The Economic Costs of Climate Change

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Abstract

This paper studies the economic costs of weather shocks using supply-chain networks. We estimate the revenue impact from weather shocks by comparing sales of intermediate goods across suppliers that trade with the same client but are exposed to different weather shocks. We find that a one standard deviation increase in local average yearly temperature (0.66°C) in the supplier location leads to a reduction in sales of 1.4%. We also show that episodes of extremely hot and cold weather lead to strong reductions in sales. The effects are more pronounced among labor-intensive suppliers and small suppliers. Our results provide evidence of significant economic costs of climate change.

JEL classification: G31, G32, L11, L14, Q54
Keywords: Climate change, Supply chain, Economic costs
1. Introduction

Climate change has caused observed impacts on organisms, ecosystems, human systems and well-being (Intergovernmental Panel on Climate Change (2019)) and is regarded as a serious international threat by policy makers (Pew Research Center (2019)). We have some knowledge about the direct economic consequences of weather shocks on agricultural outcomes, such as agricultural production (Deschênes and Greenstone (2007), Schlenker and Roberts (2009), Schlenker and Lobell (2010), Chevet et al. (2011), and Roberts et al. (2012)) and farmland value (Mendelsohn et al. (1994) and Schlenker et al. (2005)). There is also growing evidence on the impact of climate change on total factor productivity (Graff Zivin and Kahn (2016), Chen et al. (2018) and Zhang et al. (2018)). However, it is unclear whether the negative productivity has an effect on firm performance.

In this paper, we use supply-chain networks to study how weather shocks affect firm revenue. First, the supply chain is one of the key channels through which climate change may affect the broader economy (Dasaklis and Papis (2013)). Anecdotal evidence suggests that firms do take possible disruptions brought to the supply chain by climate change into account\(^1\). Second, using the supply chain as a laboratory allows us to explicitly control for demand shocks to a client in a given year and obtain an estimate for the impact of weather shocks by comparing sales across suppliers to the same client.

We gather data from various databases. We obtain supplier-to-client sales data from Compustat Segment sales, gridded weather data from PRISM Climate Group (2019), and extreme weather

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\(^1\) For example, in its annual report for the fiscal year 2014, the pharmaceutical firm Pfizer published the following statement: “Climate change presents risks to our operations, including potential physical risks to our facilities and supply chain due to more frequent and severe weather events and water availability.”
events from the National Oceanic and Atmospheric Administration (NOAA) Storm Events Database. We use an empirical strategy similar to Khwaja and Mian (2008) to quantify the impact of weather shocks to supplier-to-client sales. We include client-by-year fixed effects to explicitly control for demand shocks to a client in a given year, and compare how weather shocks to suppliers affect sales to that client. In addition, we control for supplier financial characteristics, and include supplier-industry fixed effects and supplier county fixed effects to account for unobserved heterogeneity to obtain a precise estimate.

We find that increases in temperature lead to declines in supplier-to-client sales. A one standard deviation increase in the average yearly temperature in the supplier county (0.66°C) is associated with a decrease in supplier-to-client sales of 1.4%. In addition, we study the effect on sales of extreme weather (heat and cold) events. We find that extreme heat events and especially extreme cold events can have a disruptive effect on supply chain activity. While weather shocks affect the sales of intermediate goods at the intensive margin, we do not find evidence on the extensive margin, i.e. we do not find average weather shocks lead to termination of supply chain relationships.

We next investigate the channel by which weather shocks affect supply chain networks activity. We first test a labor productivity channel as weather shocks can have a negative effect on labor productivity due to workers’ absence or harder working conditions. We find that the reduction in sales is more pronounced in more labor intensive firms, and less pronounced in more capital intensive firms. This is consistent with the notion that higher local temperature negatively affects sales of intermediate goods via a labor productivity channel. We also test the hypothesis that firm size can mediate the effect of weather shocks on sales. Larger firms should have more resources and flexibility to overcome weather shocks without disrupting production. Indeed, we find that the effect of weather shocks on sales is less pronounced among larger firms.
Finally, we test whether weather shocks produce real effects. We find some evidence that firms affected by weather shocks reduce capital expenditures.

Overall, our results suggest that climate change can affect supply-chain networks. We show for the same client buying from different suppliers, its purchases from suppliers affected by weather shocks decline significantly. The effects are economically significant and cannot be explained by changes in demand for supplier’s products or services.

