substitution interpretation: the response grows with a firm's energy exposure, as substitution requires, and it is harder to reconcile with confounders that would move employment regardless

¹⁰The implied magnitude is economically sensible: employment rises about 0.27 percent per 1 percent increase in the energy price (a 4.6 percent response to a one-standard-deviation, roughly 17-percentage-point, increase). It reflects substitution between labor and energy and is concentrated in the most energy-intensive sectors (Table 8), consistent with an energy-driven substitution channel.

of energy use, such as local-demand or cross-border supply-chain shocks, since those would not scale with energy intensity. The municipality-by-year-month and sector-by-year-month effects absorb both local shocks and sector-wide shocks, so what remains is the narrower possibility of a disturbance specific to one sector within one municipality. Replacing the municipality-by-year-month effects with a distance-to-border interaction, which isolates energy price transmission from cross-border supply-chain disruption, leaves the estimates unchanged (Table A29 in Appendix A). In the Appendix we report the results by sector (Tables A13 to A19) and find that the effect is primarily driven by the manufacturing sector (Table A15), which is notoriously energy intensive.

Section 4.5 confirms these patterns through further checks: the effect is unchanged when we replace the municipality-by-month fixed effects with distance from the U.S. border interacted with month, ruling out border-specific trade or supply-chain shocks, and it holds when we proxy exposure by proximity to the natural-gas transmission network rather than nodal prices.

4.2.1 Worker Composition

To better understand the labor expansion documented above, we begin with descriptive evidence on the kind of workers firms are hiring after the shock. Figures 13 and 14 show the wage and experience of newly hired workers relative to the average worker in the firm they are joining, while Figure 15 depicts post-shock worker flows across sectors. Newly hired workers are paid significantly less than incumbent employees, often earning wages close to or below the minimum wage. Quantitatively, new hires earn on average ~ 312 MXN/day, compared with an incumbent average of 432 MXN/day. This pattern suggests that firms rely on lower-paid, potentially temporary, part-time, or shift-based contracts in response to the shock. This interpretation is corroborated by our survey evidence (Section 5): modifying shifts and operating hours is among the most common operational responses to an energy price increase, consistent with firms reorganizing production across the day and staffing the resulting shifts. Finally, the sectoral flow analysis indicates that the majority of post-shock hires are absorbed into manufacturing, the sector most exposed to the

energy price increase.

To relate these patterns to the shock itself, we classify each worker joining or leaving a sample firm by origin and destination, aggregate these flows to the firm-month level, and estimate equation (2) with each flow as the dependent variable.

Table 9 shows where new hires come from and where departing workers go. A one-standard-deviation increase in the local energy price raises hiring from both sources: firms take on 5.2 percent more workers who had no job the month before, and 10.7 percent more workers who came directly from another firm. Both rise by similar amounts, so the mix of new hires is unchanged. Among workers who leave, the destination shifts: departures into no job rise by 7.0 percent, while departures straight into another firm fall by 11.2 percent. Workers who leave an exposed firm are therefore less likely to find another job immediately, which is what we would expect when nearby employers face the same energy shock. This foreshadows the extensive margin results, where the shock moves workers between firms without raising employment overall (Section 5.2).

Table 10 turns to the quality of the workers entering. Experience at entry falls by 1.7 percent, so exposed firms do hire less experienced workers. The shock has no economically meaningful effect on entry wages. Cross-sector hiring rises by 10.7 percent, the same rate as hiring overall, and the share of hires coming from a different sector is unchanged: firms take on more workers from other sectors only because they are hiring more in total.

Table 11 interacts these flows with credit access. Every flow points the same way. Firms without credit access raise hiring from both sources, by 7.0 percent out of non-employment and 14.6 percent from another firm, and although they also lose more workers to non-employment, the net effect is an increase in the workforce, in line with the employment results in Section 4.2 (Table 7). Each interaction with credit access is negative, so firms with credit access move far less on every margin and show very little movement in employment overall. Neither the entry wage relative to incumbents nor the experience of new hires differs by credit access. This supports the interpreta-

tion that firms without credit substitute toward labor while better-financed firms absorb the shock financially.

4.2.2 The Intensive Margin of Credit Access

The baseline measures credit access with an indicator, which separates firms with credit access from those without but abstracts from its intensive margin, the variation in credit available among the firms that have access. If credit availability is what moderates the response to the shock, the interaction should scale with the amount of credit available rather than with the presence of credit access alone. We test this by re-estimating equation (2) on firms with credit access, replacing $Credit_i$ with six pre-shock measures of credit availability, each measured over the five months before February 2021: the share of the credit line unused, the size of the credit line, the number of credit products, the number of lending banks, the share of debt not backed by collateral, and an indicator for delinquency. The continuous characteristics are standardized, so each coefficient reports the effect of a one-standard-deviation difference in that characteristic.

Tables 12 and 13 show that the labor response weakens as credit availability rises. A one-standard-deviation increase in local energy prices raises employment by 1.7 percent at the average firm with credit access, and that response is 1.4 percentage points smaller for each standard deviation of the unused share of the credit line and 0.7 points smaller for each standard deviation of the credit line itself. The wage bill moves in the same direction and roughly twice as strongly. The unused share is the more precisely estimated of the two, which is what the smoothing account predicts, since it measures how much borrowing capacity a firm still has when the shock arrives. The number of credit products, the number of lending banks, the unsecured share of debt, and delinquency are individually insignificant, so the pattern tracks the amount of credit available rather than the breadth of the relationship or the firm's distress going into the shock. That 1.7 percent is itself well below the 4.6 percent response of the average firm in the full sample, so having credit access at all already dampens the response substantially, and the amount available dampens it further.

4.3 Balance Sheet Results

Table 14 reports the effect of median municipality-level energy price increases on firms' balance sheet outcomes from the Orbis dataset at the yearly level¹¹. Whereas earlier we focus on short-term adjustments, this table extends the analysis to three years after the shock.¹² The post-shock estimates indicate that higher local energy prices are associated with increases in debt, declines in total assets, fixed assets, and cash holdings. Firms experiencing larger energy cost shocks subsequently contract their asset base and increase leverage in the years following the event, consistent with the adaptation patterns documented in the short run. This contraction in fixed assets also speaks to the uncertainty channel: because Uri raised not only the level but the uncertainty of future energy costs, the real-options logic of the energy-price-uncertainty literature predicts that firms delay or scale back irreversible investment (Yoon and Ratti, 2011; Elder and Serletis, 2010; Bloom, 2009), precisely the pullback in fixed assets we document. Event-study graphs for each variable are reported in the Appendix (Figures A7, A8, A9, and A10).

4.4 Financial Results

We estimate the same baseline specification as equation (1), now taking firm-level financial outcomes as the dependent variable Y_{imt} for firm i in municipality m at time t . As before, the coefficient of interest β_1 captures the differential change in each outcome following the shock for firms in municipalities that experienced larger electricity price increases.

Each column of Table 15 is associated with a distinct financial outcome. *Debt* measures the total amount owed by the firm to its bank/banks. *Average interest rate* corresponds to the weighted interest rate across all outstanding financial products. *New credit* captures the ratio of newly granted

¹¹Firms in this sample are comparable in size to the sample used for the prior sections.

¹²We cannot interact these variables with credit access because most of the available balance sheet information belongs to firms in the credit-registry sample. This is an important limitation: our central argument is that firms with and without credit access adjust along different margins, but we can only test the differential response for employment and credit outcomes (from matched employer-employee and credit registry data), not for balance sheet dynamics. The balance sheet results in this table should therefore be interpreted as average effects across all firms, not as evidence specific to the financial smoothing channel.

credit to total existing credit. *Credit used* measures the share of available credit lines that has been drawn down. The results indicate that higher energy prices are associated with an increase in debt, interest charged¹³, new credit, and the share of credit lines drawn down. Figures 16, 17, and 18 show the event study graphs for debt, interest charged, and new credit.

Decomposing the credit response by the type of financial product, we find that the increase is driven primarily by collateral-backed borrowing, debt refinancing, and liquidation finance.¹⁴ This pattern indicates that firms buffer the shock through the products that deliver liquidity quickly, either by taking on new credit or by restructuring existing positions. The registry records the type of product rather than its contractual maturity, so we characterize the response by product type; the instruments that account for the increase are those firms draw on for immediate liquidity rather than for long-horizon investment. The disaggregated tables are reported in the Appendix, Tables A5 to A12.

4.5 Robustness

4.5.1 Pre-Shock Trends

The design shows no sign of differential pre-shock trends. In Figures 10 and 11 the event-study coefficients for the months before February 2021 are individually indistinguishable from zero and display no systematic drift, and in Figure 12 firms with and without credit access track each other closely until the shock and separate only after it. The same holds for the price series itself: daily prices evolve in parallel across shock deciles in the 60 days before Uri (Figure 9).

4.5.2 Distance from the U.S. Border

A concern raised about our design is that the results might reflect a broader U.S. trade shock rather than the energy price shock itself: because Winter Storm Uri originated in Texas and trav-

¹³In Table 15, the coefficient of 0.003 on the average interest rate corresponds to a 0.3 percent increase in the rate.

¹⁴Liquidation finance refers to short-term credit that provides a firm with immediate liquidity to meet its obligations, typically by monetizing or restructuring existing assets and credit positions.

elled across the U.S.-Mexico border, municipalities closer to the border could have been affected through cross-border trade or supply-chain links rather than through energy prices alone. To separate the two channels, we replace the municipality-by-month fixed effects with distance from the U.S. border interacted with month fixed effects, a coarser spatial control that absorbs any shock varying smoothly with border proximity over time while still allowing the price effect to be estimated. The estimates are unchanged, both for employment and the wage bill and for firms' credit outcomes (Tables A29 and A30 in Appendix A), mitigating the concern that border-specific trade or supply-chain disruptions, rather than energy price transmission, drive the patterns.

4.5.3 The Window Used to Measure Credit Access

Credit access is measured by whether a firm appears in the credit registry before the shock, so the classification depends on how far back we look. A firm that borrowed nine months before Uri but not in the month immediately before it is treated as having credit access under a wide window and not under a narrow one. If that boundary were driving the result, the estimated moderating effect would move with the window. We therefore re-estimate equation (2) defining Credit_i over the three, six, and nine months before February 2021, leaving the rest of the specification unchanged.

Table A31 reports the results. The interaction is negative and significant at every window. The moderating role of credit access is therefore a feature of credit availability itself rather than of the particular months over which we measure it.

4.5.4 High and Low Energy Intensity Sectors

If the employment response reflects substitution away from energy, it should be concentrated where energy matters most in production. Table 8 tests this with a continuous measure of sector energy intensity. As a more transparent version of the same test, we split sectors at the median of pre-shock energy intensity and estimate a separate price effect for each half in a single regression. Concretely, we interact $\Delta P_m \times \text{Post}_t$ with indicators for the high- and low-intensity groups rather

than with the difference between them, so that each coefficient is the absolute response of its own group instead of a contrast with the omitted one. The credit-access interaction enters as in equation (2). This specification omits municipality-by-month fixed effects, which would absorb the average price effect and leave only the difference between the two groups identified rather than the two levels we want to report.

Table A32 reports the results. A one-standard-deviation increase in local energy prices raises employment by 7.0 percent in high-intensity sectors and 1.7 percent in low-intensity sectors, both significant at the 1 percent level. The response in the least energy-intensive sectors is thus roughly a quarter of the response in the most intensive ones, which is what the substitution channel implies: firms with little energy in their production function have correspondingly little scope to substitute labor for it, and a shock operating through some general municipality-level channel rather than through energy costs would not produce this gradient.

5 Mechanisms

The reduced-form evidence establishes what firms do in response to the energy shock: they expand employment, draw on credit, and take on more debt while shrinking their assets. This section turns to how and why, uncovering two mechanisms. At the intensive margin, firms reorganize production, shifting to off-peak hours and replacing energy-intensive machinery; we draw this evidence from a purpose-built survey on firms' energy adaptation that we designed and the Central Bank of Mexico fielded (Section 5.1). At the extensive margin, the shock reallocates workers across firms: firm exit rises and is concentrated among smaller firms, whose workers are absorbed by larger survivors, as we document in Section 5.2.

5.1 *The Intensive Margin: Survey Evidence on Firm Adjustment*

The administrative and financial data show how firms adjust employment and finances after the shock, but reveal little about the operational mechanisms behind these responses. To pro-

vide direct evidence on firms' adaptation strategies, we designed a dedicated survey module on adaptation to energy shocks in collaboration with the Central Bank of Mexico, embedded as a special module of the *Encuesta Mensual de Opinión Empresarial sobre la Actividad Económica Regional* (EMAER), the central bank's monthly business opinion survey. The survey was fielded in March 2026 on approximately 1,700 firms from the Central Bank's firm sample; these firms can be matched to the administrative and credit registry data used in this paper. Because it is embedded in EMAER, a long-established survey with a stable, high-response firm panel, the module draws on a strong sample that is representative of our matched administrative and credit-registry data. This design allows us to directly link self-reported adjustment strategies to observed labor and financial outcomes.

The questionnaire asks firms about their intended responses to a hypothetical 5-10 percent increase in electricity or gas prices. The sample is organized into three strata, and each stratum is asked about a single horizon (short run: 3 months, medium run: 6 months, or permanent), so that intended adjustments are observed across all three horizons. Within each stratum, firms report expected adjustments along three dimensions: (i) pricing, (ii) financing, and (iii) operational responses (including adjustments to operating hours, shift reallocation, and machinery replacement). A separate block elicits firms' realized experiences with energy price increases and supply disruptions over the previous 12 months, and the mitigation strategies they have adopted. Comparing responses across horizons allows us to distinguish short-run smoothing behavior from longer-run production reorganization and capital adjustment.

These data allow us to validate the behavioral mechanisms inferred from the reduced-form evidence and to provide direct micro-level support for the adjustment channels documented in the administrative analysis.

5.1.1 Survey Results: Realized Experiences and Mitigation Strategies

Table 16 summarizes firms' realized experiences over the previous 12 months and the strategies they have already adopted in response. Roughly 28 percent of firms report having faced electricity or gas price increases over the past year, and an additional 10 percent report supply interruptions. Among firms that adopted a mitigation strategy, the most common responses are solar panel installation (31 percent) and acquisition of generators (20 percent). Of those that did not adopt any strategy, more than half (54 percent) cite financial constraints as the main reason, followed by lack of information (38 percent). These patterns are directly consistent with the financial-frictions channel emphasized in our administrative results: a substantial share of firms would adopt mitigating technologies but cannot finance them.

5.1.2 Survey Results: Hypothetical Scenarios

Table 17 reports firms' intended responses to a hypothetical 5-10 percent increase in the price of electricity (or of gas, for firms that rely on gas), broken down by horizon (short run: 3 months; medium run: 6 months; permanent). Three patterns stand out. First, and most directly linked to our empirical results, the operational responses help explain the employment and balance-sheet findings: a meaningful share of firms (25-28 percent) would modify shifts and operating hours, and a growing fraction over time (19-29 percent) would replace energy-intensive machinery. Extending production into off-peak hours requires additional workers to staff them, which can account for the employment expansion and its concentration in lower-paid, less experienced workers, while retiring and replacing energy-intensive machinery is consistent with the medium-run contraction in firms' fixed-asset base and with firms becoming more labor-intensive. Second, on the financing side, the survey underscores that external finance is a first-order margin of adjustment: only 20 to 26 percent of firms report that they would need no external funds at all, so most anticipate relying at least partly on financing beyond current cash flow.¹⁵ Commercial bank

¹⁵Because the question allows multiple responses and distinguishes internal funds from "no financing required," this share identifies firms expecting to use some financing, not firms expecting to borrow externally; the external-source shares themselves sum to below 40 percent.

credit (18-20 percent) and supplier credit (8-11 percent) are the main external sources; internal funds, the most commonly cited source (49-61 percent), are drawn down first before firms turn to costlier external finance. That most firms cannot fully self-finance the shock is precisely the margin our credit-access results turn on: firms with established banking relationships can smooth it by drawing on their credit lines and taking on new credit, whereas those without must absorb it through real adjustment. Third, firms largely absorb the shock rather than passing it on to buyers: the dominant pricing response is to leave prices unchanged in the short run (62 percent) and to raise them only when the increase is permanent (54 percent), so in the short run adjustment falls on the input and financing margins above rather than on consumers. Together these patterns reinforce the administrative-data result that firms adjust along multiple margins simultaneously, with the input substitution margin operating primarily through shift reorganization and capital replacement.

5.2 *The Extensive Margin: Firm Exit and Employment Reallocation*

Our sample is restricted to the firms most likely to face wholesale-linked energy prices; the estimates so far follow these firms in a balanced panel and so describe how survivors adjust. The shock also operates at the extensive margin, through firm exit. Because more exposed firms may shut down, the aggregate employment effect depends not only on how survivors adjust but on how the workers of exiting firms are reallocated across the firm size distribution.

We estimate the exit response with a Poisson model of exit on local price exposure, using the monthly IMSS establishment records for all firms, in which an establishment is counted as exiting the month it ceases to report any employees,

$$\mathbb{E}[\text{Exit}_{imt}] = \exp\left(\alpha + \beta (\Delta P_m \times \text{Post}_t) + \delta_{s \times t} + \delta_{r \times t}\right) \quad (4)$$

where Exit_{imt} indicates that establishment i in municipality m exits in month t , $\delta_{s \times t}$ and $\delta_{r \times t}$ are sector-by-year-month and state-by-year-month fixed effects, and β measures the change in the monthly exit probability for a one standard-deviation increase in the local energy price change.

Figure 19 presents the event-study coefficients for firm exit. Following the shock, exit probabilities rise sharply and remain elevated, indicating a persistent increase in firm turnover among more exposed municipalities. Table 18 confirms that a one-standard-deviation increase in municipality-level energy prices raises the exit rate by about 2.2 percent. The rise in exit is concentrated among the smallest firms. Splitting the sample by firm size (Table 5), the exit response to the price shock is positive and significant for micro firms, indistinguishable from zero for small and medium firms, and negative for large firms, which become, if anything, less likely to exit. The firms pushed out are therefore small, while larger firms survive.

To assess whether the employment gains documented in surviving firms reflect genuine job creation or merely reallocation from exiting firms, Table 19 restricts the sample to firms that remain active throughout the post-shock period, without imposing any restriction on firm size. The coefficient on energy price exposure is small (-0.001) and statistically insignificant, indicating that surviving firms do not expand employment differentially. This sample spans the full universe of firms of all sizes, not just the large firms of our main sample, so the near-zero average is consistent with the expansion being concentrated among large survivors. The aggregate employment response is therefore driven by reallocation across firms: larger, more resilient firms absorb workers displaced from exiting firms, rather than by job creation within continuing establishments. The energy price shock thus accelerates the exit of smaller firms while leaving the employment decisions of surviving firms largely unchanged. At the aggregate level, by contrast, the net employment effect of energy shocks is typically muted: such shocks reallocate labor across firms and sectors more than they change net employment (Davis and Haltiwanger, 2001), and the macro literature tends to find limited aggregate effects (Bachmann et al., 2024). Our results explain why: a sizable firm-level expansion, concentrated among larger survivors, is offset by the exit of smaller firms, leaving only a small aggregate footprint.

Our firm-level estimates so far draw on IMSS records, which cover only the formal sector. To gauge the aggregate consequences, we extend the exercise to informal employment in a back-

of-envelope calculation (Table 20). We take the number of firms in each size class from INEGI's Censos Económicos (Instituto Nacional de Estadística y Geografía, 2024) and apply two of our estimates to these counts: the exit response (Table 18), which gives the workers displaced as smaller firms close, and the large-firm employment response (Table 7), which gives the jobs larger firms gain. We then scale the displacement up to the informal sector using the informal-to-formal employment ratio from INEGI's Encuesta Nacional de Ocupación y Empleo (ENOE). The exercise underscores the paper's central message: the shock chiefly reallocates workers, from the small and informal firms that shed labor toward the large formal firms that expand. Within the formal sector the exit and expansion channels roughly offset, leaving a small net gain; once the larger informal sector is included, the net effect turns modestly negative, a reduction of roughly 1.3 percent of employment, in line with the modest aggregate unemployment increases that the macro literature attributes to energy price shocks (Känzig, 2021; Kilian, 2009).

6 A Dynamic Structural Model: Credit Access and Firms' Adjustment to Energy Shocks

We specify and estimate a dynamic model of a local labor market in which firms that differ in size and in access to credit respond to an energy price shock. We do this for two reasons. First, to show that a working-capital constraint can account for the difference in the employment response to an energy shock between firms with and without credit access. Second, to determine the optimal government policy in response to an energy shock. The model has four elements: (i) firms produce with labor, installed capital, and energy: in large firms, labor substitutes for powered capital, the combination of installed equipment and the energy that runs it, while in small firms labor and energy are complements, in line with our reduced-form results; (ii) workers move between firms on a job ladder with search frictions, so that the contraction of small firms changes the hiring and retention conditions that large firms face; (iii) a firm without credit access pays for energy out of the cash left after its other up-front outlays, so a higher energy bill can make it cash constrained;

and (iv) firms learn slowly about how long the increase in energy prices will last. The model is stylized to describe the short-run response to the shock: capital is fixed, wages are posted and do not respond to the shock, and firms neither enter nor exit.

6.1 Firms and the labor market

A municipality has a unit mass of jobs at the initial steady state and a pool U of non-employed searchers. There are six types of firms j . Firms are small (fewer than 100 workers) or large, and within each size they are of three kinds: with credit access, cash rich without credit access, and cash poor without credit access. Cash-poor firms are a share λ of firms without credit access. A mass n_j of firms of type j employs ℓ_j workers each. Each type posts a wage w_j that does not change during the period, consistent with the absence of any response of entry wages in the data (Table 10). Large firms pay more than small firms, and firms with credit access pay more than firms without it, in line with the employer-employee records.