This paper contributes to several strands of the literature. First, we contribute to the literature on the indirect costs of climate change on the economy. Graff Zivin and Kahn (2016), Chen et al. (2018) and Zhang et al. (2018) find that heat affects total factor productivity. We complement this finding by documenting that higher temperature affects supplier-to-client sales via a labor productivity channel. Addoum, Ng, and Ortiz-Bobea (2019) find no evidence that location-specific temperatures affect sales, productivity, and profitability using establishment-level data in the U.S. We improve on the identification of the effect of temperature on sales by using detailed information of sales from suppliers to clients, and control supplier financial characteristics, and confounding demand effects at the client level by including client-by-time fixed effects. In addition, while temperature and precipitation may impact agricultural outcomes in a non-linear fashion (Mendelsohn et al. (1994) and Schlenker and Roberts (2009)), we only find the level of average temperature to affect supplier sales and client purchases.

Second, we contribute to the literature on climate change and the supply chain. Dasaklis and Pappis (2013) outline how climate change may affect the supply chain qualitatively. Pankratz and Schiller (2019) find that heat waves and flooding at supplier locations lead to termination of relationships in global supply chain and reduction in client sales. In contrast, controlling for shocks
to client demand, we show that both average weather shocks and extreme weather events lead to changes in supplier-to-client sales in the intensive margin, but not in the extensive margin.

The paper proceeds as follows. Section 2 describes the data and methodology. Section 3 presents the results. Section 4 concludes.

2. Data and Methodology

2.1. Sample and variables

Our sample consists of supplier-client pairs whose headquarters are located in the U.S. To obtain this data, we rely on regulations SFAS numbers 14 and 131, which requires that publicly listed firms in the U.S. must disclose, on a yearly basis, the identity of clients and the sales to clients whose purchases represent more than 10% of total sales. We collect this information from the Compustat Segment files for the period 2000-2015. From these files we unambiguously identify the suppliers (using the GVKEY unique code from Compustat), and obtain the text names for their most important clients. Using text-searching algorithms complemented with manual searches, we match the reported client names to the Compustat database to obtain information about clients. As we restrict the searches to publicly traded firms in Compustat, we are unable to identify clients that are private firms, governments, or firms based outside of the U.S. Similarly, the reporting regulations imply that we cannot identify clients that buy small amounts or aggregate clients.

We obtain temperature and precipitation data from the PRISM Climate Group (2019), who provides daily gridded weather data at 4km × 4km grids in the continental U.S. PRISM gathers climate observations from weather stations and uses sophisticated climate modelling techniques and quality control methods to interpolate weather data at each grid (PRISM (2013)). The interpolation method takes elevation, wind direction, rain shadows, and many other climate and
geographical factors into account. This results in a balanced panel of weather data for the contiguous U.S.

We obtain extreme weather events data from the National Oceanic and Atmospheric Administration (NOAA) Storm Events Database (NOAA (2019)). This database records the occurrence of significant weather events that have enough intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce (NOAA (2018)).

We map the weather grids in PRISM and extreme weather event locations to counties in the U.S. Census Bureau files. We compute annual average weather variables at the county level for each year. We compute the annual number of extreme weather events by event type at the county level for each year. Finally, we match the weather variables in each county to the firms in Compustat using the county location of the firms’ main headquarters and the firm’s fiscal year end. Since a firm’s production plants and sales locations are not always located in the same county as their headquarters, our proxy of the exposure to temperature is prone to measurement error, which is likely to bias our results against finding any effect on a firm’s sales.

2.2. Summary statistics

Panel A of Table I contains a year-by-year description of our sample. Our sample consists of 12,547 supplier-client-year observations for 1,854 unique suppliers and 423 unique clients over the period 2000-2015, with an average of slightly less than 800 observations per year. Sales to clients in our sample account, on average, for 37.2% of the total sales of sample firms. Panel A also shows that the coefficient of our variable of interest is estimated using the variation in temperature of slightly more than five suppliers per client each year on average. The last two columns show that there is also a moderate time-series variation in the average temperatures in the counties where firms are located, with average annual temperatures in the counties where firms
are headquartered of slightly above 13°C. Figure IA.I in the Internet Appendix shows that there is a large geographic variation in the temperature levels across counties in the U.S.

Panels B and C of Table I contain descriptive statistics for the firms in our sample. Panel B presents summary statistics for supplier firms. Panel C presents summary statistics for client firms. Client firms are larger than supplier firms both in terms of total assets and number of employees. This is due to regulation SFAS 14, which only requires disclose of the names of clients that account for at least 10% of the suppliers’ total sales. Client firms more levered, hold less cash, have more tangible assets, and have a lower Tobin’s Q than supplier firms. Average daily temperature and average daily precipitation in headquarters counties for both client firms and supplier firms are similar.