Workers search on and off the job. Employed workers search with relative intensity ξ , so there are $S = U + \xi \sum_j n_j \ell_j$ effective searchers, and firms post $V = \sum_j n_j v_j$ vacancies in total. Searchers and vacancies meet through a standard matching function, $M = \mu S^\eta V^{1-\eta}$ (Moscarini and Postel-Vinay, 2013; Burdett and Mortensen, 1998): a searcher meets a vacancy at rate $\lambda^m = M/S$, a vacancy meets a searcher at rate $q = M/V$, and the vacancy belongs to a type- k firm with probability $\varphi_k = n_k v_k / V$. A non-employed worker accepts every offer. A worker employed at type j accepts an offer from type k with probability

$$a_{jk} = \Lambda\left(\frac{\ln w_k - \ln w_j}{\tau}\right), \quad (5)$$

where Λ is the logistic function and τ indexes the dispersion of non-wage job values: workers move up the wage ladder on average but sometimes move down it. A type- j firm loses workers in two ways: to other firms, at rate $\xi \lambda^m F_j$, where $F_j = \sum_k \varphi_k a_{jk}$ is the probability that its worker accepts an offer; and to non-employment, at rate δ , plus any layoffs x_j , which cannot exceed the workers who remain. Each vacancy it posts yields $q \Psi_j$ hires, where $\Psi_j = (U + \xi \sum_i n_i \ell_i a_{ij})/S$ is

the probability that the searcher it meets accepts. Employment is therefore:

$$\ell'_j = \ell_j(1 - \delta - \xi\lambda^m F_j) + q\Psi_j v_j - x_j. \quad (6)$$

Posting v vacancies costs $c_j(v, \ell) = \frac{\kappa_j}{1+\gamma} (v/\ell)^{1+\gamma} \ell$, where v/ℓ is the vacancy rate, κ_j is the cost level of type j , $\gamma > 0$ makes hiring fast more costly, so firms adjust employment gradually (Bloom, 2009), $1/(1+\gamma)$ is a normalization, and multiplying by ℓ scales the cost with firm size. Layoffs are costless.

6.2 Technology

Firms produce with labor ℓ and powered capital G , the combination of installed equipment and the energy e that runs it. The capital stock is fixed over the estimation window, as in short-run models of factor demand (Morrison, 1988; Berndt and Fuss, 1986), since capital adjustment is lumpy and infrequent at monthly frequency (Khan and Thomas, 2008; Cooper and Haltiwanger, 2006). In the short run, with their equipment in place, firms change the mix of energy and labor by reorganizing how and when they use it, rather than by replacing it.¹⁶

Output is

$$y = A[\alpha\ell^\rho + (1-\alpha)G^\rho]^{\nu/\rho}, \quad (7)$$

where A is productivity, α is the weight on labor, $\nu < 1$ gives decreasing returns to scale, and $1/(1-\rho)$ is the elasticity of substitution between labor and powered capital, which we denote σ_{LG} in large firms and σ_S in small firms. In large firms, powered capital is produced from the capital stock K and energy e ,

$$G = [\theta K^\phi + (1-\theta)e^\phi]^{1/\phi}, \quad (8)$$

where θ is the weight on capital and $\sigma_{KE} = 1/(1-\phi)$ is the elasticity of substitution between capital and energy. Machines need power, so energy is a close complement to installed capital (σ_{KE} close to zero), while workers can take over tasks that powered machines perform ($\sigma_{LG} > 1$,

¹⁶Our survey is consistent with this: the share of firms that would replace energy-intensive machinery rises from 19 percent at a three-month horizon to 29 percent when the increase is permanent.

so $0 < \nu < \rho < 1$) (Oberfield and Raval, 2021; Hassler et al., 2021; Atkeson and Kehoe, 1999; Berndt and Wood, 1975). Small firms have the same technology (7), with parameters α_S and ρ_S , but energy enters directly, $G = e$, and their fixed capital stock K_S scales output:

$$y = AK_S^{1-\nu} [\alpha_S \ell^{\rho_S} + (1 - \alpha_S) e^{\rho_S}]^{\nu/\rho_S}. \quad (9)$$

For small firms labor and energy are complements, $\sigma_S = 1/(1 - \rho_S) < 1$: when energy becomes more expensive, they cut both energy and workers, as our reduced-form results show. Their response is governed by this complementarity, so we do not separate capital from energy, and with K_S fixed, capital only scales output.

For every type, $\pi_j(\ell, p) = \max_e y_j(\ell, e) - pe$ denotes operating profit when the firm chooses energy optimally.

6.3 Financing

Energy is a working-capital expense: firms pay for it before they receive the revenue from the output it produces. Firms with credit access cover it by drawing on their credit lines. A firm of type j without credit access pays the bill out of its cash C_j , which also has to cover its other costs paid in advance, O_j , such as materials. Since O_j is fixed in the short run, the energy bill can use at most the cash left over:

$$p_t e_t \leq W_j \equiv C_j - O_j. \quad (10)$$

We call W_j residual cash: the cash left to pay for energy once the other costs are paid. We write it as a multiple of the firm's monthly energy bill before the shock, $W_j = \omega_j p_0 e_{0j}$, so that ω_j is the number of pre-shock energy bills the residual cash can pay. A firm with $\omega_j = 1$ can pay exactly its pre-shock bill, so any increase in the bill constrains it. Constraints of this kind are standard in models of financial frictions (Almeida et al., 2024; Jermann and Quadrini, 2012; Neumeyer and Perri, 2005). The wages of the existing workforce are paid after the work is done, at intervals that Mexican labor law caps at one week for manual workers and fifteen days for others (Cámara

de Diputados del H. Congreso de la Unión, 1970), and recruiting costs are paid out of current revenue, so neither enters (10). Cash-rich firms hold enough residual cash that (10) never binds. Cash-poor firms, which make up a share λ of firms without credit access, hold residual cash equal to one pre-shock bill, $\omega_j = 1$; we measure λ from firms' balance sheets. Firms do not accumulate cash out of profits during the period, so the constraint does not relax as the shock persists. Models of financial frictions make the same assumption to keep constraints from disappearing over time (Bernanke et al., 1999; Kiyotaki and Moore, 1997), since self-financing would otherwise relax them (Moll, 2014).

6.4 *Energy prices and beliefs*

The realized energy price is $p_t = p_0(1 + \Delta_t)$, where Δ_t is the measured month-by-month increase in the energy price in a municipality one standard deviation more exposed to the shock than another (Appendix C.3). Firms do not know how long the price increase will last. They enter the shock believing that the price increase of the first thirty days, b_1 , will persist, and revise that belief toward what they observe,

$$b_{t+1} = b_t + g(\Delta_t - b_t). \quad (11)$$

The gain g is the share of the gap between the observed price increase and the current belief by which firms revise their belief each month: the smaller g , the more slowly firms learn that the shock is fading.

6.5 *The firm's problem and equilibrium*

The state of a firm is its workforce ℓ , and its choices depend on the current belief b_t . Its value is

$$V_{jt}(\ell; b_t) = \max_{v \geq 0, x, e} \left\{ y_j(\ell, e) - p_t e - w_j \ell - c_j(v, \ell) + \beta \tilde{V}_{jt}(\ell'; b_t) \right\}. \quad (12)$$

Each month the firm earns output net of its energy bill, its wage bill, and the vacancy cost $c_j(v, \ell)$ defined above. It chooses vacancies v , layoffs x , and energy e subject to the law of motion of employment (6), to layoffs being non-negative and no larger than the workers who remain after

separations, and, if it has no credit access, to the cash constraint (10). Each month, firms act as if the current belief were permanent: they plan as if the price will remain at $p_0(1 + b_t)$ in every future month. They revise the belief the next month according to (11), but do not anticipate doing so. The continuation value $\tilde{V}_{jt}$ is computed by backward induction over twenty-four months at the believed price and the expected path of labor-market conditions, and recomputed each month as the belief is updated. Let $\mu_t \geq 0$ be the multiplier on (10); a constrained firm faces an effective energy price $p_t(1 + \mu_t)$, while its marginal cost of hiring is unaffected.

Given the path of energy prices $\{p_t\}$ and the learning rule (11), an equilibrium consists of the firms' choices of vacancies, layoffs, and energy, $\{v_{jt}, x_{jt}, e_{jt}\}$, and the labor-market conditions they face, $\{\lambda_t^m, q_t, F_{jt}, \Psi_{jt}\}$, such that: (i) each firm's choices solve its problem (12); (ii) employment evolves according to (6); and (iii) the labor-market conditions are those that the matching function and the acceptance probabilities (5) imply, given the vacancies firms post and their employment. Before the shock, the economy is in a steady state in which each type's hires equal its separations.

6.6 How credit access shapes the response

Proposition 1 (Sign). *Hold labor-market conditions fixed. A higher energy price raises a firm's marginal value of labor if and only if $\nu < \rho_j$. Hence, when firms expect a higher energy price, large firms, for which $\nu < \rho$, raise employment, and small firms, for which $\nu > \rho_S$, reduce it.*

Proposition 2 (When the cash constraint binds). *Suppose energy demand has constant price elasticity ε and employment is at its pre-shock level. After a price increase Δ_t , a firm without credit access is constrained if and only if its residual cash, in months of its pre-shock bill, is below $(1 + \Delta_t)^{1+\varepsilon}$. This threshold exceeds one month when energy demand is inelastic, $|\varepsilon| < 1$, which holds when energy is a close complement to installed capital.*

Proposition 3 (The credit gap). *Hold labor-market conditions fixed, and let $\nu < \rho$. A large firm without credit access whose cash constraint binds employs weakly more workers than it would with credit access; if*

the constraint does not bind, it employs the same number.

Proofs are in Appendix C.2. Propositions 1 and 3 hold labor-market conditions fixed; we verify numerically that both orderings also hold along the equilibrium paths (Appendix C.4).

Proposition 1 separates firms by technology: large firms, for which $\nu < \rho$, expand when energy becomes more expensive, while small firms, whose labor and energy are complements, shrink. Because a hire pays off over the prices the firm expects to face, the response also depends on beliefs.

Proposition 2 explains why energy is nested with capital. If energy were as substitutable for capital as labor is, the energy bill would fall when the price rises, and the shock would relax rather than tighten the cash constraint. Because energy is close to a perfect complement to installed capital, short-run energy demand is inelastic and the bill rises with the price: at the estimates, a firm is constrained if its residual cash covers less than about 1.14 months of its pre-shock bill. Small firms are never constrained, because their energy demand is elastic and their bill falls when the price rises. Cash-poor large firms, with $\omega = 1$, are at the threshold before the shock, so any increase in the price makes the constraint bind.

Proposition 3 implies that the credit gap equals the share of firms without credit access whose constraint binds times the additional hiring of those firms; at the estimates, unconstrained large firms barely respond to the shock, so the expansion of large firms comes from the cash constraint. Finally, the job ladder adds a slack mechanism: when small firms post fewer vacancies, workers at large firms receive fewer acceptable outside offers, so fewer of them quit (Appendix C.2).

6.7 Estimation

We estimate two parameters, the elasticities of substitution between labor and powered capital in large firms, σ_{LG} , and between labor and energy in small firms, σ_S , and calibrate the others (Table 21). The energy share $s_E = pe/(pe + w\ell)$ and returns to scale ν are measured from the

manufacturing Economic Census. Firm sizes, employment shares by size, the share of firms with credit access, relative wages, and worker flows are taken from the employer-employee records used in the reduced-form analysis.

We measure the share of cash-poor firms, λ , from the balance sheets of Mexican firms in Orbis that report no bank debt, the closest observable counterpart of firms without credit access. Because the energy bill competes for cash with the other costs firms pay in advance, we classify a firm as cash poor if its cash holdings cover less than one month of its operating costs. Setting $\omega = 1$ for these firms follows the normalization common in the working-capital literature (Neumeyer and Perri, 2005; Jermann and Quadrini, 2012). Appendix C.3 documents this mapping and the alternative in which the energy bill is the only cost paid in advance. Beliefs follow the learning literature: the monthly gain is $g = 0.006$, the monthly equivalent of the quarterly gain estimated by Milani (2007), and firms in survey data are similarly slow to revise their expectations (Coibion et al., 2018).

We estimate $\Theta = (\sigma_{LG}, \sigma_S)$ by the Method of Simulated Moments, choosing Θ to minimize

$$Q(\Theta) = \sum_k \left(\frac{m_k(\Theta) - \hat{m}_k}{se_k} \right)^2, \quad (13)$$

where $\hat{m}_k$ is the k -th targeted moment in the data, se_k its standard error, and $m_k(\Theta)$ the same moment simulated from the model. Each deviation is weighted by the precision of the data moment, so the model is held closer to the moments that are estimated more precisely. The ten targeted moments are event-study coefficients per standard deviation of exposure: large-firm employment and small-firm employment at months three, six, nine, and twelve, and the credit gap in large-firm employment at months six and twelve (Figures 10 and 12). Standard errors are from a parametric bootstrap.

The credit gap is produced by whether the cash constraint binds, which is set by the measured share λ and by the technology through Proposition 2, rather than by a parameter dedicated to it (Strebulaev and Whited, 2012; Bazdresch et al., 2018). The two estimated parameters are dis-

ciplined by different moments, as can be seen in Figure A13 in appendix: the small-firm path identifies σ_S , while σ_{LG} sets the level of the large-firm response and how much more constrained firms hire.

6.8 *Estimates and fit*

Table 22 reports the estimates and Figure 20 the fit for every month after the shock. At the estimates, the model reproduces the credit gap, the decline of small firms, and the initial rise in large-firm employment. We cap σ_{LG} at four and also report a restricted estimate with $\sigma_{LG} \leq 3$. Moments the model is not asked to match support its mechanism. Although no worker flow is targeted, the model reproduces the rise in hires from non-employment and generates credit gaps of the right sign and similar size in all four worker flows: firms without credit access hire more workers both from non-employment and from other firms, as in the data (Figure A15 in appendix).

We interpret σ_{LG} as a short-run reorganization elasticity conditional on fixed capital: when the price of energy differs across hours, the firm-level elasticity combines substitution within each hour with the reallocation of production across hours and shifts, and so exceeds the technical elasticity, by the same logic that makes an aggregate elasticity exceed the plant-level one (Oberfield and Raval, 2021; Shapiro, 1996; Tishler, 1984).

6.9 *Counterfactual policies*

Two instruments are available to a government facing the shock. An energy subsidy pays a fraction s of every firm's energy price. A credit guarantee lets firms without credit access borrow, for D months, to pay the part of the energy bill their residual cash does not cover, and its fiscal cost is the expected loss on that credit (Appendix C.6). We compare the instruments by welfare, the present value of output net of energy and recruiting costs plus the value of non-employment, and report fiscal costs separately. We also compute welfare counting the damage from the carbon emissions of energy use, valued at the social cost of carbon estimated by U.S. Environmental Pro-

tection Agency (2023). Without policy, the cash constraint creates a credit friction, and this friction is what the policies target. Figure 21 compares the two instruments at the same fiscal cost. A credit guarantee for the duration of the price increase, costing about 1 percent of a month's wage bill, eliminates about 80 percent of the friction, while an energy subsidy of the same cost leaves it essentially unchanged, because most of the subsidy is paid to firms that are not constrained. The guarantee also lets constrained firms keep their equipment running, so energy use and output fall by less, and at every budget it raises welfare far more than the subsidy (Figure 22 and Table 23). When emissions are priced, the guarantee still raises welfare, while every subsidy lowers it, because it lowers the price of energy for all firms. The welfare-maximizing response is therefore a credit guarantee for the duration of the price increase and no energy subsidy. The guarantee raises welfare through output and energy use rather than jobs: by letting constrained firms keep using energy, it reduces their substitution toward labor.

7 Conclusion

This paper shows that access to credit governs how firms adjust their employment to an energy shock. We identify the response from the electricity-price spike that Winter Storm Uri set off in February 2021, when it cut the natural gas Mexico imports to generate power. Because the spike varied across municipalities with the inherited structure of the grid, it separates the shock to energy costs from the macroeconomic conditions that usually accompany it, and linking it to credit-registry, employer-employee, and balance-sheet data lets us observe, for the same firms, the shock they faced, their employment, and their access to credit.

Large firms respond to higher energy prices by hiring: a one-standard-deviation increase in electricity prices raises their employment by 4.6 percent, through lower-paid, less experienced workers, so labor substitutes for energy. Credit access weakens this response by 40 percent, as firms with credit access before the shock draw on their credit lines instead. In the years that follow, exposed firms carry persistently higher leverage and contract their total assets, fixed assets, and cash.

Survey evidence shows that firms shift production to off-peak hours and replace energy-intensive machinery. The aggregate response is reallocative: exit rises among small, informal firms in exposed municipalities, and surviving large firms absorb their workers, so the shock changes which firms employ workers far more than how many are employed.

A dynamic structural model with a working-capital constraint and a job ladder accounts for the gap by credit access. Because energy is a close complement to installed equipment, the energy bill rises with the price, and a firm without credit access, which pays that bill out of its cash, becomes constrained and substitutes further toward labor. The model reproduces the credit gap, the decline of small firms, and the rise in large-firm employment. A credit guarantee for firms without credit access, lasting as long as the price increase, eliminates most of this credit friction at a small fiscal cost, while an energy subsidy of the same cost leaves it essentially unchanged, because most of the subsidy goes to firms that are not constrained. The guarantee raises welfare far more than the subsidy, and once emissions are priced it still raises welfare while every subsidy lowers it. It works through output and energy use rather than jobs, by letting constrained firms keep their equipment running.

These results connect the literatures on energy shocks and on financial frictions. The modest employment effects of energy shocks found at the macro level mask a deep reallocation of workers from exiting firms toward the larger firms that absorb them. And credit access, known to shape how other shocks pass through to firms' real decisions, determines whether a firm bears an energy shock on its workforce or on its balance sheet.

The policy implication follows directly. The emergency energy price support that governments deploy in energy crises is paid to every firm, while the friction we document is concentrated among firms without credit access. Targeting liquidity to those firms when a shock hits raises welfare far more than subsidizing energy, and remains welfare improving once the cost of emissions is counted. More broadly, shocks that originate in global input markets reach firms through the

interaction of their energy dependence and their financial structure, and policy that ignores the second misses where the shock binds.

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Tables and Figures

Tables

Table 1: Employment and Wages

	Min	25th pctl.	Median	75th pctl.	Max
Employment	100	134	199	368	55,175
Wages	2,667	37,628	73,294	161,474	695,478

Note: Distribution of employment and wages across firms in the sample, drawn from the IMSS employer-employee records. “Employment” is the number of registered workers per firm and “Wages” are reported in Mexican pesos. Columns report the minimum, the 25th percentile, the median, the 75th percentile, and the maximum. The sample is restricted to firms with at least 100 employees.

Table 2: Firms by Sector

Sector	Number of Firms
Manufacturing	8,478
Services	7,621
Wholesale and Retail Trade	6,087
Transport and Communications	2,178
Third Sector	2,139
Construction	2,031
Agriculture, Forestry, Fishing, and Hunting	1,172
Electricity and Water Collection	362
Mining	266

Note: Number of firms in the sample by one-digit economic sector.

The sample covers Mexican firms that can be matched across the IMSS employer-employee records, the R04C credit registry, and Orbis balance sheets. Manufacturing, the most energy-intensive sector and the focus of much of the analysis, is the single largest group.

Table 3: Financials Descriptives

Variable	Min	P25	Median	P75	Max	SD
Total Amount Owed to the Bank (Mexican Pesos)	356.94	806,779	6,537,970	35,049,156	490,777,194	111,063,673
Average Interest Rate	4.04	7.71	10.87	14.61	18.67	4.49
Credit Used Percentage	0.09	26.98	60.83	88.56	100	65.02
New Members	0	0	0	0	13	0.16

Note: Summary statistics for the main credit variables drawn from the R04C credit registry. “Total amount owed” is reported in Mexican pesos; “average interest rate” is the credit-weighted annual rate (percent); “credit used” is the share of available credit lines drawn down (percent); and “new members” counts firms newly entering the registry. P25 and P75 denote the 25th and 75th percentiles.

Table 4: Distribution of Firms across Municipalities (INEGI)

Municipality	State	Firms	Share (%)
Puebla	Puebla	94,811	1.73
Guadalajara	Jalisco	89,635	1.64
Ecatepec de Morelos	México	84,307	1.54
León	Guanajuato	83,778	1.53
Iztapalapa	Ciudad de México	82,077	1.50
Cuauhtémoc	Ciudad de México	63,215	1.16
Tijuana	Baja California	57,157	1.05
Monterrey	Nuevo León	55,266	1.01
Nezahualcóyotl	México	52,158	0.95
Toluca	México	51,440	0.94
Mérida	Yucatán	50,082	0.92
Querétaro	Querétaro	49,468	0.90
Zapopan	Jalisco	48,649	0.89
Aguascalientes	Aguascalientes	46,977	0.86
Morelia	Michoacán	46,937	0.86

Note: Number of firms by municipality, from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024). These counts cover the universe of formal and informal firms in Mexico rather than our estimation sample, and are reported to show how firms are distributed across municipalities. The table lists the fifteen municipalities with the most firms; "Share" is each municipality's percentage of all firms nationally. Municipality and state names are obtained by matching the INEGI state and municipality codes to the Marco Geoestadístico.