2.3. Methodology

Our main objective is to analyze whether high temperatures affect the firms’ economic activity, measured by sales to each client. To investigate this hypothesis, we estimate the following regression equation:

$$\Delta \ln(Sales)_{ijt} = \beta_1 Temp_{ct} + \beta_2 Prcp_{ct} + \gamma X_{it-1} + \delta_c + \delta_s + \delta_j + \epsilon_{ijt},$$  \hspace{1cm} (1)

where indices $i$ and $j$ denote suppliers and clients respectively. The dependent variable measures the percentage change in the supplier’s sales to each client.\textsuperscript{2} $Temp_{ct}$ is the average daily temperature in degrees Celsius in county $c$ where supplier $i$ is headquartered in year $t$. Following the climate economics literature, we also include as a control the average daily precipitation in inches in county $c$ where supplier $i$ is headquartered in year $t$, $Prcp_{ct}$. In all specifications, we

\textsuperscript{2} We require non-missing sales data in two consecutive years to calculate the change in sales for each client-supplier pair.
include supplier county fixed effects, $\delta_c$, in order to control for the average time-series temperature and precipitation across different counties; therefore, the effect of temperature on firms’ economic activity should be interpreted relative to the average in the county during the sample period. The county fixed effect also controls for all characteristics of the counties that are invariant during our sample period. We add a set of supplier controls, $X_{it-1}$, which include firm size (Assets), Tobin’s Q, cash to assets ratio (Cash), market leverage (Leverage) and asset tangibility (Tangibility). Inclusion of these firm-level controls, which affect the level of sales, reduces the variance of the estimated coefficients of the temperature variables. We also include supplier industry fixed effects, $\delta_{st}$, to control for time-invariant differences across industries.

More importantly, our client-supplier data allow us to include client-by-year fixed effects, $\delta_{jt}$, which ensures that identification comes from the variation, within the same year, of temperature across the suppliers of a given client. Client-by-time fixed effects absorb all unobserved heterogeneity at the client level in a given period, and allow us to compare the changes in economic activities across suppliers selling to the same firm. Thus, concerns that our results are driven by changes in client demand are reduced. The estimated difference in sales can therefore be plausibly attributed to supply-side factors, such as differences in the productivity of suppliers. In our most stringent specifications, we replace the client-by-year fixed effects with supplier industry-by-client-by-year fixed effects, to compare the sales across suppliers within the same industry, which are more similar.

The main coefficient of interest is $\beta_1$, which estimates the effect of temperature on supplier-to-client sales. A negative $\beta_1$ would indicate that suppliers that are exposed to higher than average temperatures in their county of location reduce their sales by larger amounts than other suppliers selling to the same client. In our baseline regressions, we cluster the standard errors at the supplier
county level as it corresponds to the variation we explore in the main explanatory variable. Table A.I in the Appendix provides variable definitions and data sources.

3. Results

3.1. Main results

Table II presents the estimates of the regression in equation (1). In all columns, we estimate the effect of temperature on the supplier’s sales. In some specifications, we control for the precipitation in the suppliers’ county. We estimate the regressions using three different sets of fixed effects with increasing degrees of stringency: supplier industry fixed effects and client-by-year fixed effects in columns (1) and (2); supplier industry-by-year fixed effects and client-by-year fixed effects in columns (3) and (4); and supplier industry-by-client-by-year fixed effects in columns (5) and (6).

The results show that the temperature variable coefficient is negative and statistically significant in all specifications. The effect of temperature on a supplier’s sales is also economically significant. Suppliers exposed to a one standard deviation increase in average yearly temperature in their county of location (an increase of 0.66°C) have a 1.4% to 1.5% stronger reduction in sales.

While the client-by-year fixed effects account for total demand for intermediate goods for a client, there may still be substitution across suppliers selling to the same client. If substitution is present, the inclusion of supplier industry-by-client-by-year fixed effects will likely increase the size of the coefficient of temperature, since we are comparing suppliers located in the same industry that sell to the same client. Since the size of the coefficient is not substantially different across specifications, it suggests that major substitution between suppliers is unlikely.

In Table IA.I in the Internet Appendix, we use the change in average temperature as a dependent variable and obtain similar results. In Table IA.II in the Internet Appendix, we include quadratic terms for temperature and precipitation. We find that the coefficient on temperature is negative and statistically significant across specifications, and the coefficient on squared temperature is positive but only statistically significant in the specification with supplier county fixed effects and
supplier industry-by-client-by-year fixed effects.

3.2. Extreme weather events

We next explore whether firms’ economic activity is affected also by extreme weather events. In Panel A of Table III, we repeat the estimations of Table II augmenting each of the specifications with the variable Heat Events, which measures the number of events, within a fiscal year, in which there were extreme heat events in the county where the supplier firm is located. The incidence of extreme heat events is rare in our sample. Table I shows that the average number of heat events in our sample is 0.0045, i.e. slightly less than one firm in 200 is hit by one such event. We find that the Heat Events variable coefficient is negative and significant. The effect of extreme heat events is also economically significant. An extreme heat event is associated with a further 9.1% reduction in sales, relative to firms with no such event.