Table 5: Effect of energy price increases on firm exit, by firm size

	All firms	Micro	Small	Medium	Large
$\Delta P_m \times \text{Post}_t$ (1 SD)	0.022*** (0.007)	0.009*** (0.003)	-0.009 (0.015)	-0.005 (0.010)	-0.070** (0.031)
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	36,663,496	24,167,218	4,374,641	1,138,851	254,404

Note: Poisson estimates of the effect of the energy price shock on firm exit, splitting the sample by firm size (micro, small, medium, and large); column (1) reproduces the pooled estimate in Table 18. Entries are the coefficient on $\Delta P_m \times \text{Post}_t$ scaled to a one standard-deviation price increase, so they are proportional effects on the exit rate rather than percentage-point changes. Standard errors, clustered at the municipality level, are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 6: Energy price regressions (log specification)

	(1)	(2)	(3)	(4)
Post Uri	0.440*** (0.002)		0.401*** (0.002)	
Short run (0–3 months)		0.338*** (0.002)		0.312*** (0.002)
Medium run (3–12 months)		0.485*** (0.002)		0.441*** (0.002)
Post Uri $\times$ High shock			0.146*** (0.003)	
Short run $\times$ High shock				0.107*** (0.003)
Medium run $\times$ High shock				0.164*** (0.003)
Observations	63,083	63,083	59,303	59,303
R^2	0.691	0.709	0.648	0.670
Node FE	Yes	Yes	Yes	Yes
SE clustered	Node	Node	Node	Node

Note: The table reports node-level monthly panel regressions; the dependent variable is the log of the marginal electricity price. Coefficients are therefore log points; the implied proportional changes are about 55 percent post-Uri, 40 percent in the short run and 62 percent in the medium run. All specifications include node fixed effects, and standard errors are clustered by node. “High shock” denotes the top two price-increase deciles (the top 20% of nodes by price increase); these coefficients are multiplicative differentials and must be combined with the main effect in the same column, which gives increases of about 73 percent on average and 83 percent in the medium run at the most exposed nodes. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 7: Effect of energy price increases on employment and the wage bill

	Employment		Wage Bill	
	(1)	(2)	(3)	(4)
$\Delta P_m \times \text{Post}_t$	0.046*** (0.007)		0.039*** (0.005)	
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$		-0.045*** (0.010)		-0.025** (0.011)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	Yes
Municipality $\times$ Month Fixed Effects	No	Yes	No	Yes
Observations	922,980	922,980	918,681	918,681

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$ with delta-method standard errors $SE = SD \cdot e^{\beta \cdot SD} \cdot SE(\beta)$. Columns (1) and (3) report the baseline specification; columns (2) and (4) add municipality-by-month fixed effects, which absorb the average price effect $\Delta P_m \times \text{Post}_t$ and identify the credit-access interaction. Stars refer to the statistical significance of the underlying Poisson coefficients; standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 8: Effect of energy price increases on employment and the wage bill, by energy intensity

	Employment		Wage Bill	
	(1)	(2)	(3)	(4)
$\Delta P_m \times \text{Post}_t$	0.041*** (0.007)		0.036*** (0.005)	
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$		-0.019* (0.010)		-0.009 (0.015)
$\Delta P_m \times \text{Post}_t \times \text{EnergyUse}_i$		0.029*** (0.003)		0.026*** (0.005)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	Yes
Municipality $\times$ Month Fixed Effects	No	Yes	No	Yes
Observations	922,980	922,980	918,681	918,681

Note: Poisson fixed-effects estimates rescaled to a one standard-deviation increase in the 30-day municipality energy price change ΔP_m (about 17 percentage points). Columns (1) and (3) report the average price effect; columns (2) and (4) add municipality-by-month fixed effects, which absorb the average price effect and identify, from a single saturated regression, the interactions of the price shock with pre-shock credit access and with the firm's pre-shock sector energy intensity. Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 9: Effect of energy price increases on worker flows into and out of the firm

	(1)	(2)	(3)	(4)	(5)
	Hires from	Hires from	Share Hired from	Exits to	Exits to
	Non-Employment	Another Firm	Non-Employment	Non-Employment	Another Firm
After the Natural Gas Price Increase	0.052***	0.107***	−0.002	0.070***	−0.112***
× Energy Price Change (1 SD)	(0.009)	(0.013)	(0.001)	(0.009)	(0.011)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	736,900	736,800	573,250	740,825	739,250

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$ with delta-method standard errors. The unit of observation is the firm-month. Flows are measured against the whole formal sector: a hire is classified as coming from non-employment if the worker held no formal job in the previous month, and as poached if the worker was employed at a different firm anywhere in the economy. Exits are defined symmetrically. Workers holding more than one registration are assigned to their highest-paid job. Standard errors clustered at the firm level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 10: Effect of energy price increases on the composition of new hires

	(1)	(2)	(3)	(4)	(5)
	Wage at Entry	Entry Wage Relative to Incumbents	Experience at Entry	Share Hired from Another Sector	Hires from Another Sector
After the Natural Gas Price Increase	0.003**	0.001	−0.017***	−0.002	0.107***
× Energy Price Change (1 SD)	(0.002)	(0.001)	(0.003)	(0.003)	(0.017)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	571,619	571,619	572,923	569,622	729,775

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$ with delta-method standard errors. The unit of observation is the firm-month, and each dependent variable is the average across that firm's hires in that month. The entry wage relative to incumbents compares the hire's wage with the mean wage at the hiring firm in the previous month. Experience is the number of months the worker appears in the formal sector before the hire. Sector is the worker's activity code, observed for the whole formal sector. Standard errors clustered at the firm level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 11: Worker flows and credit access

	(1)	(2)	(3)	(4)	(5)	(6)
	Hires from Non-Employment	Hires from Another Firm	Entry Wage Relative to Incumbents	Experience at Entry	Exits to Non-Employment	Exits to Another Firm
After the Natural Gas Price Increase	0.070***	0.146***	0.002	−0.017***	0.089***	−0.050***
× Energy Price Change (1 SD)	(0.013)	(0.018)	(0.002)	(0.005)	(0.011)	(0.014)
After the Natural Gas Price Increase	−0.050***	−0.066**	−0.002	0.010	−0.055***	−0.050*
× Energy Price Change (1 SD) × Credit Access	(0.016)	(0.032)	(0.002)	(0.007)	(0.015)	(0.016)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	735,988	733,732	571,619	571,329	740,271	736,564

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$ with delta-method standard errors. Municipality-by-month fixed effects are included, so the specification identifies the credit-access interaction from within-municipality variation. Credit access is the pre-shock indicator defined in Section 4. Standard errors clustered at the firm level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 12: The intensive margin of credit access: employment

	(1)	(2)	(3)	(4)	(5)	(6)
	Unused Credit Line	Credit Limit	Credit Products	Lending Banks	Unsecured Share	Delin- quency
After the Natural Gas Price Increase	0.012***	0.017***	0.015***	0.016***	0.014***	0.017***
× Energy Price Change (1 SD)	(0.004)	(0.006)	(0.003)	(0.005)	(0.003)	(0.007)
After the Natural Gas Price Increase	0.019***	0.019***	0.017***	0.018***	−0.007	0.009
× Credit Characteristic	(0.005)	(0.004)	(0.003)	(0.003)	(0.010)	(0.025)
After the Natural Gas Price Increase	−0.014***	−0.007**	−0.005	−0.004	−0.009	−0.007
× Energy Price Change (1 SD) × Credit Characteristic	(0.002)	(0.003)	(0.013)	(0.010)	(0.005)	(0.017)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	264,894	264,894	264,919	264,919	264,919	292,481

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change. The sample is firms with credit access. Each column replaces the credit-access indicator with one pre-shock characteristic of the credit relationship, measured over the five months before February 2021 and named in the column header: outstanding debt, the share of the credit line drawn, the size of the credit line, the number of credit products, the number of lending banks, the share of debt not backed by collateral, and an indicator for delinquency. All characteristics except delinquency, which is an indicator, are standardized. Standard errors clustered at the firm level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 13: The intensive margin of credit access: wage bill

	(1)	(2)	(3)	(4)	(5)	(6)
	Unused Credit Line	Credit Limit	Credit Products	Lending Banks	Unsecured Share	Delin- quency
After the Natural Gas Price Increase	0.017***	0.034***	0.018***	0.019***	0.017***	0.038***
× Energy Price Change (1 SD)	(0.008)	(0.009)	(0.005)	(0.006)	(0.009)	(0.007)
After the Natural Gas Price Increase	0.034**	0.015***	0.009*	0.008*	−0.003	0.022
× Credit Characteristic	(0.014)	(0.003)	(0.004)	(0.004)	(0.008)	(0.026)
After the Natural Gas Price Increase	−0.017***	−0.007**	−0.010*	−0.009*	−0.005	−0.034
× Energy Price Change (1 SD) × Credit Characteristic	(0.009)	(0.003)	(0.005)	(0.005)	(0.009)	(0.017)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality × Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	264,869	264,869	264,894	264,894	264,894	292,456

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, for the wage bill. The sample and the credit characteristics are those of Table 12. Standard errors clustered at the firm level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 14: Effect of energy price increases on balance-sheet variables

	(1) Debt	(2) Total Assets	(3) Fixed Assets	(4) Cash
$\Delta P_m \times \text{Post}_t$	0.051*	-0.122*	-0.094*	-0.072*
	(0.020)	(0.061)	(0.044)	(0.035)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Industry $\times$ Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	176,000	175,918	137,801	139,215

Note: The table reports the effect of the energy price shock on balance-sheet items, estimated by OLS with firm and year fixed effects. Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 15: Effect of energy price increases on financial outcomes

	(1) Debt	(2) Avg. Interest	(3) New Credit	(4) Credit Used
$\Delta P_m \times \text{Post}_t$	0.019*	0.003	0.028**	0.010**
	(0.007)	(0.002)	(0.010)	(0.003)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	No
Observations	171,490	171,490	152,892	171,424

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in energy prices ($SD = 17$). Effects are computed as $e^{\beta \cdot SD} - 1$, with delta-method standard errors $SE = SD \cdot e^{\beta \cdot SD} \cdot SE(\beta)$. Stars refer to the statistical significance of the underlying Poisson coefficients; standard errors are clustered at the firm or institution level as indicated. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 17: Survey: intended responses to a hypothetical temporary energy price increase

	Short run (3m)	Medium run (6m)	Permanent
<i>Q1: Firm pricing of own goods and/or services in response to an energy price increase (single choice)</i>			
Decrease prices	1.7%	1.2%	2.4%
No change	61.5%	57.4%	43.6%
Increase prices	36.8%	41.3%	54.1%
<i>Q2: Financing sources to cope with the price increase (multiple choice)</i>			
Internal funds	55.3%	61.2%	49.5%
New /additional commercial bank credit	18.0%	20.2%	20.4%
New /additional development bank credit	2.4%	2.1%	3.1%
New /additional credit from non-bank financial institutions	2.7%	1.8%	2.5%
New /additional supplier or trade credit	8.1%	9.0%	10.7%
Other financing source	1.5%	1.4%	2.7%
No financing required	24.6%	19.9%	25.9%
<i>Q3a: Number of employed temporary workers (single choice)</i>			

Continued on next page

	Short run (3m)	Medium run (6m)	Permanent
Decrease	21.7%	22.5%	27.3%
No change	76.9%	76.2%	71.6%
Increase	1.4%	1.2%	1.1%
<i>Q3b: Number of employed permanent workers (single choice)</i>			
Decrease	13.6%	11.3%	15.4%
No change	85.4%	87.4%	83.5%
Increase	1.0%	1.2%	1.1%
<i>Q3c: Change in operating hours (single choice)</i>			
Reduce operating hours	8.5%	8.0%	7.8%
Modify shifts without changing total hours worked	25.3%	27.3%	27.8%
Increase operating hours	2.9%	1.6%	2.5%
None of the above	63.3%	63.1%	61.8%
<i>Q3d: Other operational changes (multiple choice)</i>			
Hire workers to replace energy-intensive processes	5.3%	4.6%	5.8%
Replace machinery/equipment with high energy costs	19.2%	21.5%	28.9%
Other operational changes	2.9%	5.1%	4.3%
None	73.5%	70.2%	63.3%

Notes: Firm-level survey responses on intended adjustments to a hypothetical 5-10 percent increase in electricity or gas prices, by horizon (short run: 3 months; medium run: 6 months; permanent). Q1 and Q3a to Q3c are single choice; Q2 and Q3d allow multiple responses. Table 17 spans two pages.

Table 16: Survey: realized experiences and mitigation strategies during the last 12 months (March 2025 to February 2026)

	%
<i>Q1: Operational challenges in the last 12 months (multiple choice)</i>	
Increases in electricity or gas prices	27.7%
Interruptions in electricity or gas supply	10.3%
None of the above	67.2%
<i>Q2: Strategies adopted to mitigate price increases or supply disruptions (multiple choice)</i>	
Generators	20.4%
Solar panels	30.7%
Other	16.4%
No strategy	39.6%
<i>Q3: If no strategy, why? (multiple choice)</i>	
Financial constraints	54.1%
Lack of information	37.8%
Other	13.5%

Notes: Firm-level survey responses for March 2025-February 2026. Questions allow multiple responses; Q3 is conditional on having reported “no strategy” in Q2.

Table 18: Effect of energy price increases on firm exit

	Exit
$\Delta P_m \times \text{Post}_t$	0.022*** (0.007)
Month-Year Fixed Effects	Yes
Industry $\times$ Month Fixed Effects	Yes
Observations	36,663,496

Note: Poisson fixed-effects estimate of the effect of energy prices on firm exit. The dependent variable is an indicator equal to one if the firm exits the formal employment registry; the entry is the coefficient on $\Delta P_m \times \text{Post}_t$ scaled to a one standard-deviation price increase, a proportional effect on the exit rate rather than a percentage-point change. The specification includes month, year, and sector-by-month fixed effects. Standard errors, clustered at the municipality level, are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 19: Effect of energy price increases on employment within remaining firms

	Employment (within remaining firms)
$\Delta P_m \times \text{Post}_t$	−0.001 (0.003)
Firm Fixed Effects	Yes
Month-Year Fixed Effects	Yes
Industry $\times$ Month Fixed Effects	Yes
Observations	25,291,680

Note: Poisson fixed-effects estimate of the effect of energy prices on employment within continuing firms; the sample is restricted to firms active throughout the post-shock period. The entry is the coefficient on $\Delta P_m \times \text{Post}_t$ scaled to a one standard-deviation price increase, a proportional effect on employment. The specification includes firm, month, year, and sector-by-month fixed effects. Standard errors, clustered at the municipality level, are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table 20: Back-of-envelope: net employment reallocation

Panel A: Assumed average firm size by category

Size	Avg. workers per firm	Number of firms
Micro (1–5)	3	793,475
Small (6–25)	15.5	148,396
Medium (25–100)	62	43,213
Large (100+)	300	11,525

Panel B: Workers displaced and absorbed

Per +1 SD shock (+17%)	Formal only	Formal + informal
Displaced by firm exit (+2.2%)	238k (2.46%)	531k (5.49%)
informal scaling ($\times 1.23$)	—	293k (3.03%)
Gained at large firms (+5.5% / +3.2%)	406k (4.20%)	406k (4.20%)
Net	+168k (+1.74%)	–125k (–1.29%)

Note: Back-of-envelope aggregation of the estimated employment responses to a one standard-deviation (+17%) energy price shock. Firm counts and size categories are from INEGI's Censos Económicos (Instituto Nacional de Estadística y Geografía, 2024); the exit response (+2.2%) is taken from Table 18 and the large-firm employment response (+5.5% for firms without credit access and +3.2% for firms with credit access) from separate Poisson estimates on the two subsamples. Percentages are relative to the ~9.7M formal workforce. The formal-plus-informal column scales displacement by the informal-to-formal employment ratio from INEGI's Encuesta Nacional de Ocupación y Empleo (ENOE). Figures are illustrative.

Table 21: Structural model: calibrated parameters

Parameter	Description	Value	Source
s_E	Energy share of labor and energy costs	0.26	Censos Económicos 2019, 251+ workers, electricity and fuels
Δ_t	Price differential per SD of exposure	path, avg. 0.08	CENACE nodal prices, Feb 2021 to Feb 2023
b_1	Initial belief	0.17	Thirty-day differential per SD
g	Belief gain (monthly)	0.006	Milani (2007): 0.018 per quarter
λ	Cash-poor share of firms without credit	0.63	Orbis, cash below one month of operating costs
ω	Residual cash of cash-poor firms, months of bill	1.00	Assumed (normalization)
	Bill-only alternative (λ, ω)	0.14, 0.43	Orbis, cash below 1.14 months of the bill
σ_{KE}	Capital and energy	0.01	Leontief limit (criterion monotone)
ν	Returns to scale	0.268	Censos Económicos 2019, 251+ workers (see note)
	Share of firms with credit access	0.41	Credit registry
	Large-firm share of employment	0.32	Censos Económicos
	Firm size, small and large	15, 300	IMSS records
w_j	Monthly wages by type (pesos)	9,300 to 13,350	IMSS records
$\delta + \xi \lambda^m F$	Monthly separation rate	0.077	IMSS
	Job-to-job rate	0.030	IMSS
τ	Dispersion of non-wage values	0.3	Calibrated
q_0, η	Vacancy filling rate, matching elasticity	0.6, 0.5	Standard values
κ_j	Vacancy cost scale	half a month's wage per hire	Standard values
β	Monthly discount factor	0.996	
U	Non-employed searchers per job	1.0	

Note: Calibrated parameters. Appendix C.3 describes the measurement of the price increase, cash, and beliefs. λ is measured from balance sheets, and ω is set to one month of the pre-shock bill. Returns to scale ν are wages plus electricity over census gross value added plus electricity, for manufacturing establishments with 251 or more workers.

Table 22: Structural model: estimates and fit to the targeted moments

	Data	Model		
		Best fit	$\sigma_{LG} \leq 3$	Bill-only cash
<i>Estimated parameters</i>				
σ_{LG} , labor and powered capital		4.00 (at bound)	3.00 (at bound)	4.00
σ_S , labor and energy, small firms		0.98 (0.01)	0.98 (0.01)	0.98
<i>Targeted moments (employment response per SD of exposure)</i>				
Large firms, month 3	0.021 (0.005)	0.017	0.014	0.005
Large firms, month 6	0.045 (0.007)	0.023	0.019	0.007
Large firms, month 9	0.039 (0.007)	0.027	0.021	0.008
Large firms, month 12	0.043 (0.007)	0.029	0.023	0.008
Small firms, month 3	0.000 (0.002)	-0.010	-0.009	-0.007
Small firms, month 6	-0.010 (0.006)	-0.014	-0.013	-0.010
Small firms, month 9	-0.017 (0.006)	-0.015	-0.015	-0.012
Small firms, month 12	-0.018 (0.006)	-0.016	-0.015	-0.013
Credit gap, month 6	-0.063 (0.015)	-0.038	-0.031	-0.007
Credit gap, month 12	-0.061 (0.013)	-0.048	-0.039	-0.008
Criterion Q (ten moments)		47.9	63.2	134.3

Note: Method of simulated moments estimates with returns to scale of 0.268, an energy share of 0.26, capital and energy at the Leontief limit ($\sigma_{KE} = 0.01$), a belief gain of 0.006, and cash measured in Orbis. Best fit searches $\sigma_{LG} \in [1.5, 4]$; the second column restricts $\sigma_{LG} \leq 3$. In both, 63 percent of firms without credit access hold cash that does not cover a month of operating costs ($\lambda = 0.63, \omega = 1$). The last column holds the elasticities of the best fit and measures cash against the electricity bill alone ($\lambda = 0.14, \omega = 0.43$). Standard errors in parentheses: for parameters, from 500 parametric bootstrap draws of the targeted moments re-estimated over the estimation grid, where at bound means that σ_{LG} is at the upper limit of its search in every draw; for data moments, from the 95 percent confidence intervals of the event studies. The credit gap is the response of large firms with credit access minus that of large firms without it.

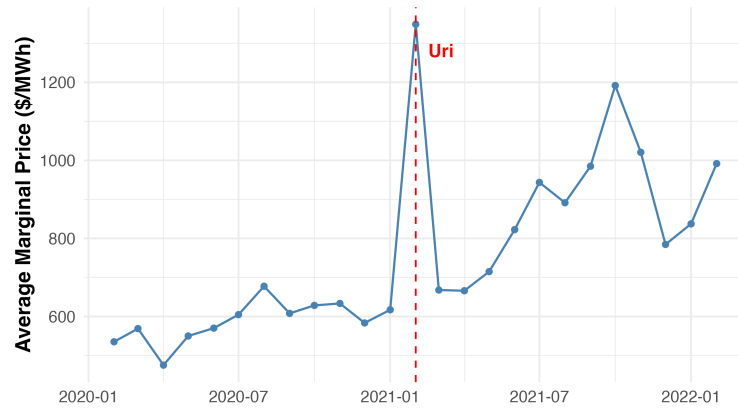
Table 23: Structural model: counterfactual policies at the best-fit estimates

	Shock, no policy	Credit guarantee, months			Energy subsidy	
		3	12	25	equal cost	5 percent
Large-firm employment	2.46	2.42	1.81	0.75	2.45	1.72
Small-firm employment	-1.36	-1.35	-1.26	-1.11	-1.35	-1.04
Total employment	-0.13	-0.14	-0.28	-0.52	-0.14	-0.16
Large-firm share (pp)	0.83	0.82	0.67	0.41	0.83	0.60
Output	-0.47	-0.45	-0.41	-0.35	-0.47	-0.18
Energy use	-6.41	-6.28	-5.89	-5.24	-6.32	-2.62
Fiscal cost (% of monthly wage bill)		0.12	0.46	1.02	1.02	44.29
Welfare gain (% of monthly wage bill)		2.24	6.89	14.16	0.34	11.56
Welfare gain, emissions priced		1.16	2.69	4.71	-0.37	-19.40

Note: Percent deviations from a municipality without the shock, averaged over the first twenty-four months, except the large-firm share, in percentage points. The guarantee lets firms without credit access borrow to pay the part of the energy bill their cash does not cover for the first D months; its fiscal cost is the expected loss at a ten percent loss rate. The equal-cost subsidy has the present-value cost of the twenty-five-month guarantee (a rate of 0.120 percent). Welfare is the present value of output net of energy at its resource cost and of recruiting costs, plus the value of non-employment at 40 percent of the mean wage, relative to the shock without policy; fiscal outlays are transfers. The emissions variant adds a cost of 0.90 times the pre-shock price per unit of energy (0.494 tCO₂e per MWh at 190 dollars per ton).

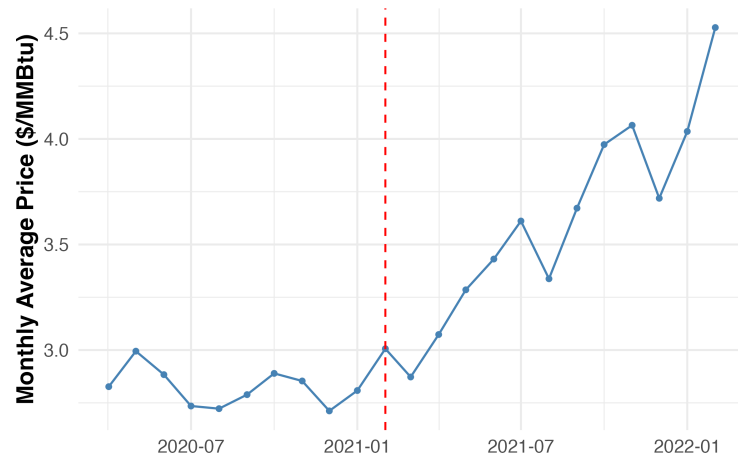
Figures

Figure 1: Monthly average wholesale electricity price around Winter Storm Uri



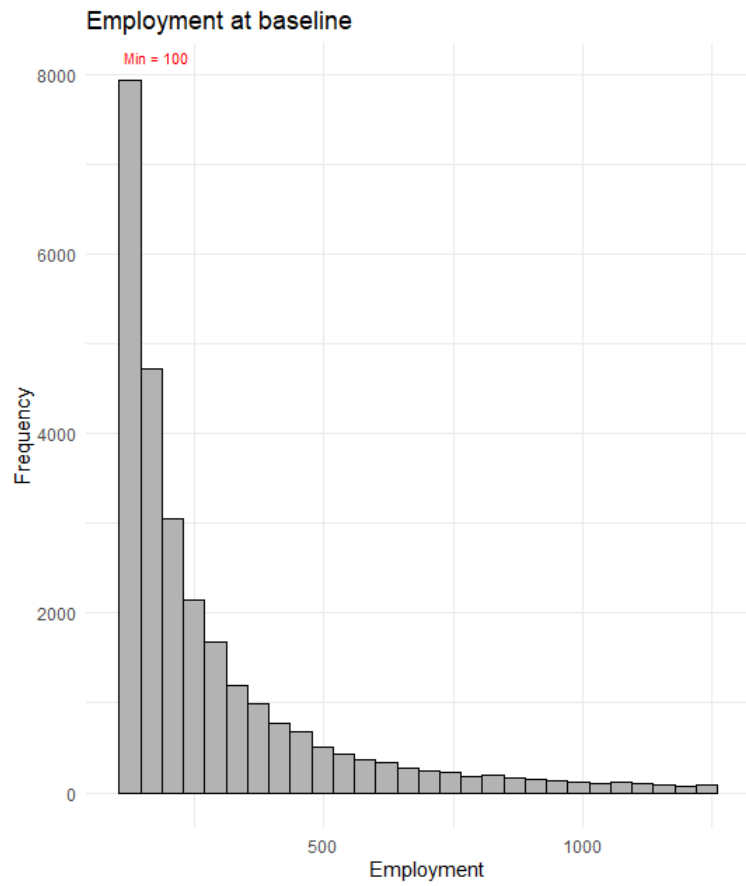
Note: Monthly average wholesale (nodal) electricity price across CENACE nodes. The series spikes sharply at Winter Storm Uri (February 2021) and does not return to its pre-shock level within the sample period. Source: CENACE.

Figure 2: Monthly average price of the 8-month forward Henry Hub natural gas futures contract



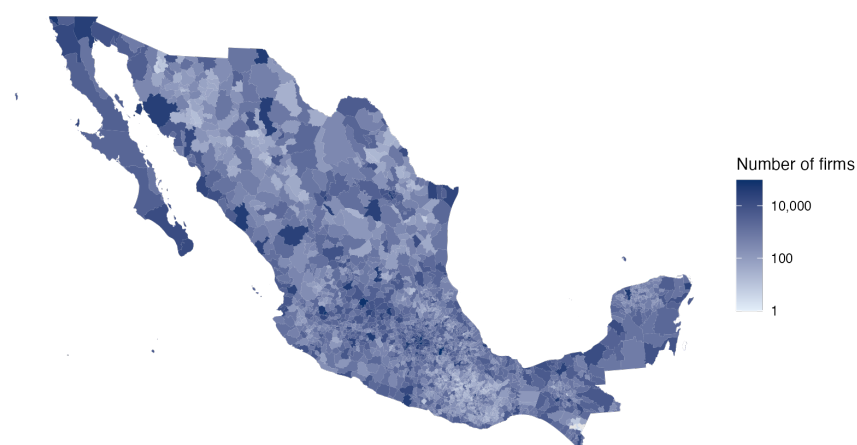
Note: Monthly average price of the eight-month forward Henry Hub natural gas futures contract, shown around Winter Storm Uri (February 2021). Source: Bloomberg.

Figure 3: Firms by size



Note: Distribution of firms by number of employees, grouped into the standard size categories (micro, small, medium, and large). The sample spans a wide range of firm sizes. Source: IMSS formal employer-employee records.

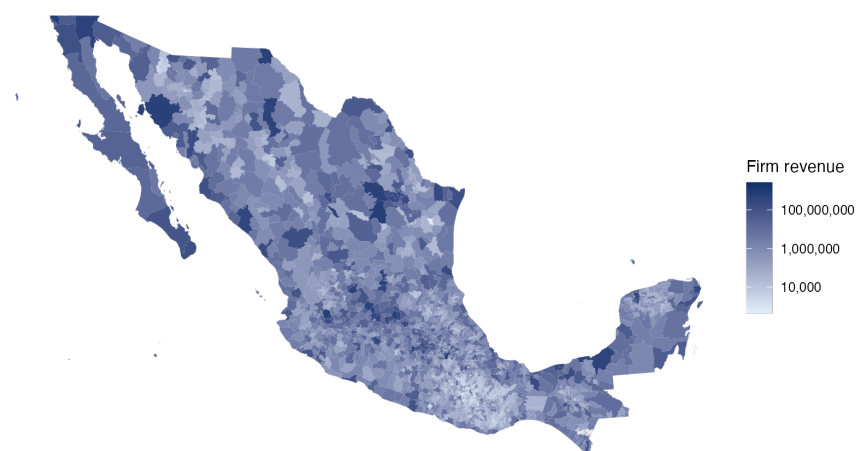
Figure 4: Number of firms by municipality (INEGI)



Source: INEGI Censos Economicos 2024 (formal and informal firms), by municipality

Note: Number of firms per municipality (formal and informal), from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024). These counts cover the universe of Mexican firms, not our estimation sample. The color scale is base-10 logarithmic. Municipality boundaries are from INEGI's Marco Geoestadístico (2022); grey denotes municipalities without reported data.

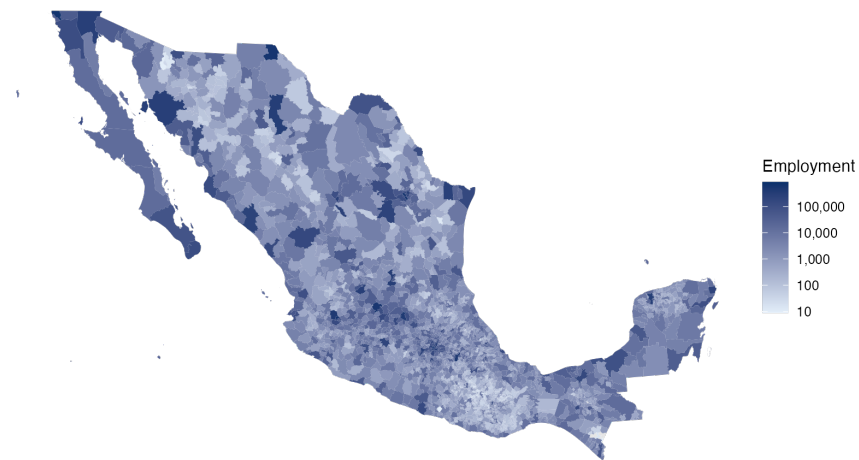
Figure 5: Firm revenue by municipality (INEGI)



Source: INEGI Censos Economicos 2024 (formal and informal firms), by municipality

Note: Total firm revenue (Mexican pesos) per municipality, from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024); base-10 logarithmic color scale. See Figure 4 for construction details.

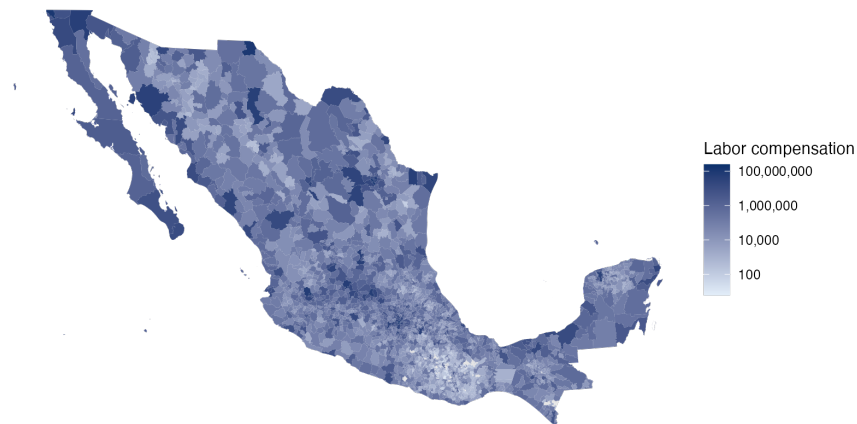
Figure 6: Employment by municipality (INEGI)



Source: INEGI Censos Economicos 2024 (formal and informal firms), by municipality

Note: Total employment per municipality, from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024); base-10 logarithmic color scale. See Figure 4 for construction details.

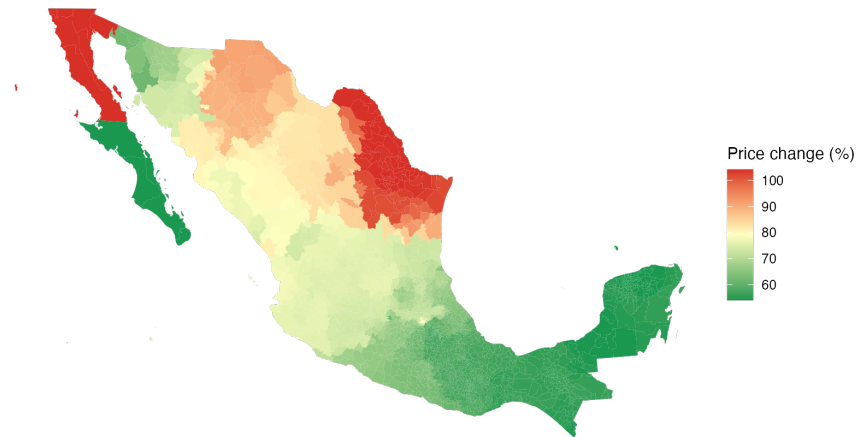
Figure 7: Labor compensation by municipality (INEGI)



Source: INEGI Censos Economicos 2024 (formal and informal firms), by municipality

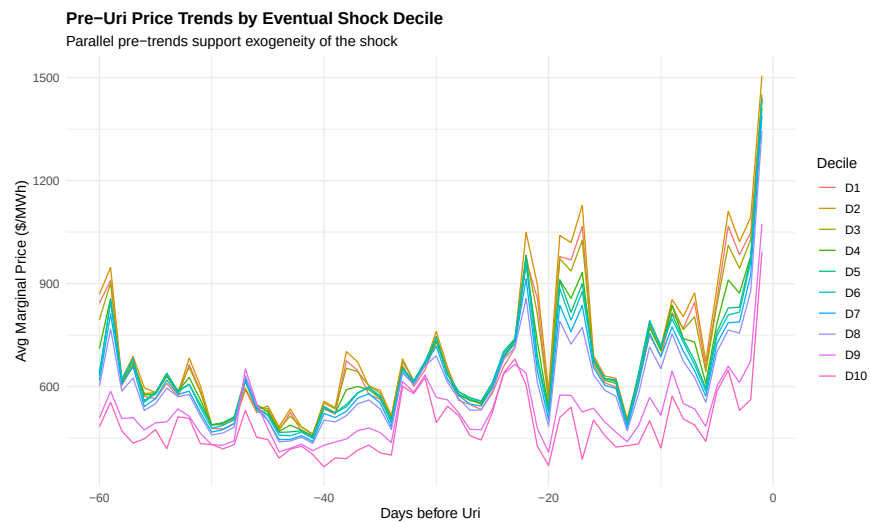
Note: Total labor compensation per municipality (Mexican pesos), from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024). Labor compensation is the total remuneration paid to workers (wages, salaries, and benefits), aggregated across all firms in the municipality. Base-10 logarithmic color scale; see Figure 4 for construction details.

Figure 8: Municipal-level change in wholesale electricity prices 30 days after Winter Storm Uri.



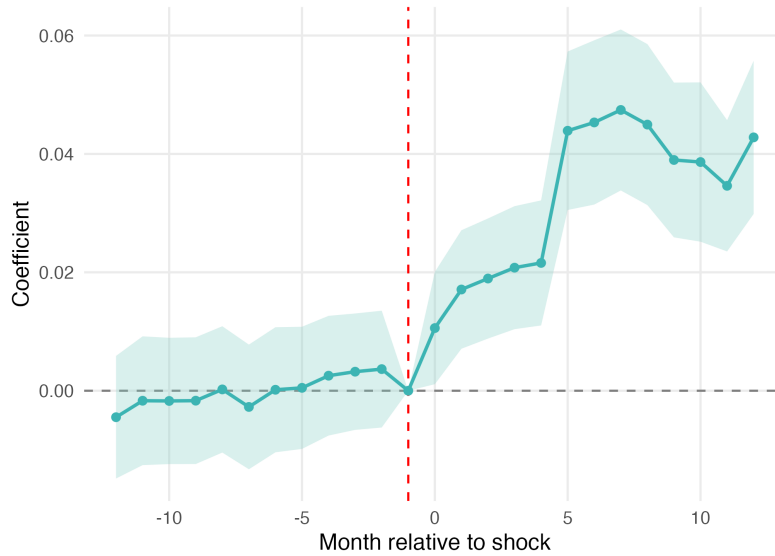
Note: Percentage change in municipal wholesale (nodal) electricity prices over the 30 days following Winter Storm Uri, relative to the pre-shock baseline. Increases run from green (smallest) to red (largest), concentrated in the gas-reliant north and in Mexico City. Source: CENACE and authors' calculations.

Figure 9: Pre-trends by shock decile



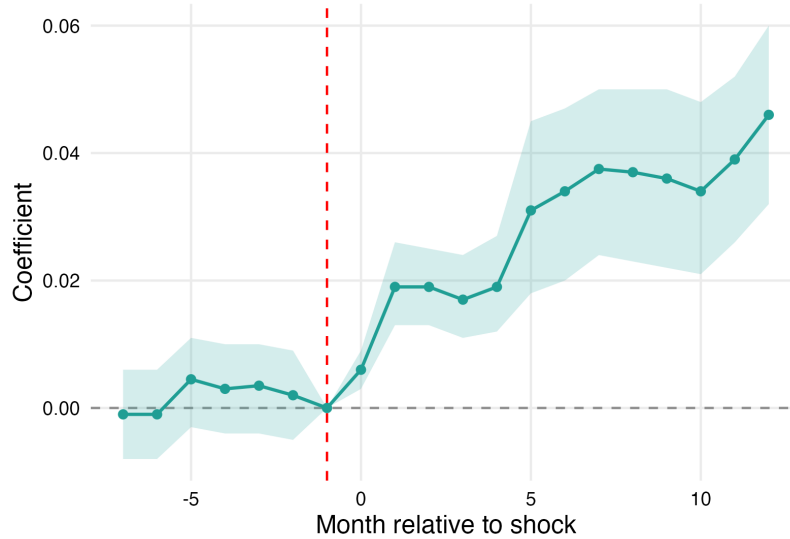
Note: Daily average price in the 60 days before Uri, by eventual shock decile. Parallel evolution across deciles supports the identifying assumption.

Figure 10: Employment Change following the increase in Energy Prices



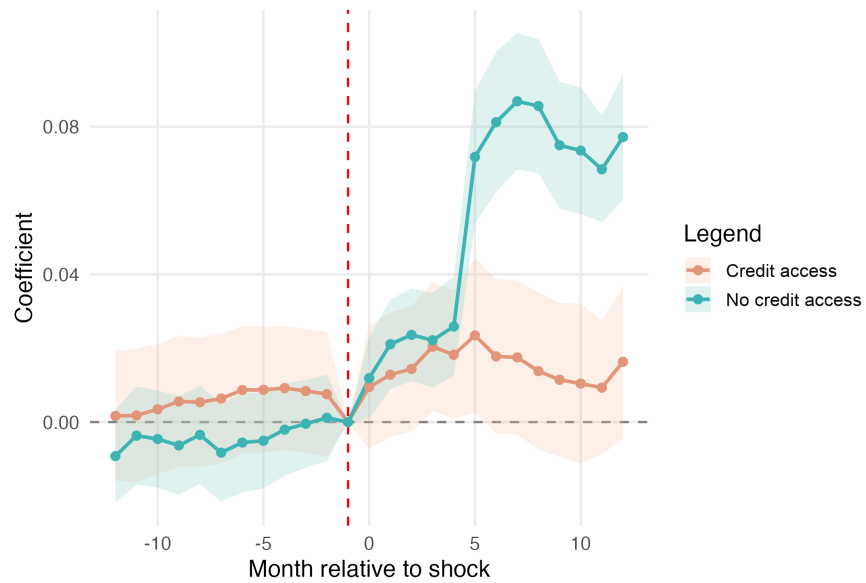
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. Employment and wage data are from IMSS.

Figure 11: Wage Change following the increase in Energy Prices



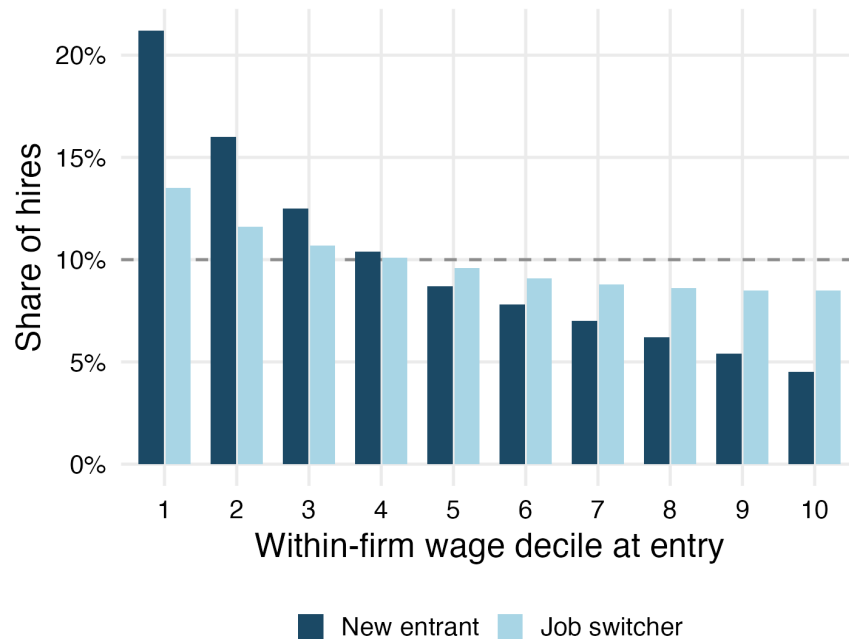
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. Employment and wage data are from IMSS.

Figure 12: Employment Change following the increase in Energy Prices, by Credit Access



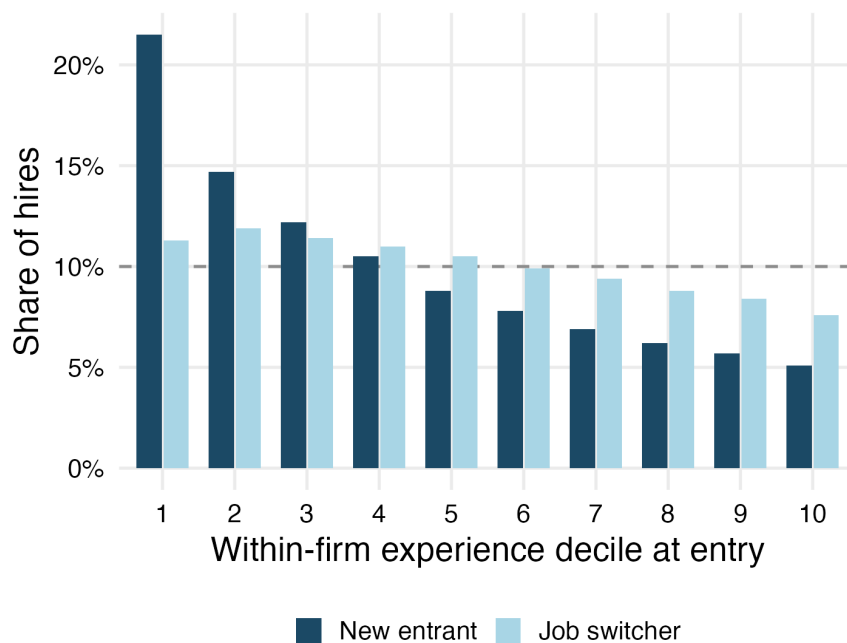
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. The figure plots the employment response separately for firms with and without pre-shock credit access. Employment data are from IMSS.

Figure 13: New Entrants and Job Switchers Wage with respect to existing workers in the firm



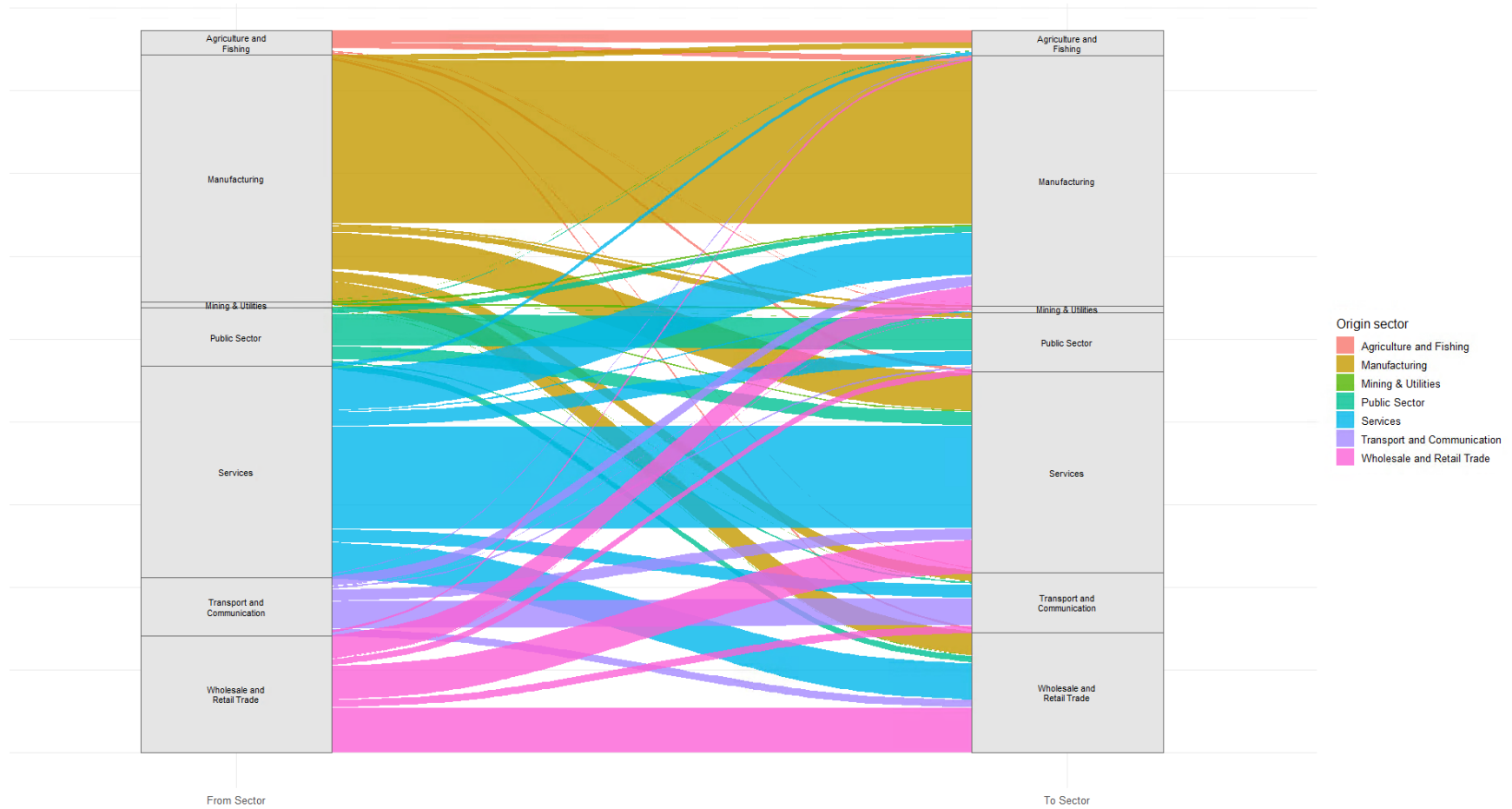
Note: Each post-shock hire is placed into a decile of the hiring firm's existing wage distribution according to its entry wage (decile 1 = lowest-paid within the firm, decile 10 = highest-paid). Bars give the share of hires falling in each decile, shown separately for new entrants (workers entering formal employment) and job switchers (workers moving from another firm). The dashed line at 10% is the uniform benchmark, the share each decile would receive if hires entered at random positions in the firm's wage distribution; mass above the line in the lowest deciles therefore means hires disproportionately enter at the bottom of the firm's pay ladder. Source: IMSS.

Figure 14: New Entrants and Job Switchers Experience with respect to existing workers in the firm



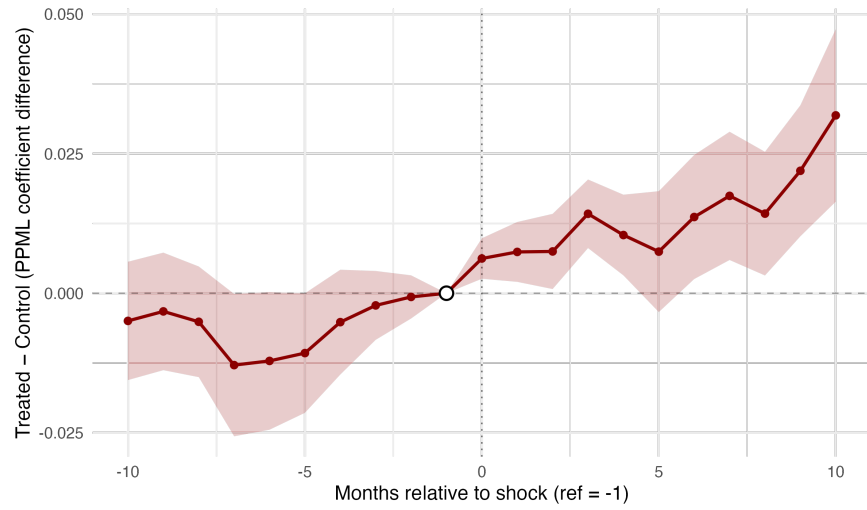
Note: Each post-shock hire is placed into a decile of the hiring firm’s existing experience distribution according to its experience at entry (decile 1 = least experienced within the firm, decile 10 = most experienced). Bars give the share of hires falling in each decile, shown separately for new entrants (workers entering formal employment) and job switchers (workers moving from another firm). The dashed line at 10% is the uniform benchmark, the share each decile would receive if hires entered at random positions in the firm’s experience distribution; mass above the line in the lowest deciles therefore means hires disproportionately enter at the bottom of the firm’s experience ladder. Source: IMSS.

Figure 15: Flow of Workers post Shock



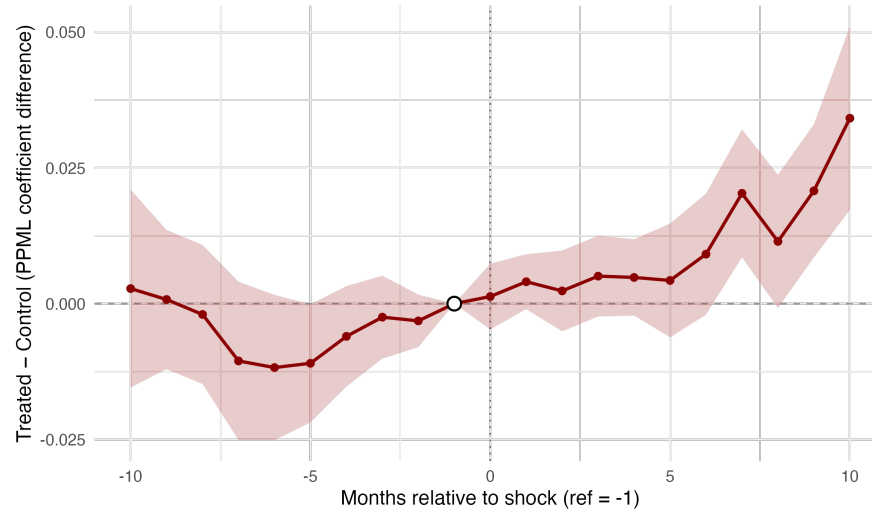
Note: Flows of workers across one-digit economic sectors in the period following Winter Storm Uri, constructed from matched employer-employee records. Source: IMSS.

Figure 16: Change in Debt before and after the energy shock.



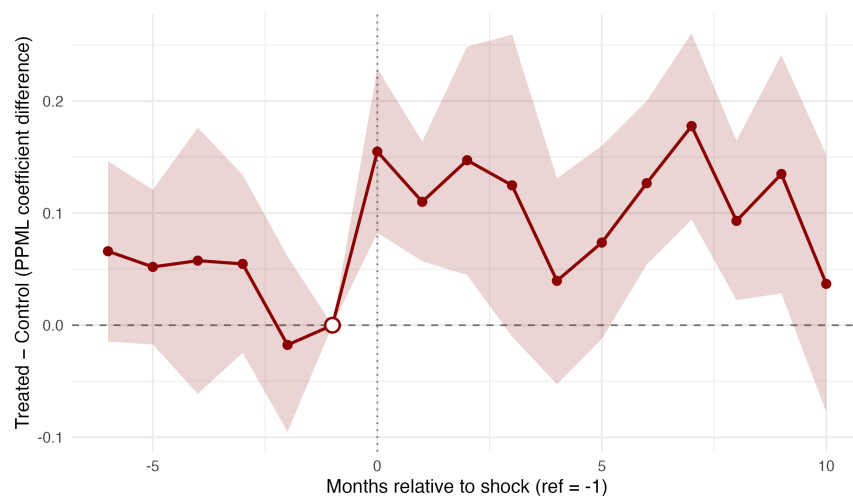
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. Credit outcomes are from the R04C credit registry.

Figure 17: Change in Interest Charged before and after the energy shock.



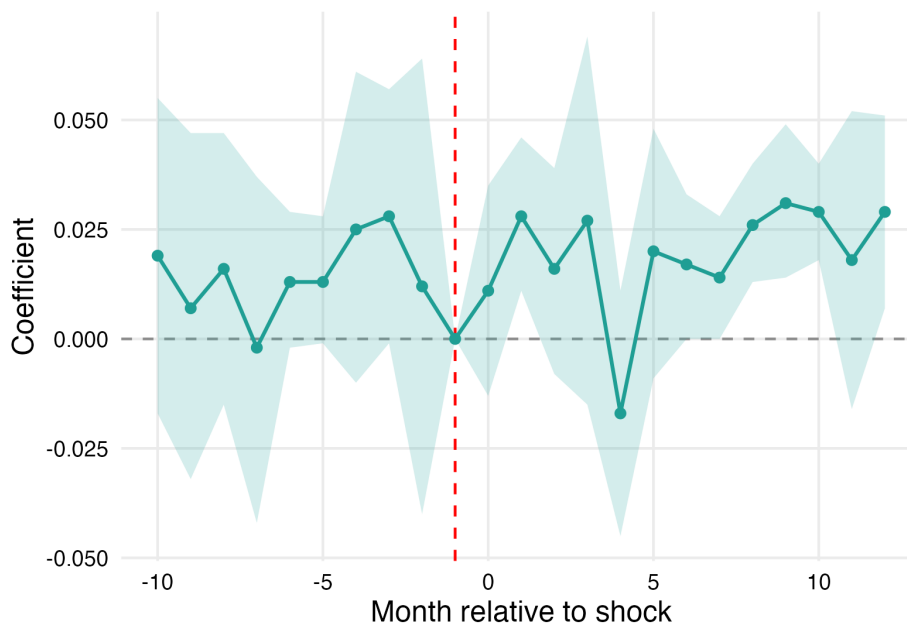
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. Credit outcomes are from the R04C credit registry.

Figure 18: Change in New Credit before and after the energy shock.



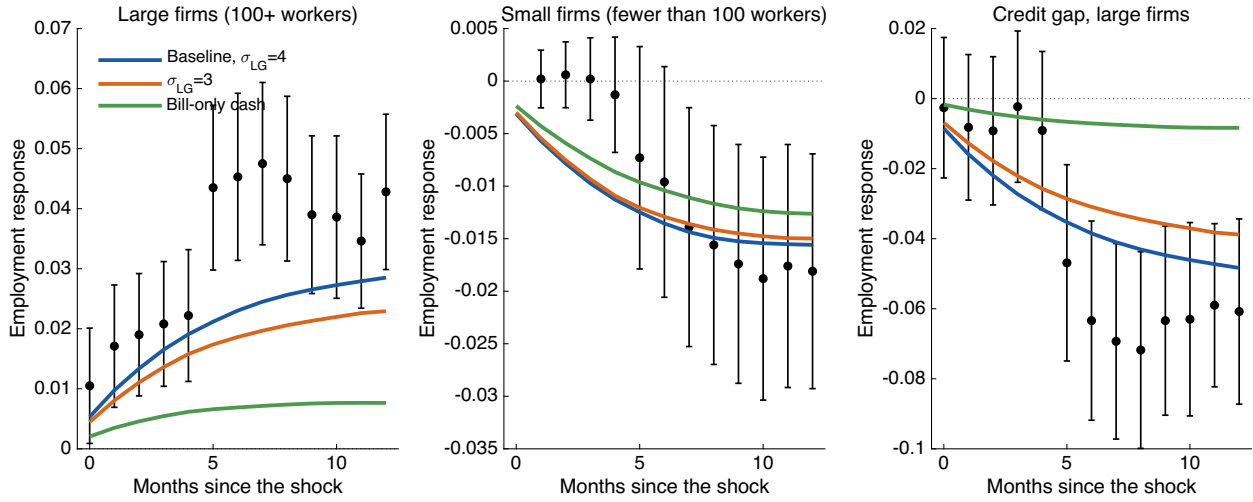
Note: Event-study coefficients with 95% confidence intervals; standard errors are clustered at the municipality level. The omitted period is immediately before Winter Storm Uri. Credit outcomes are from the R04C credit registry.

Figure 19: Event-study coefficients for firm exit



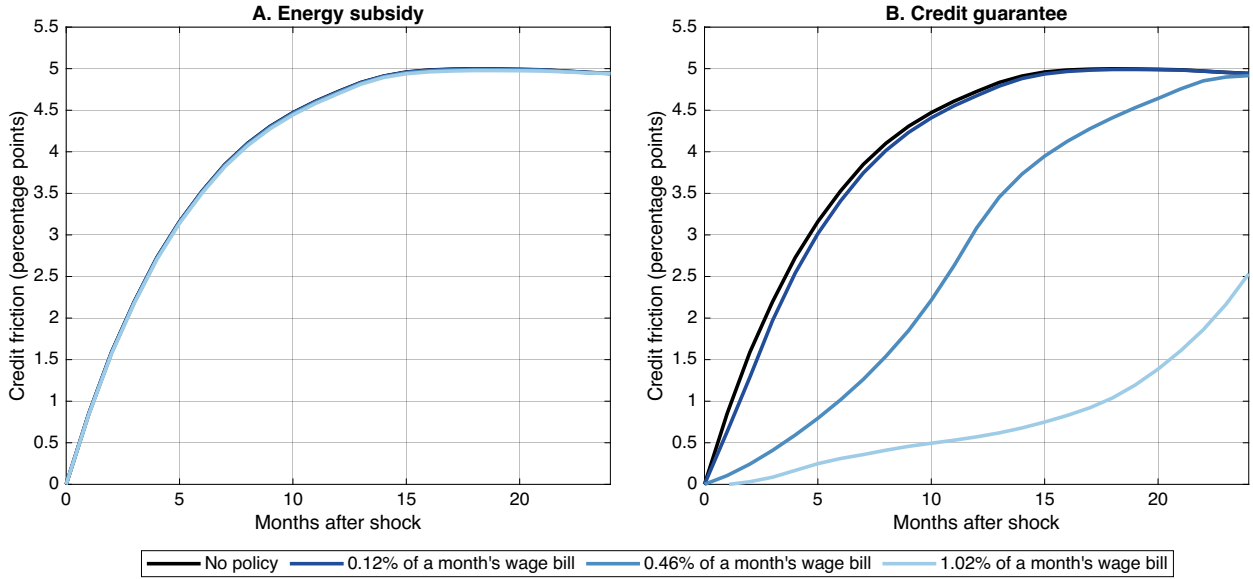
Note: Coefficients from the continuous difference-in-differences specification with firm exit as the dependent variable. The vertical dashed line marks the onset of the energy price shock (February 2021). Bars indicate 95% confidence intervals, based on standard errors clustered at the municipality level. Firm exit is measured from IMSS employment records.

Figure 20: Structural model: fit of the event-study paths



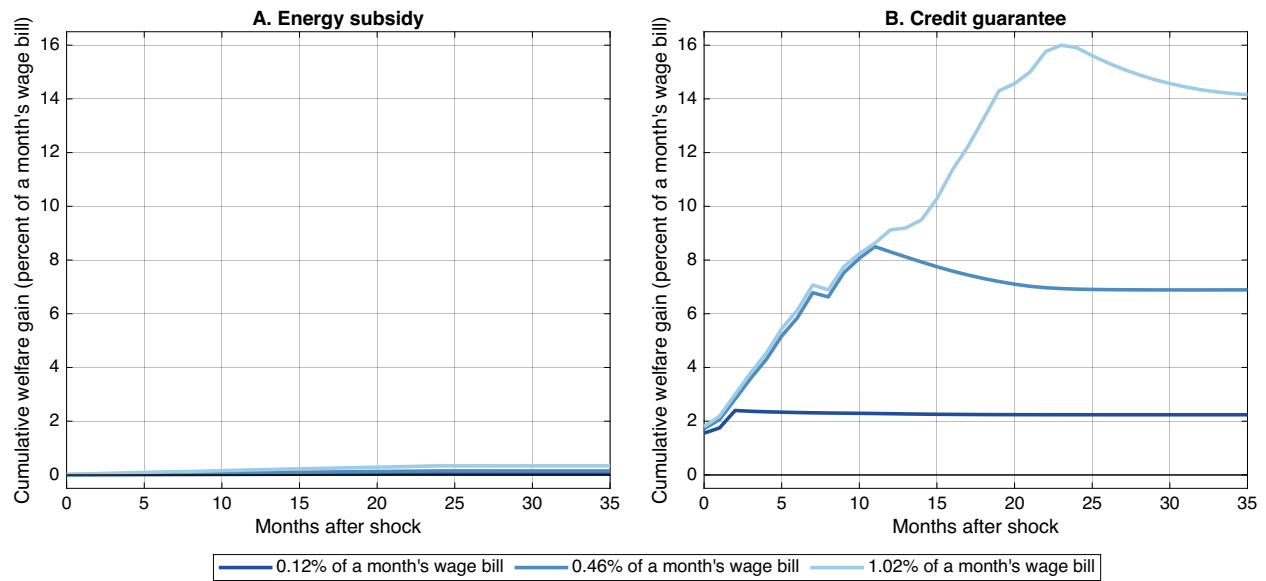
Note: Employment responses to a one standard deviation increase in exposure, months 0 to 12, model against the reduced-form estimates with 95 percent confidence intervals. Large-firm and credit-gap estimates are read from Figures 10 and 12; small-firm estimates are digitized from the event study for firms with fewer than 100 workers. Months 3, 6, 9, and 12 (large and small firms) and 6 and 12 (credit gap) are targeted. The credit gap is the response of large firms with credit access minus that of large firms without it.

Figure 21: Structural model: the two instruments at the same fiscal cost



Note: Credit friction: the employment response of large firms without credit access minus that of large firms with credit access, in percentage points relative to the path without the shock, at the best-fit estimates. Each line is a policy whose expected fiscal cost is the share of a month's wage bill shown in the legend: credit guarantees lasting 3, 12, and 25 months (Panel B) and energy subsidies of the same cost (Panel A). The horizontal axis covers the twenty-four months of the measured price increase.

Figure 22: Structural model: welfare gains of the two instruments at the same fiscal cost



Note: Cumulative discounted welfare gain relative to no policy, in percent of a month's wage bill, at the best-fit estimates. Welfare is output net of energy and recruiting costs plus the value of non-employment. Each line is a policy whose expected fiscal cost is the share of a month's wage bill shown in the legend: energy subsidies (Panel A) and credit guarantees lasting 3, 12, and 25 months (Panel B). The value at month 35 is the welfare gain reported in Table 23.

Online Appendix

A Appendix Tables

Table A1: Distribution of Firms and Employment by State (INEGI)

State	Firms	Firms (%)	Employment	Emp. (%)
México	749,365	13.70	2,795,495	10.00
Ciudad de México	425,005	7.77	3,556,589	12.72
Puebla	368,108	6.73	1,251,065	4.47
Jalisco	365,421	6.68	2,092,026	7.48
Veracruz	314,344	5.75	1,111,079	3.97
Guanajuato	270,040	4.94	1,454,251	5.20
Michoacán	260,631	4.77	832,096	2.98
Oaxaca	252,176	4.61	612,999	2.19
Chiapas	208,717	3.82	590,159	2.11
Nuevo León	181,791	3.32	1,925,137	6.88
Guerrero	167,069	3.06	468,411	1.67
Hidalgo	142,566	2.61	502,740	1.80
Yucatán	130,438	2.39	574,909	2.06
Tamaulipas	129,404	2.37	875,866	3.13
Sinaloa	122,935	2.25	634,394	2.27
Chihuahua	122,407	2.24	1,121,537	4.01
Baja California	120,980	2.21	1,155,112	4.13
San Luis Potosí	113,597	2.08	606,745	2.17
Sonora	110,691	2.02	772,126	2.76
Coahuila	109,235	2.00	984,646	3.52
Morelos	101,601	1.86	378,904	1.35
Querétaro	97,696	1.79	718,723	2.57
Tlaxcala	87,264	1.60	268,002	0.96

Continued on the next page

Table A1 – continued from the previous page

State	Firms	Firms (%)	Employment	Emp. (%)
Tabasco	83,884	1.53	356,746	1.28
Zacatecas	65,541	1.20	262,299	0.94
Nayarit	64,937	1.19	256,320	0.92
Durango	64,760	1.18	351,860	1.26
Aguascalientes	64,549	1.18	423,999	1.52
Quintana Roo	58,722	1.07	431,158	1.54
Campeche	41,385	0.76	193,656	0.69
Colima	36,776	0.67	178,977	0.64
Baja California Sur	36,145	0.66	227,389	0.81

Note: Number of firms and total employment by state, from INEGI’s Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024). Counts cover the universe of formal and informal firms rather than our estimation sample. “Firms (%)” and “Emp. (%)” give each state’s share of the national total. States are ordered by number of firms; names follow INEGI’s Marco Geoestadístico.

Table A2: Balance - Firms With and Without Credit Access in the Estimation Sample

Credit access	Number of Firms	Average Employment	Average Wage
Without	17,489	388.42	193,136.67
With	12,151	385.74	199,330.27

Note: Firm counts, average employment (registered workers), and average monthly wage (Mexican pesos) for firms with and without access to formal bank credit in the five months before the shock, within the estimation sample of firms with at least 100 employees. Firms with and without credit access are similar in size and pay comparable wages.

Table A3: Credit Moderation interacted with Firm Size

	(1) Employment	(2) Wage Bill
After the Natural Gas Price Increase	0.054***	0.047***
× Energy Price Change (1 SD)	(0.008)	(0.006)
After the Natural Gas Price Increase	−0.027***	−0.023*
× Energy Price Change (1 SD) × Credit Access	(0.005)	(0.014)
After the Natural Gas Price Increase		
× Energy Price Change (1 SD) × Credit Access	0.005	0.009
× Log Baseline Employment	(0.020)	(0.011)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry × Month Fixed Effects	Yes	Yes
Municipality × Month Fixed Effects	Yes	Yes
Observations	922,980	918,681

Note: PPML estimates that add a quadruple interaction of the shock, credit access, and log baseline employment to the credit specification. The credit interaction ($\Delta P_m \times \text{Post}_t \times \text{Credit}_i$) stays negative and significant, while its interaction with log baseline employment is small and statistically insignificant for both outcomes, so the credit-access moderation of the response does not vary with firm size. Standard errors clustered at the firm level in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A4: Energy-price shock and local economic activity

	Correlation with ΔP_m
Number of firms	0.12
Employment	0.20

Note: Correlations across Mexican municipalities between the 30-day post-Uri change in the local wholesale electricity price (ΔP_m) and the log of each measure of local economic activity, from INEGI's Censos Económicos 2024 (Instituto Nacional de Estadística y Geografía, 2024). The weak correlations indicate that the geography of the shock does not track where economic activity is concentrated. Based on 2,469 municipalities.

Table A5: Effect of energy price increases on collateral backed borrowing

	Credit Outstanding (1)	Average Interest (2)	New Credit (3)
$\Delta P_m \times \text{Post}_t$	0.0249** (0.0124)	0.0007 (0.0036)	0.1190*** (0.0338)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	79,584	78,380	42,292

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A6: Effect of energy price increases on debt refinancing

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0231*	-0.0196***	0.2951**
	(0.0142)	(0.0053)	(0.1405)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	24,113	23,622	9,866

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A7: Effect of energy price increases on working capital

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0016	0.0071***	0.0053
	(0.0053)	(0.0018)	(0.0089)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	249,362	240,605	174,722

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A8: Effect of energy price increases on liquidation finance

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.1351*	−0.0016	0.2596
	(0.0729)	(0.0107)	(1.4092)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	2,098	2,079	151

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A9: Effect of energy price increases on real estate finance

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0907***	−0.0124	0.1102
	(0.0356)	(0.0089)	(0.1689)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	3,824	3,823	2,455

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A10: Effect of energy price increases on project finance

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	-0.0107 (0.0284)	-0.0071 (0.0071)	-0.0693 (0.3450)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	3,021	3,023	804

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A11: Effect of energy price increases on credit card

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.1476 (0.2098)	0.0071 (0.0142)	-0.0533 (0.2151)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	759	302	455

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A12: Effect of energy price increases on stocks, bonds, derivatives

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	−0.0373	−0.0142	−0.1760
	(0.0516)	(0.0196)	(0.3432)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	820	731	332

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on the credit product named in the caption, following the specification in Table 15. Standard errors are clustered at the municipality level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A13: Effect of energy price increases on firms in the agriculture sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0249 (0.0249)	0.0356 (0.0284)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0658 (0.0516)	-0.0818 (0.0676)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	36,978	35,954

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A14: Effect of energy price increases on firms in the construction sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0338 (0.0373)	0.0445 (0.0409)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0658 (0.0818)	-0.1156 (0.1245)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	59,549	59,549

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A15: Effect of energy price increases on firms in the manufacturing sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0516*** (0.0071)	0.0284*** (0.0053)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0213** (0.0107)	-0.0142 (0.0099)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	271,128	271,128

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A16: Effect of energy price increases on firms in the mining sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	-0.0978** (0.0391)	-0.0996*** (0.0391)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	0.0533 (0.0711)	0.0729 (0.0605)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	7,759	7,759

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A17: Effect of energy price increases on firms in the public sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0053 (0.0053)	0.0124*** (0.0036)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0124 (0.0089)	-0.0053 (0.0089)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	73,867	73,867

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A18: Effect of energy price increases on firms in the retail sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0338 (0.0373)	0.0445 (0.0409)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0658 (0.0818)	-0.1173 (0.1245)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	59,549	59,549

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A19: Effect of energy price increases on firms in the service sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0089 (0.0142)	0.0071 (0.0196)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0320 (0.0231)	-0.0006 (0.0249)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	217,705	214,502

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A20: Effect of energy price increases on firms in the transport sector - employment and wage

	(1) Employment	(2) Wage Bill
$\Delta P_m \times \text{Post}_t$	0.0551 (0.0409)	0.0480 (0.0302)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.0160 (0.0445)	0.0071 (0.0373)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Observations	68,174	68,174

Note: Poisson (PPML) estimates of the effect of a one-standard-deviation increase in local electricity prices on employment and the wage bill for the sector named in the caption, following the credit-access specification in Table 7. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A21: Effect of energy price increases on firms in the agriculture sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	-0.0160 (0.0107)	-0.0142 (0.0124)	-0.1760 (0.1849)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	3,711	3,692	3,444

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A22: Effect of energy price increases on firms in the construction sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	-0.0016 (0.0142)	-0.0089 (0.0107)	0.0089 (0.0391)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	16,159	16,121	14,866

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A23: Effect of energy price increases on firms in the manufacturing sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0391*	0.0089***	0.0409
	(0.0196)	(0.0036)	(0.0267)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	29,709	29,846	26,017

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A24: Effect of energy price increases on firms in the mining sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0445**	-0.0012	0.0391
	(0.0178)	(0.0071)	(0.0302)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	25,147	24,183	23,226

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A25: Effect of energy price increases on firms in the public sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0089	0.0267	0.4232**
	(0.0249)	(0.0302)	(0.2116)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	957	957	706

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A26: Effect of energy price increases on firms in the retail sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0015	0.0036	0.0533**
	(0.0142)	(0.0071)	(0.0213)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	44,047	43,435	40,281

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A27: Effect of energy price increases on firms in the service sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
Post $\times$ Energy Price Change (1 SD)	-0.0213 (0.0427)	0.0213 (0.0160)	-0.1476 (0.2897)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	428	428	364

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A28: Effect of energy price increases on firms in the transport sector - financial outcomes

	Credit Outstanding	Average Interest	New Credit
	(1)	(2)	(3)
$\Delta P_m \times \text{Post}_t$	0.0107 (0.0089)	0.0053 (0.0036)	0.0338** (0.0160)
Firm Fixed Effects	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes
Observations	86,567	82,144	81,651

Note: PPML estimates of the effect of a one-standard-deviation increase in local electricity prices on firms' credit outcomes for the sector named in the caption, following the specification in Table 15. Standard errors are clustered at the firm level. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A29: Robustness - distance from the U.S. border

	Employment	Wage Bill
	(1)	(2)
$\Delta P_m \times \text{Post}_t$	0.045*** (0.007)	0.038*** (0.004)
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$	-0.042*** (0.008)	-0.024** (0.010)
Firm Fixed Effects	Yes	Yes
Month-Year Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Distance to U.S. Border $\times$ Month Fixed Effects	Yes	Yes
Observations	922,980	918,681

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$. The municipality-by-month fixed effects are replaced with distance from the U.S. border interacted with month fixed effects. Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A30: Robustness - distance from the U.S. border, credit outcomes

	Debt	Interest rate	New credit	Credit used
	(1)	(2)	(3)	(4)
$\Delta P_m \times \text{Post}_t$	0.017**	0.003	0.031***	0.010**
	(0.007)	(0.002)	(0.011)	(0.005)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	No
Distance to U.S. Border $\times$ Month Fixed Effects	Yes	Yes	Yes	Yes
Observations	171,490	171,490	152,617	171,424

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$. The municipality-by-month fixed effects are replaced with distance from the U.S. border interacted with month fixed effects. Outcomes are total debt, the average interest rate, new credit, and the share of credit lines drawn down. Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

Table A31: Robustness - the window used to measure credit access

	3 months		6 months		9 months	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Employment</i>						
$\Delta P_m \times \text{Post}_t$	0.052***		0.048***		0.054***	
	(0.007)		(0.006)		(0.009)	
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$		-0.033***		-0.038***		-0.040***
		(0.010)		(0.008)		(0.007)
<i>Wage Bill</i>						
$\Delta P_m \times \text{Post}_t$	0.041***		0.052***		0.050***	
	(0.006)		(0.008)		(0.007)	
$\Delta P_m \times \text{Post}_t \times \text{Credit}_i$		-0.017*		-0.033***		-0.019**
		(0.008)		(0.011)		(0.010)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Municipality $\times$ Month Fixed Effects	No	Yes	No	Yes	No	Yes
Observations, employment	922,980	922,980	922,980	922,980	922,980	922,980
Observations, wage bill	918,681	918,681	918,681	918,681	918,681	918,681

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$. Columns are grouped by the window over which pre-shock credit access is measured, namely the three, six, and nine months before February 2021, and within each window the first column omits municipality-by-month fixed effects and the second includes them. Those fixed effects absorb $\Delta P_m \times \text{Post}_t$ entirely, so the average price effect is reported in the first column of each pair and the credit-access interaction of equation (2) in the second, as in Table 7. A firm is coded as having credit access if it appears in the R04C credit registry at any point within the window. Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

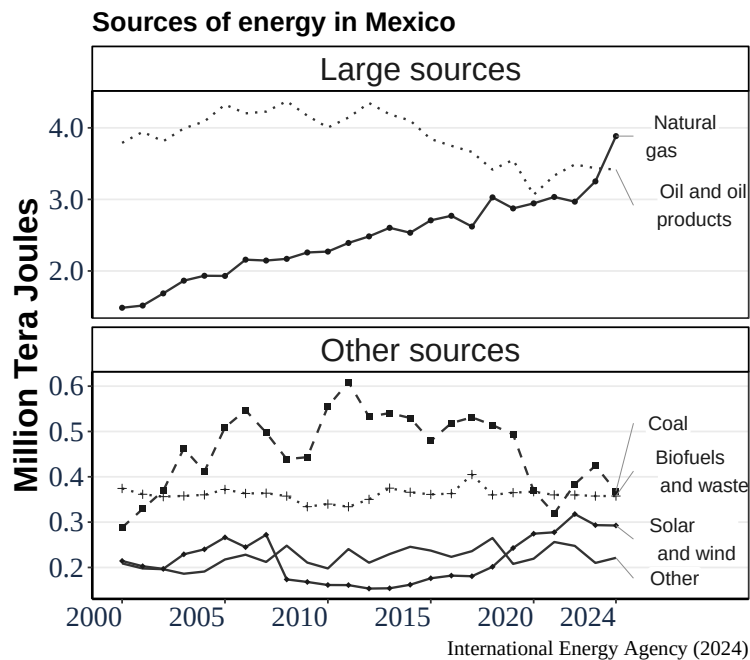
Table A32: Robustness - high and low energy intensity sectors

	Employment	Wage Bill
	(1)	(2)
$\Delta P_m \times \text{Post}_t \times \text{High Energy Intensity}_s$	0.070*** (0.005)	0.062*** (0.007)
$\Delta P_m \times \text{Post}_t \times \text{Low Energy Intensity}_s$	0.017*** (0.007)	0.022** (0.009)
Firm Fixed Effects	Yes	Yes
Industry $\times$ Month Fixed Effects	Yes	Yes
Municipality $\times$ Month Fixed Effects	No	No
Observations	922,980	918,681

Note: Entries report proportional effects implied by Poisson fixed-effects estimates for a one standard-deviation increase in the municipality energy price change, computed as $e^{\beta \cdot SD} - 1$. Sectors are split at the median of pre-shock energy intensity, and the price shock is interacted with an indicator for each half rather than with their difference, so that the two coefficients report the absolute response of the high- and low-intensity groups rather than a contrast between them. The specification therefore omits municipality-by-month fixed effects, which would absorb the average price effect and identify only the difference between the groups. The credit-access interaction is included as in equation (2). Standard errors clustered at the municipality level are in parentheses. We denote significance using * for 10%, ** for 5%, and *** for 1%.

B Appendix Figures

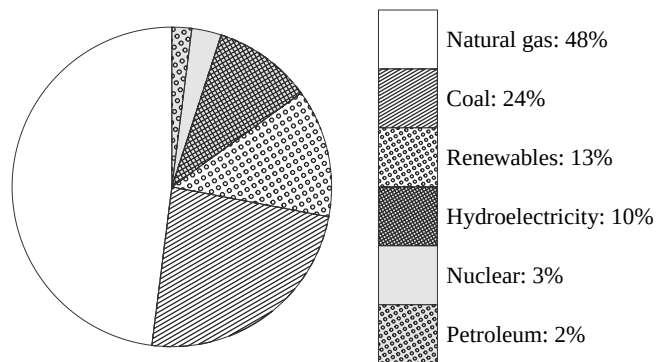
Figure A1: Total energy supply by source



Note: Total primary energy supply in Mexico by source. Fossil fuels (oil and natural gas) account for the large majority of supply, with renewables a modest share. Source: IEA (International Energy Agency).

Figure A2: Electricity generation by source

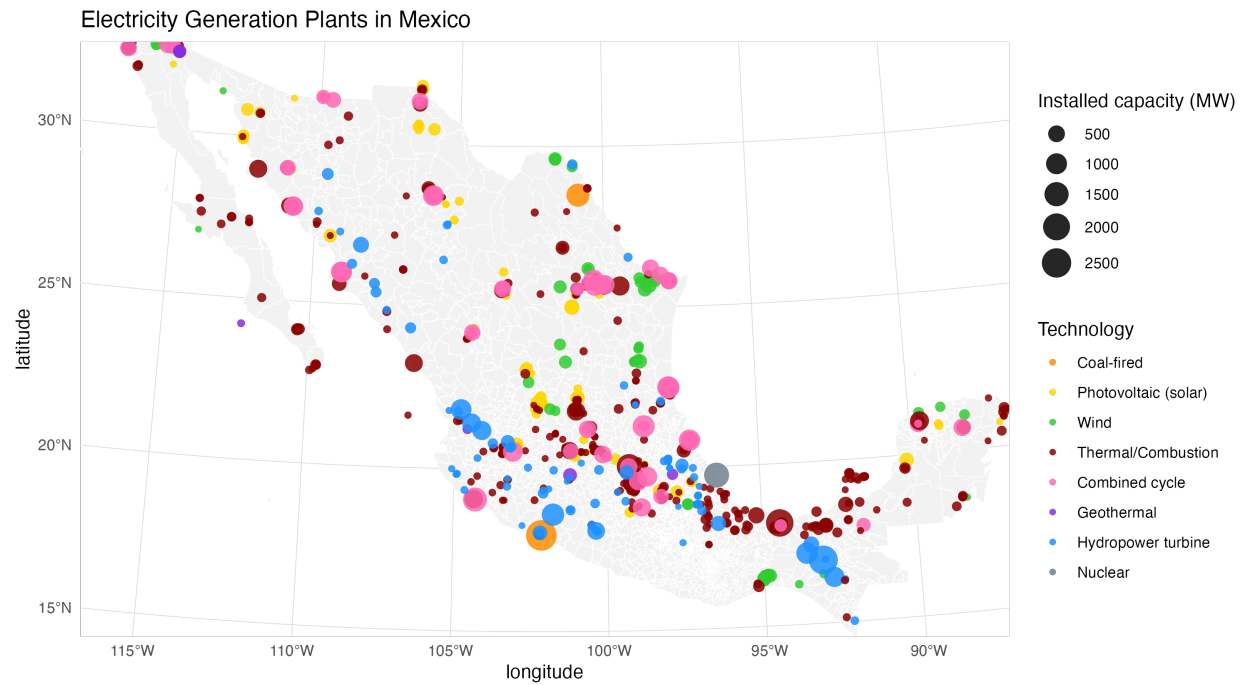
Electricity generation by source, Mexico



International Energy Agency (2021)

Note: Electricity generation in Mexico by source. Generation is dominated by natural gas, leaving the power system exposed to disruptions in cross-border gas supply. Source: IEA (International Energy Agency).

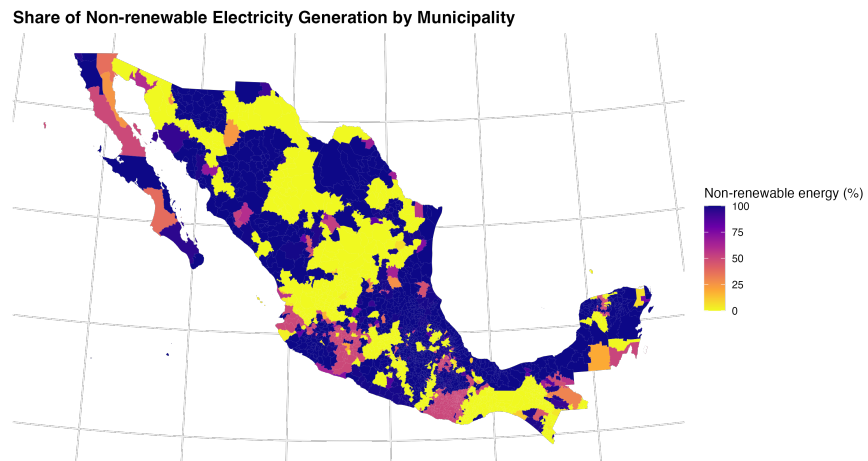
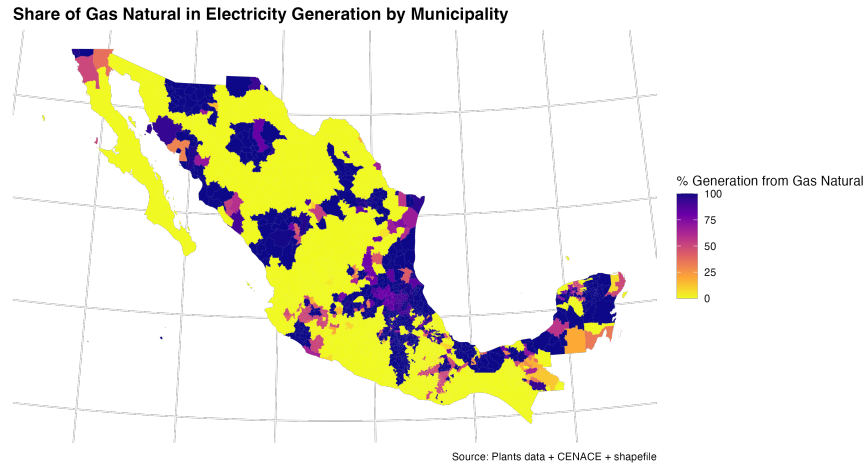
Figure A3: Mexico plant location, type and generation capacity.



Note: Each marker is an electricity-generation plant, colored by generation technology and sized by installed capacity.

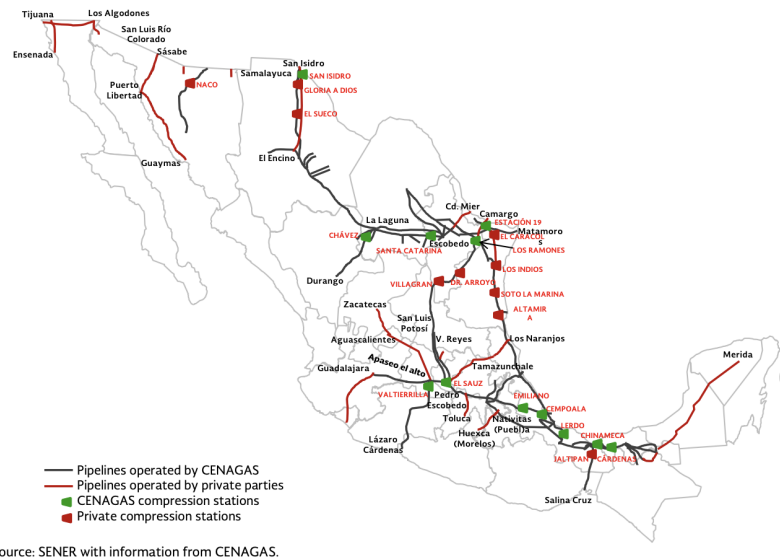
Gas-fired plants cluster in the north and center of the country, while renewable capacity is sparse and spatially concentrated. Source: plant locations obtained through a Freedom of Information request to Mexico's Secretaría de Energía; authors' calculations.

Figure A4: Municipal energy mix: natural gas and non-renewable generation shares.



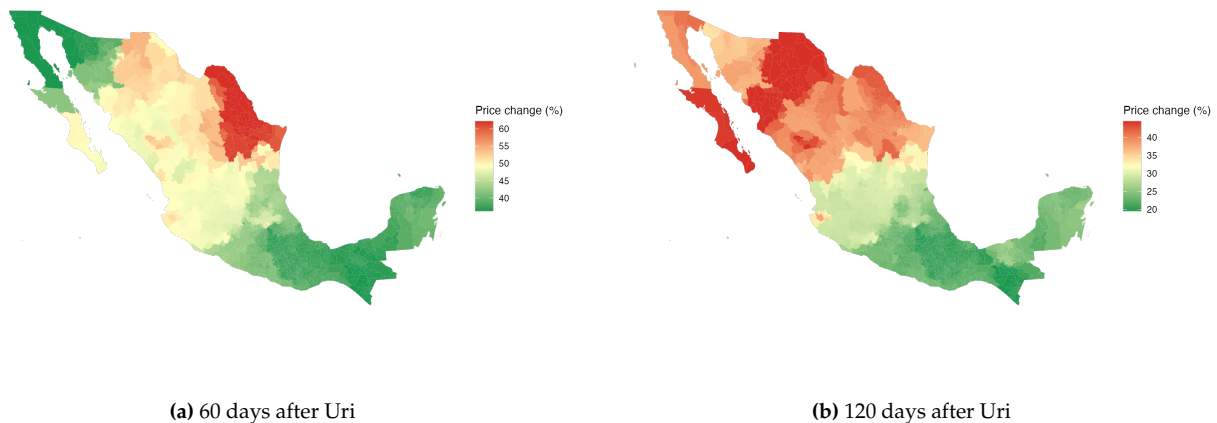
Note: Municipal shares of generation from natural gas (left) and from all non-renewable sources (right). Darker shading denotes greater local reliance; gas dependence is concentrated near pipelines and import terminals in the north. Source: CENACE and authors' calculations.

Figure A5: Mexico's Natural Gas Pipeline



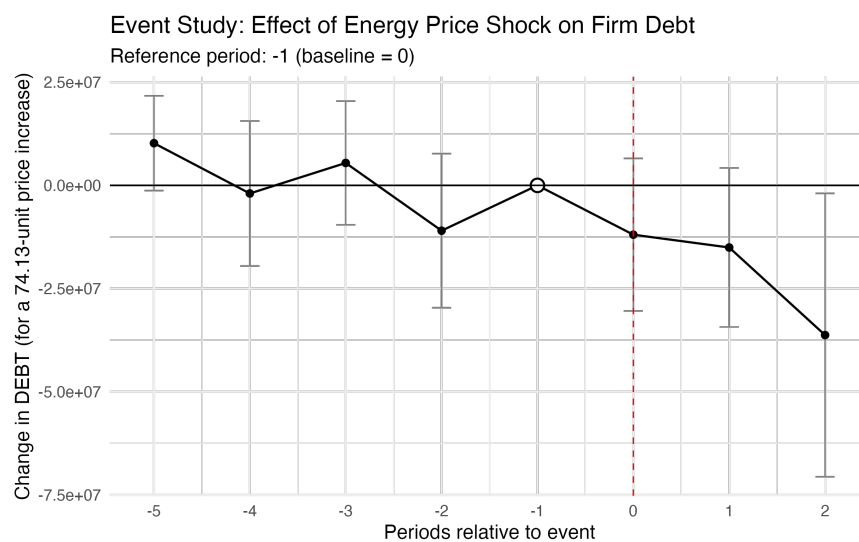
Note: Mexico's natural gas pipeline network, which carries imported U.S. natural gas into the interior. Reliance on a limited set of cross-border pipelines concentrates the exposure of domestic power generation to disruptions in U.S. supply. Source: Secretaría de Energía (SENER).

Figure A6: Persistence of municipal price exposure: 60 and 120 days after Winter Storm Uri



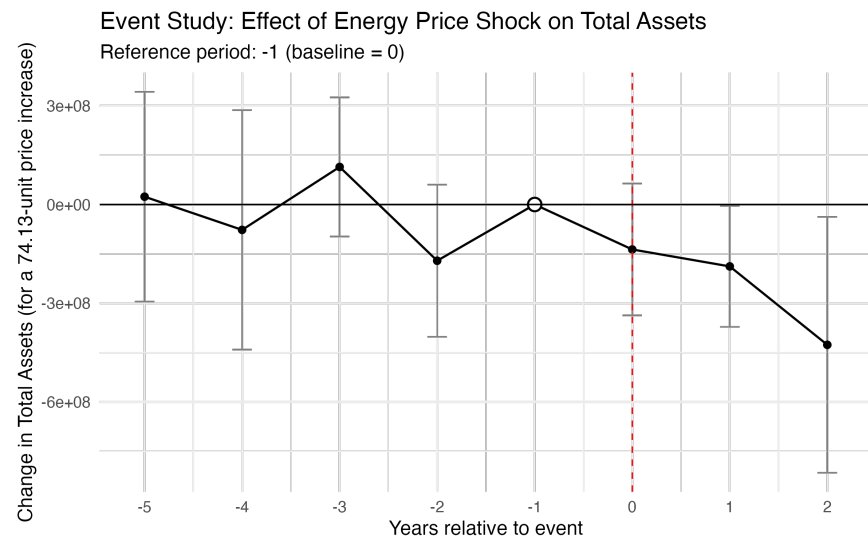
Note: Percentage change in municipal wholesale (nodal) electricity prices 60 days (left) and 120 days (right) after Winter Storm Uri, relative to the pre-shock baseline. The spatial pattern of exposure persists well beyond the initial shock. Source: CENACE and authors' calculations.

Figure A7: Event Study Results - Debt



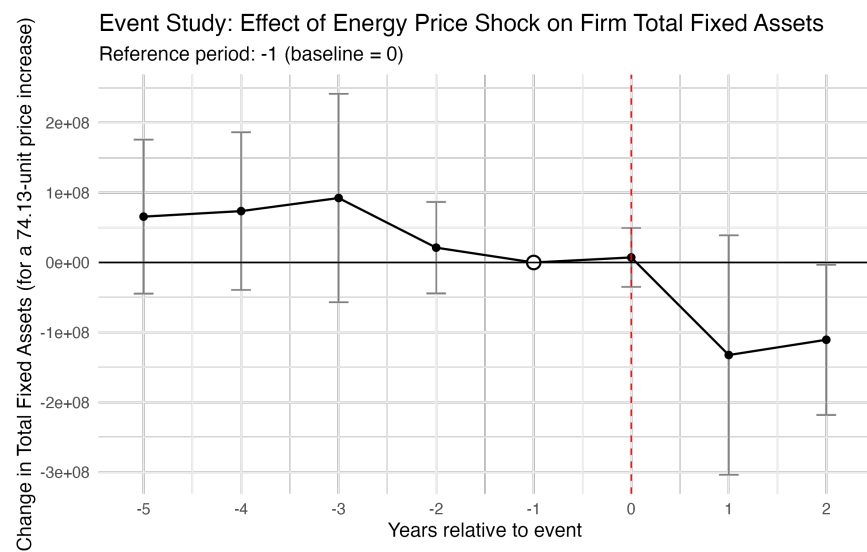
Note: Event-study estimates of the effect of the energy price shock on firm debt, from the Orbis balance-sheet data. Each point is the coefficient on the interaction of the municipality energy price change with a year indicator, measured relative to the year before Winter Storm Uri; the vertical bars are 95 percent confidence intervals. The specification includes firm and year fixed effects, and standard errors are clustered at the municipality level. Because Orbis is annual, the horizon is coarser than in the monthly employment and credit event studies. The corresponding pooled estimate is reported in Table 14.

Figure A8: Event Study Results - Total Assets



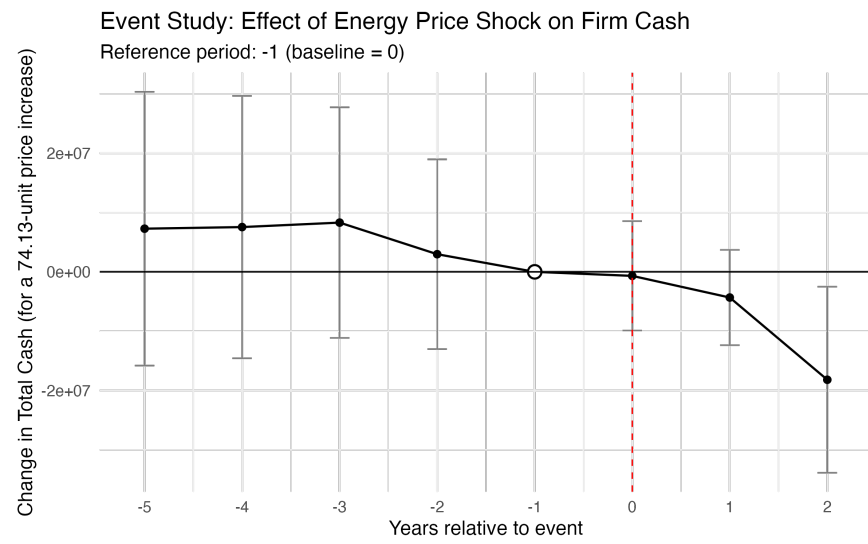
Note: Event-study estimates for total assets. Data, specification, and inference are those of Figure A7 in appendix.

Figure A9: Event Study Results - Total Fixed Assets



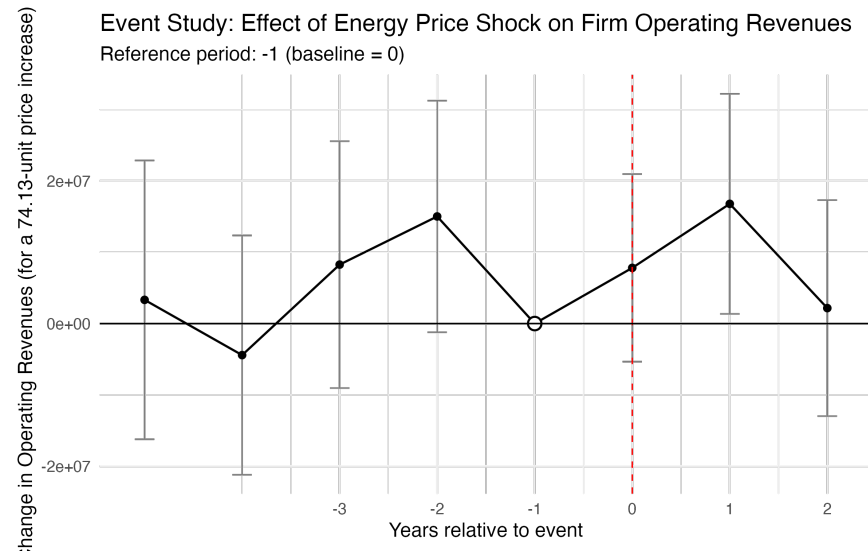
Note: Event-study estimates for total fixed assets. Data, specification, and inference are those of Figure A7 in appendix.

Figure A10: Event Study Results - Cash



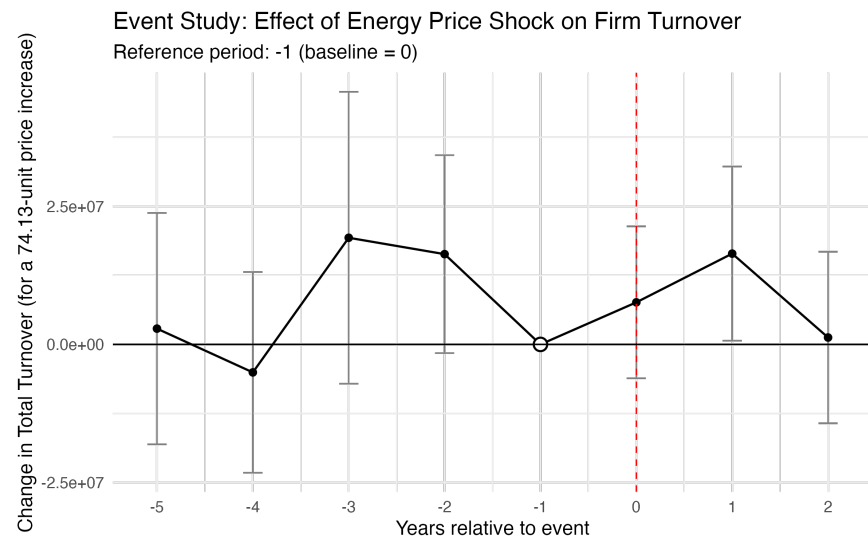
Note: Event-study estimates for cash holdings. Data, specification, and inference are those of Figure A7 in appendix.

Figure A11: Event Study Results - Operating Revenues



Note: Event-study estimates for operating revenues. Data, specification, and inference are those of Figure A7 in appendix.

Figure A12: Event Study Results - Turnover



Note: Event-study estimates for turnover. Data, specification, and inference are those of Figure A7 in appendix.

C Structural Model Appendix

C.1 Optimality conditions

Write $y_j(\ell, e)$ for the production function of type j , $s_{jt} = \delta + \xi \lambda_t^m F_{jt}$ for its separation rate, and $h_{jt} = q_t \Psi_{jt}$ for hires per vacancy, and suppress the belief argument of $\tilde{V}_{jt}(\cdot; b_t)$. For a firm without credit access, the Lagrangian of (12) is

$$\begin{aligned} \mathcal{L} = & y_j(\ell, e) - p_t e - w_j \ell - c_j(v, \ell) + \beta \tilde{V}_{jt}(\ell(1 - s_{jt}) + h_{jt}v - x) \\ & + \mu_t(W_j - p_t e) + \chi_v v + \chi_x x + \bar{\chi}_x(\ell(1 - s_{jt}) - x), \end{aligned}$$

where $\chi_v, \chi_x, \bar{\chi}_x \geq 0$ are the multipliers on $v \geq 0$, $x \geq 0$, and $x \leq \ell(1 - s_{jt})$. With ℓ' given by (6), the Kuhn-Tucker conditions are

$$\begin{aligned} \partial y_j / \partial e &= p_t(1 + \mu_t), & \mu_t &\geq 0, & W_j - p_t e &\geq 0, & \mu_t(W_j - p_t e) &= 0, \\ \partial c_j / \partial v &\geq \beta h_{jt} \tilde{V}'_{jt}(\ell'), & v &\geq 0, & v(\partial c_j / \partial v - \beta h_{jt} \tilde{V}'_{jt}(\ell')) &= 0, \\ \beta \tilde{V}'_{jt}(\ell') &= \chi_x - \bar{\chi}_x, & \chi_x x &= 0, & \bar{\chi}_x(\ell(1 - s_{jt}) - x) &= 0. \end{aligned}$$

The last line says that $\tilde{V}'_{jt}(\ell') \geq 0$ if $x = 0$, $\tilde{V}'_{jt}(\ell') = 0$ if $0 < x < \ell(1 - s_{jt})$, and $\tilde{V}'_{jt}(\ell') \leq 0$ if the firm lays off its whole remaining workforce. Since $\partial c_j / \partial v = \kappa_j(v/\ell)^\gamma$ is zero at $v = 0$, a firm posts vacancies if and only if the marginal continuation value of a worker is positive, and it lays off workers only when that value is zero, so it never hires and lays off in the same month. For a firm with credit access, $\mu_t = 0$. The envelope condition is

$$V'_{jt}(\ell; b_t) = \frac{\partial y_j}{\partial \ell}(\ell, e) - w_j + \frac{\gamma}{1+\gamma} \kappa_j(v/\ell)^{1+\gamma} + (1 - s_{jt})(\beta \tilde{V}'_{jt}(\ell') + \bar{\chi}_x),$$

where the derivative of y_j is evaluated at the chosen, possibly constrained, energy use, because (10) does not depend on ℓ . In the initial steady state, with $\vartheta_j = v_j/\ell_j$ the vacancy rate, no layoffs, and a slack or just-binding constraint, these conditions pin down the gap between the marginal product of labor and the wage, $\partial y_j / \partial \ell - w_j = \kappa_j \vartheta_j^\gamma (1 - \beta(1 - s_j)) / (\beta q_0 \Psi_j) - \frac{\gamma}{1+\gamma} \kappa_j \vartheta_j^{1+\gamma}$, which we use to calibrate productivity.

C.2 Proofs

Throughout, the path of labor-market conditions $(\lambda_t^m, q_t, F_{jt}, \Psi_{jt})$, and hence s_{jt} and h_{jt} , is held fixed.

Proof of Proposition 1. By the envelope theorem $\partial\pi_j/\partial\ell = y_\ell(\ell, e^*)$, so $\partial^2\pi_j/\partial\ell\partial p = y_{\ell e}\partial e^*/\partial p$, with $\partial e^*/\partial p = 1/y_{ee} < 0$. With $M = \alpha\ell^\rho + (1 - \alpha)G^\rho$ and $y = AM^{\nu/\rho}$, $y_{\ell G} = A\nu(\nu - \rho)\alpha(1 - \alpha)M^{\nu/\rho-2}\ell^{\rho-1}G^{\rho-1}$ and $y_{\ell e} = y_{\ell G}G_e$ with $G_e > 0$ (for small firms $G = e$ and the fixed K_S scales A). Hence $y_{\ell e} < 0$, and the marginal value of labor rises with p , if and only if $\nu < \rho$. For the dynamic statement, because the firm treats its current belief as permanent, at date t it solves a dynamic program in which the price is constant at $p_0(1 + b_t)$ and labor-market conditions follow their given path, so b_t enters only through the flow payoff $\pi_j(\ell, p_0(1 + b_t))$. The cheapest cost of moving from ℓ to ℓ' , $C(\ell, \ell') = \frac{\kappa}{1+\gamma}h^{-(1+\gamma)}(\ell' - \ell(1 - s))^{1+\gamma}\ell^{-\gamma}$ above the attrition level and zero below it, has a derivative in ℓ' that is non-increasing in ℓ , so $-C$ has increasing differences in (ℓ, ℓ') . If $\nu < \rho$ the flow payoff has increasing differences in (ℓ, b) ; backward induction preserves increasing differences of the continuation value in (ℓ, b) , and by Topkis's theorem the policy $\ell'(\ell, b)$ is non-decreasing in b . The case $\nu > \rho$ follows with $-b$. The argument uses fixed conditions: in equilibrium a higher belief also changes other firms' vacancies and employment, and hence s_{jt} and h_{jt} , so we verify the ordering numerically along the equilibrium paths (Section 6.6). $\square$

Proof of Proposition 2. In general, with $W = \omega p_0 e_0$, (10) binds if and only if the unconstrained bill exceeds residual cash, $p_t e^*(p_t, \ell_t) > \omega p_0 e_0$, so the exact threshold is $p_t e^*(p_t, \ell_t)/(p_0 e_0)$, the ratio of the unconstrained bill at the current price and workforce to the pre-shock bill. If $e^*(p, \ell_0) = e_0(p/p_0)^\varepsilon$, the unconstrained bill at the initial workforce is $p_0 e_0(1 + \Delta_t)^{1+\varepsilon}$, so the threshold is $(1 + \Delta_t)^{1+\varepsilon}$, which for $\Delta_t > 0$ exceeds one if and only if $1 + \varepsilon > 0$, that is, $|\varepsilon| < 1$. Away from the initial workforce, $\partial e^*/\partial\ell = -y_{\ell e}/y_{ee}$ has the sign of $y_{\ell e}$: a firm with $\nu < \rho$ that hires, and a firm with $\nu > \rho$ that shrinks, both use less energy than at ℓ_0 , so their exact threshold lies below the constant-elasticity expression. Holding ℓ fixed, e^* solves $y_G(\ell, G)G_e = p$; as $\phi \rightarrow -\infty$

($\sigma_{KE} \rightarrow 0$), $G \rightarrow \min\{K, e\}$ in the neighborhood of $e_0 = K$, the marginal product of energy falls discontinuously beyond K , and e^* becomes locally insensitive to p , so $\varepsilon \rightarrow 0$. $\square$

Proof of Proposition 3. Let $\pi^c(\ell, p) = \max_{e: pe \leq W} y(\ell, e) - pe$ be the flow payoff of a firm without credit access. Its energy use is $e^c = \min\{e^*(\ell, p), W/p\} \leq e^*(\ell, p)$, and, since (10) does not depend on ℓ , $\partial \pi^c / \partial \ell = y_\ell(\ell, e^c)$. Since $y_{\ell e} < 0$ when $\nu < \rho$, $y_\ell(\ell, e^c) \geq y_\ell(\ell, e^*)$, with strict inequality where the constraint binds. The flow payoff therefore has increasing differences in ℓ and an indicator for the absence of credit access, and the argument above, with labor-market conditions fixed, gives a weakly higher employment policy. A firm whose cash exceeds the threshold at every date has the same payoff as a firm with credit access and, facing the same conditions, the same policy. The average response of firms without credit access is therefore the share-weighted average of constrained and unconstrained responses, so the credit gap equals the share of constrained firms times the difference between their response and that of unconstrained firms. $\square$

The slack mechanism follows from the matching function. The job-to-job separation rate of a type- j worker is $\xi \lambda^m F_j$. Since $\lambda^m = M/S$, $F_j = \sum_k \varphi_k a_{jk}$, and $\varphi_k = n_k v_k / V$, the rate is $\xi \mu S^{\eta-1} V^{-\eta} \sum_k n_k v_k a_{jk}$, whose derivative with respect to v_k is $\xi \mu S^{\eta-1} V^{-\eta} n_k (a_{jk} - \eta F_j)$. Hence fewer vacancies at type k lower the quit rate of type- j workers if and only if $a_{jk} > \eta F_j$, that is, if those workers accept offers from type k more often than a threshold proportional to their average acceptance rate. A larger pool of non-employed searchers U raises S , which lowers the quit rate because $S^{\eta-1}$ falls when $\eta < 1$, and raises the vacancy filling rate $q = \mu(S/V)^\eta$.

C.3 Measured inputs: the shock, cash, and beliefs

For each month from February 2021 to February 2023 we regress the log change in the municipality average of CENACE nodal prices, relative to the thirty days before the storm, on standardized thirty-day exposure, and scale the coefficient to the standard deviation used in the reduced-form estimates of seventeen percentage points. The differential is about 14 percent in February 2021 and

averages about 8 percent over the following twenty-four months. Prices of natural gas imported at the border crossings that supply each region show no persistent differential, so gas does not add to the shock.

We take Mexican firms in the Orbis file used in Section 3, keep each firm's last balance sheet between 2018 and 2020, and classify a firm as without credit access if it reports neither short-term bank loans nor long-term debt (2,173 firms; 2,385 report bank debt). The monthly electricity bill is 3.2 percent of operating revenue divided by twelve, the ratio in the annual manufacturing survey. Table A34 reports the distribution. Against the bill alone, the median firm without bank debt holds 12.3 months, and 14.1 percent hold less than 1.14 months, the threshold of Proposition 2 at the measured shock; the median among them is 0.42 months. The share ranges from 9 to 21 percent as the bill share varies between 2.0 and 4.5 percent of revenue and the threshold between one and one and a half months. Against a month of operating costs, the median is 0.54 months and 62.7 percent hold less than one month (68.1 percent of firms with bank debt, which can draw on credit lines). What Orbis measures is the share of firms whose cash falls short of their up-front costs, not the cash left for the energy bill once the other up-front outlays are paid. The baseline therefore combines the measured share, $\lambda = 0.63$, with an assumption on residual cash, $\omega = 1$, under which the constraint binds at the margin at the initial price. The bill-only mapping, which treats all cash as available for the bill ($O_j = 0$, so $W_j = C_j$), is the lower bound. Two caveats apply. Firms without bank debt in Orbis are smaller than the large firms of the estimation sample, with a median of 11 employees, and Orbis reports too few large firms without bank debt to measure their cash separately. And the 2021 national business financing survey (ENAFIN) reports that 41.5 percent of large firms used credit in 2019 to 2021 and 38 percent financed operations from own resources, consistent with the split we use, but publishes no cash holdings by credit status.

The survey asks firms how they would respond to a price increase of 5 to 10 percent lasting three months, six months, or permanently, but not how long they expected the 2021 differential to last. Responses rise with the horizon (machinery replacement from 19 to 29 percent, price increases

from 37 to 54 percent), so firms respond more to shocks they consider persistent, which is the force the belief channel captures. Adoption of solar panels and generators does not reveal beliefs about the differential, because at Mexican industrial tariffs and installation costs of 12,000 to 18,000 pesos per kilowatt of capacity, solar pays back in four to five years without any shock. We therefore take the gain from estimates of constant-gain learning (Milani, 2007). At $g = 0.006$, beliefs close about 14 percent of their distance to the realized differential within the twenty-five months of the period.

C.4 Numerical solution

Given flow targets, the steady-state vacancy shares solve a linear system and the contact rate and on-the-job search intensity are found by bisection; vacancy costs are set so that the cost per hire equals half a month's wage, and productivity so that each type's initial size is optimal. Under the baseline ($\omega = 1$), cash-poor firms sit at the kink of (10) before the shock: at their initial size the unconstrained bill equals their residual cash, so the constraint holds with equality and its multiplier is about zero. The shock raises the multiplier to about 2.6, and it stays between 2.3 and 2.7 over the period. Small firms are never constrained, because their energy demand elasticity of about -1.06 makes the bill fall with the price. Under bill-only cash ($\omega = 0.43$), cash-poor firms are rationed before the shock, and their initial size is computed from their constrained steady state, about 43 percent above their unconstrained size. Value functions are computed on a grid of 241 points spanning 85 to 160 percent of each type's initial size. Firms treat their current belief as permanent. At each date t , the continuation value is computed by backward induction over twenty-four months at the constant price $p_0(1 + b_t)$ and the path of labor-market conditions from the current iteration, with terminal value the stationary value at that price, interpolated linearly across seven belief nodes between zero and b_1 ; it is recomputed at every date as b_t is updated. Policies are announced at the start of the shock, and firms anticipate them over this horizon. Layoffs never occur along any solved path, and the monotonicity of the policies holds along these paths apart from numerical noise. Along the simulated path, employment is chosen continuously over a piecewise cubic interpolation of the continuation value. Labor-market conditions are updated with damp-

ing 0.7 until their largest relative change is below 10^{-4} . At the estimates, the energy demand of large firms has an elasticity of -0.014 , and along the solved paths the constant-elasticity threshold of Proposition 2 differs from the exact threshold by less than 5×10^{-5} months. The orderings of Propositions 1 and 3 hold along the equilibrium paths up to numerical error, and unconstrained large firms, with or without credit access, respond to the shock by less than 0.05 percentage points.

C.5 Identification, sensitivity, and robustness

We search σ_{LG} over $[1.5, 4]$ and σ_S over $[0.7, 0.98]$, and set $\sigma_{KE} = 0.01$, the Leontief limit. Figure A13 reports the local Jacobian of the targeted moments with respect to the two estimated parameters, scaled by the standard errors of the moments. The Jacobian has full rank, with a condition number of 1.37. σ_S moves almost only the small-firm path, while σ_{LG} moves the large-firm path and the credit gap together, because given the cash distribution a higher elasticity raises both the response of constrained firms and the average. The criterion is flat in σ_S between 0.95 and one, and decreasing in σ_{LG} over the whole search (Figure A14); in every bootstrap draw the estimate of σ_{LG} is at the upper bound of the search, four in the best fit and three in the restricted estimate, while the bootstrap standard error of σ_S is 0.009 (Figure A16). The value of four is therefore a constrained estimate at the upper limit of the search: the data bound σ_{LG} from below rather than point identify it. Beyond four, the criterion keeps falling: it is 45.6 at $\sigma_{LG} = 4.25$, 40.1 at 5, and 33.7 at 8, reaches a minimum of about 32.9 near 12, and rises again by 20. At 12, the credit gap at month twelve overshoots the data, -7.4 against -6.1 . The data therefore push σ_{LG} beyond the bound, and we cap it at four. We do not adopt values above four, which are hard to reconcile with any reading of the elasticity, and report the restricted estimate, $\sigma_{LG} \leq 3$, as the economically plausible calibration.

Table A33 changes one input at a time relative to the restricted estimate. Beliefs matter little within the range supported by the learning literature: with $g = 0$ the criterion falls from 63.2 to 62.7, and with $g = 0.03$ it rises to 70.2, as faster learning erodes the response once the realized differential

settles below the initial belief. At the best-fit elasticities, the criterion is 46.6 with $g = 0$ and 52.2 with $g = 0.03$, against 47.9 at the baseline gain. Under perfect foresight, by contrast, the criterion rises to 100.4, and the large-firm response and the credit gap are roughly halved (the gap at month twelve is -2.2): slow learning is what produces the persistent response. The energy share matters moderately: the credit gap at month twelve is -3.4 points with electricity alone and -4.5 points with the cost-weighted share of electricity and fuels, which treats fuel prices as having moved with electricity, an upper bound given the absence of a differential in gas prices. The cash mapping matters most. The gap scales with the measured share of firms without credit access whose cash falls short, from -0.7 points under bill-only cash ($\lambda = 0.14$) to -3.1 , -3.9 , and -4.5 points at $\lambda = 0.50$, 0.63 , and 0.75 , as Proposition 3 implies. For comparison, an alternative calibration, in which every firm without credit access held 0.85 months of the bill, beliefs never updated, and the energy share was 0.40, comes closer to the large-firm level but fits the ten path moments worse ($Q = 97.1$), and its inputs are the ones the data do not support.

C.6 Welfare and the policy family

Welfare is the present value over thirty-six months of output, net of energy valued at the realized price and of recruiting costs, plus the value of non-employment, which we set to 40 percent of the mean wage. Wages, subsidy payments, and guarantee losses are transfers between agents and do not enter, so the fiscal cost of each policy is reported separately. Because the price shock is common to all policies, the comparison isolates how each policy changes the allocation of energy and labor. We treat the realized price as the resource cost of energy because the increase reflects the cost of gas imported from the United States, which supplies most of Mexico's gas (U.S. Energy Information Administration, 2022). Part of the increase, in particular where nodal prices reflect transmission congestion, may instead be a scarcity rent to domestic generators; that part is a transfer, and counting it as a resource cost overstates the welfare cost of energy use.

The guarantee is modeled as a relaxation of (10) in the months it is in force: firms without credit

access face no cash limit on the energy bill, and the credit they draw is the part of the bill their residual cash does not cover. Lenders are assumed to extend this credit, at no cost to the firm, because the government bears the loss. The model has no decision of banks to participate, no loan pricing, and no endogenous default, and the loss rate of ten percent is assumed. Because firms do not pay for the guarantee and the excess burden of public funds is zero, the loss rate scales the fiscal cost and leaves the allocation and welfare unchanged: at loss rates of 5, 10, 20, and 30 percent, the ratio of the welfare gain of the twenty-five-month guarantee to its fiscal cost is 27.6, 13.8, 6.9, and 4.6, and the guarantee dominates the subsidy at every loss rate. The ratio of the welfare gain to the fiscal cost is therefore not a net return per peso of public spending.

We evaluate guarantees of one, three, six, twelve, and twenty-five months and subsidies of 0.5, 1, 2, and 5 percent for twenty-five months, and interpolate the subsidy rate whose present-value cost equals that of the twenty-five-month guarantee. In the emissions variant, each unit of energy carries an additional cost of 0.90 times the pre-shock price, the product of a grid emission factor of 0.494 tons of carbon dioxide equivalent per megawatt hour and a social cost of carbon of 190 dollars per ton (U.S. Environmental Protection Agency, 2023), at 20.3 pesos per dollar and a pre-shock price of 2,120 pesos per megawatt hour; at the earlier interim value of 51 dollars per ton the factor is 0.24. We set the excess burden of public funds to zero; a positive burden would lower the welfare value of the subsidy, whose outlays are about forty-three times larger, by more than that of the guarantee. Firm exit is outside the model, so any benefit of liquidity support in preventing the exit of firms without credit access is not counted.

Table A33: Structural model: robustness

	Q	Large, m.12	Small, m.12	Gap, m.12	Large, 24-month avg.
Data		0.043	-0.018	-0.061	0.046
$\sigma_{LG} = 3$ (restricted estimate)	63.2	0.023	-0.015	-0.039	0.020
Belief gain $g = 0$	62.7	0.023	-0.015	-0.039	0.020
Belief gain $g = 0.03$	70.2	0.020	-0.013	-0.033	0.017
Energy share 0.18 (electricity only)	68.4	0.020	-0.010	-0.034	0.017
Energy share 0.40 (cost-weighted)	71.7	0.028	-0.022	-0.045	0.025
Cash-poor share $\lambda = 0.50$	79.7	0.018	-0.014	-0.031	0.016
Cash-poor share $\lambda = 0.75$	52.4	0.027	-0.016	-0.045	0.023
Bill-only cash ($\lambda = 0.14, \omega = 0.43$)	146.6	0.005	-0.012	-0.007	0.005
Returns to scale $\nu = 0.225$ (earlier estimate)	57.1	0.024	-0.013	-0.040	0.020
Returns to scale $\nu = 0.333$ (labor, electricity and fuels)	76.9	0.022	-0.018	-0.034	0.019
Alternative calibration (see note)	97.1	0.040	-0.028	-0.052	0.035

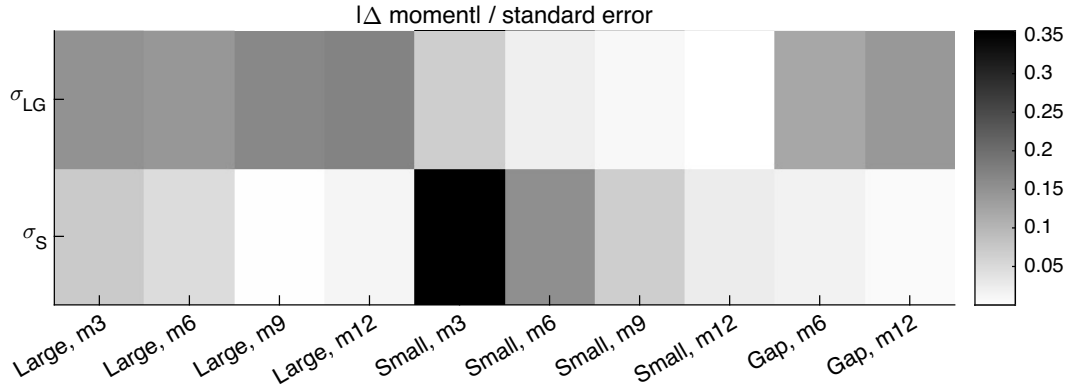
Note: Each row changes one input relative to the restricted estimate ($\sigma_{LG} = 3, \sigma_S = 0.98, \nu = 0.268, \sigma_{KE} = 0.01, \lambda = 0.63, \omega = 1, g = 0.006, s_E = 0.26$) and re-solves the model without re-estimating. The last row is an alternative calibration in which every firm without credit access held 0.85 months of the bill ($\lambda = 1, \omega = 0.85$), beliefs never updated ($g = 0$), the energy share was 0.40, and $\sigma_{KE} = 0.12$; it is evaluated on the same ten targets. The returns-to-scale rows replace $\nu = 0.268$ with the earlier estimate of 0.225 and with 0.333, which adds fuels to electricity in the measured share.

Table A34: Structural model: cash holdings of Mexican firms in Orbis, last pre-shock year

	No bank debt	Bank debt
Firms	2,173	2,385
Cash in months of the electricity bill: 25th percentile	2.99	3.45
median	12.32	10.35
75th percentile	41.11	33.39
Share below 1.14 months of the bill	0.141	0.112
median cash among them (months of the bill)	0.42	0.46
Cash in months of operating costs: median	0.54	0.43
Share below one month of operating costs	0.627	0.681

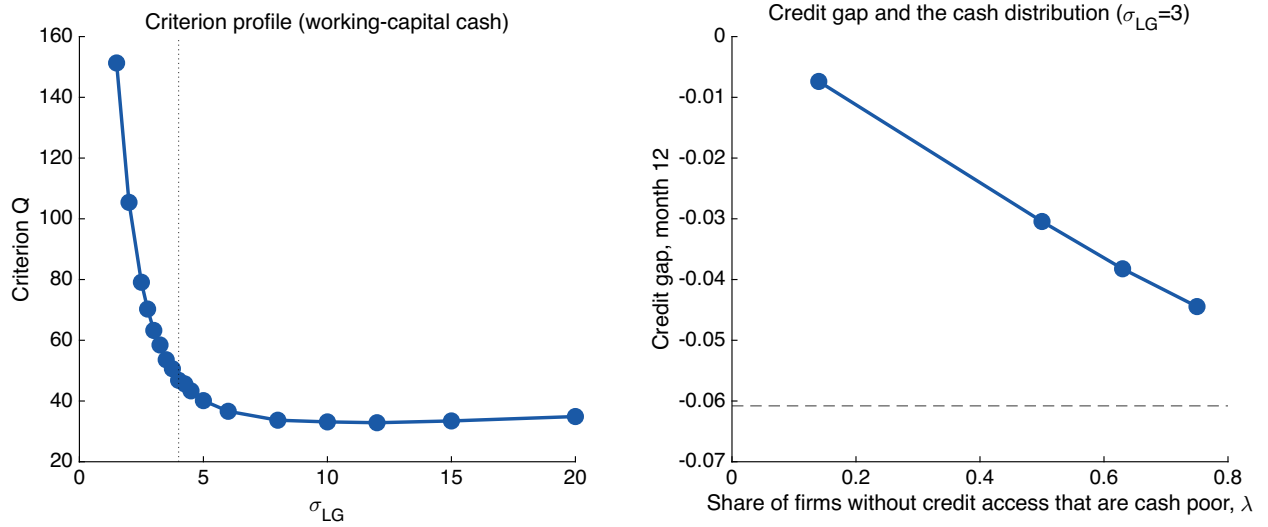
Note: Mexican firms in the Orbis file used in Section 3, last balance sheet between 2018 and 2020. A firm has no bank debt if it reports neither short-term bank loans nor long-term debt. The monthly electricity bill is 3.2 percent of operating revenue divided by twelve; operating costs are the cost of goods sold. 1.14 months is the threshold of Proposition 2 at the measured shock.

Figure A13: Structural model: local identification



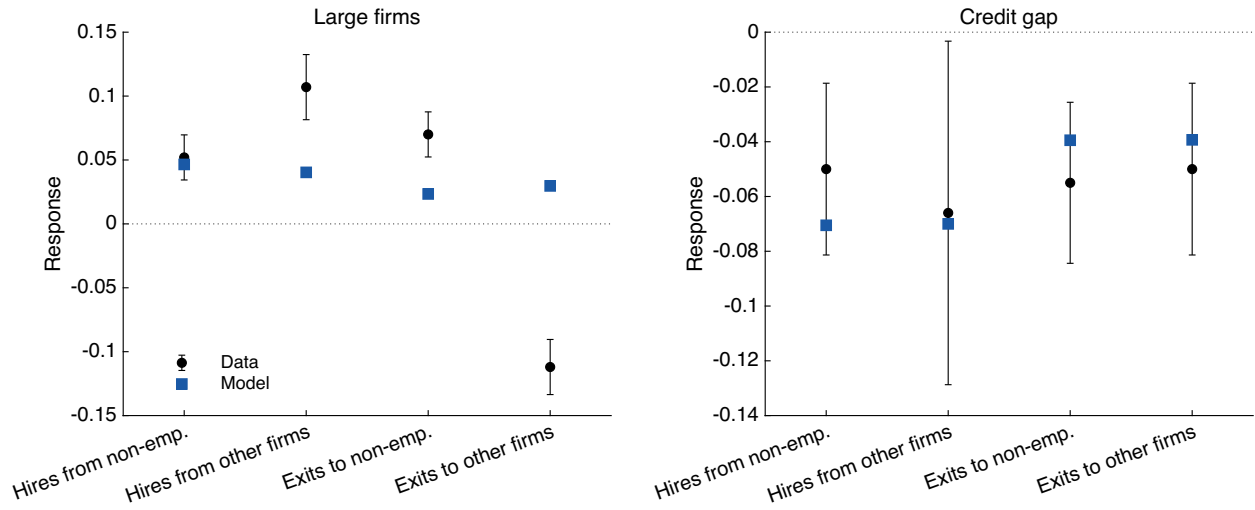
Note: Change in each targeted moment, divided by its standard error, for a change of 0.25 in σ_{LG} and of 0.05 in σ_S at the baseline estimates, computed by central finite differences.

Figure A14: Structural model: sensitivity



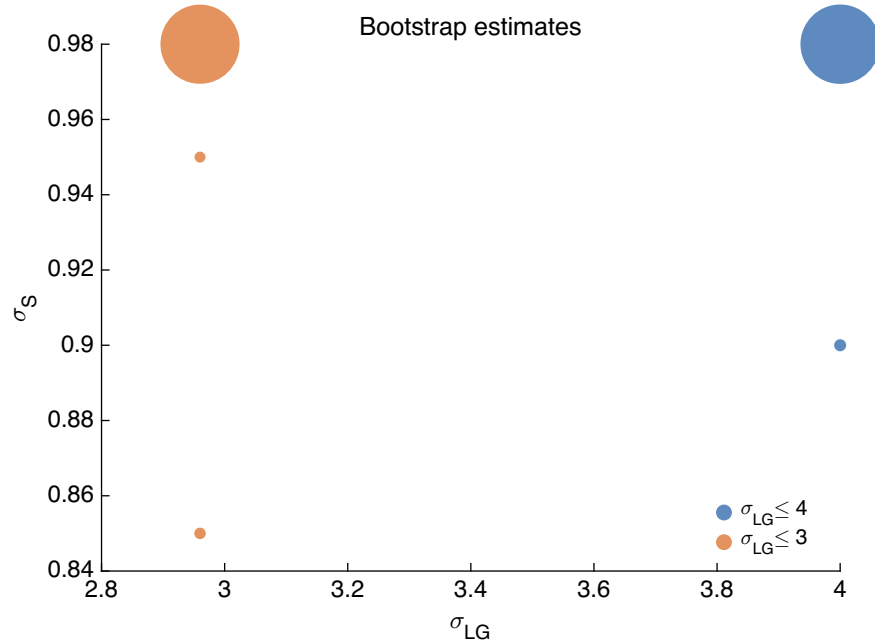
Note: Left: estimation criterion Q against σ_{LG} , minimizing over σ_S , with working-capital cash. Right: credit gap at month twelve against the share λ of firms without credit access that are constrained, at $\sigma_{LG} = 3$; the point at $\lambda = 0.14$ is bill-only cash ($\omega = 0.43$), the others hold $\omega = 1$. The dashed line is the data.

Figure A15: Structural model: worker flows: model and data



Note: Responses of large-firm worker flows, averaged over twenty-four months (left), and their credit gaps (right), at the baseline estimates against the reduced-form estimates with 95 percent confidence intervals. These moments are not targeted.

Figure A16: Structural model: bootstrap distribution of the estimates



Note: Distribution of the estimated (σ_{LG}, σ_S) across parametric bootstrap draws of the targeted moments, re-estimated over the estimation grid. Marker area is proportional to the share of draws.