In Panel B of Table III, we estimate the effect of extreme cold events, by adding to the regressions in Table II the variable Cold Events, the number of extreme cold events hitting the firms during the fiscal year. The incidence of such events is even lower in our sample, with an average value of 0.0009, or slightly less than one firm in one thousand. We find that the Cold Events variable coefficient is negative and significant. The extreme cold events have an even more meaningful effect on firms’ sale than the extreme heat events. Firms hit an extreme cold event suffer an additional reduction in their sales of 26% to 34%. These results suggest that extreme cold events, even if less often, can have a more disruptive effect on the supply chain activity.

3.3. Extensive margin

Our baseline results in Table II are determined under the assumption that clients and suppliers maintain their relationship during two consecutive years; otherwise these transactions would not be observed in the data. Therefore, our baseline results are on the intensive margin. We also estimate an extensive margin regression based on equation (1), but replacing the dependent variable with a dummy that takes a value of one if we observe transactions in year $t-1$ but not in
A significant coefficient for the temperature variable would indicate that suppliers exposed to higher temperatures suffer a significant decrease in sales, such that clients stop buying large amounts (i.e., they do not represent more 10% of the sales). Table IV presents the estimates of a linear probability model. We find that the coefficients are not statistically significant in any of the specifications, suggesting that higher than normal temperatures do not lead to relationship termination.

In Table V, we repeat the estimations on the extensive margin, but augmenting the regressions with the number of extreme weather events. In Panel A, we report the estimations for extreme heat, and in Panel B we report these estimations for extreme cold events. Similarly to the results in Table IV, we find that the coefficients are not statistical significant.

Our results in Tables IV and V contrast with those of Pankratz and Schiller (2019), who find that heatwaves and natural disasters (floodings) can disrupt the global supply chain in the extensive margin. Our findings show that in the U.S., higher than normal temperatures and extreme weather events are not likely to have such a disruptive effect. This may be explained by the fact that our sample is a domestic supply-chain network other than a global one and client and suppliers may have a stronger relationship due to proximity.

3.4. **Heterogeneity analysis**

In this section, we analyze whether certain types of firms might exhibit a sensitivity to temperature that differs from the average effects in Table II. For example, previous research has shown that high temperatures have a negative impact on labor productivity (Graff Zivin and Neidell (2014)). If this is the case, we expect that labor-intense firms to exhibit higher sensitivity of sales to the temperature. We also expect larger firms to be better prepared to deal with higher temperatures, as they might have more spare capacity or might hedge their exposures to higher temperatures.

To analyze these issues, we augment equation (1) by adding interaction terms between the temperature variables and proxies for labor intensity and firm size. Table VI presents the results.
To proxy for the labor intensity of the firms, we use the ratio of the number of employees to assets in columns (1) and (2), and we use the ratio of property, plant, and equipment to assets (a proxy for high capital intensity, which can be interpreted as an inverse proxy for labor intensity) in columns (3) and (4). We use firm size (log of assets) to analyze whether there is a differential impact of temperature for large firms. In columns (5) and (6). For ease of interpretation of the interaction terms, we standardize all interacted variables by subtracting the mean and dividing by its standard deviation.

Columns (1)-(4) show that the sensitivity of supplier sales to temperature is higher for firms that are more labor intensive. Columns (1) and (2) suggest that a 0.66°C higher than average temperature in the county where a supplier is located leads to a 0.8% to 1.1% higher drop in sales for firms that have a one-standard deviation higher than average ratio of labor intensity (measured with the number of employees to assets). These effects are almost twice as large as our baseline estimates in Table II. In contrast, the effect is lower for firms with high capital intensity: The estimates in columns (3) and (4) show that a 0.66°C higher than average temperature in the county where a supplier is located leads to only a 0.3% drop in sales for firms that have a one-standard deviation higher than average ratio of capital intensity. Finally, columns (5) and (6) show that larger firms are better able to mitigate the effects of higher temperature on sales. The change in sales driven by a 0.66°C higher average temperature in the county where the firm is located is -1.5%, whereas it corresponds to -1.7% for firms that are smaller than the average by one standard deviation.

The estimates in Table VI suggest that the lower sales of suppliers located in hotter counties, relative to those of cooler counties, is driven by a lower productivity of the workers exposed to higher temperature. To analyze this issue further, in Table VII we estimate equation (1) over the subsample of supplier firms in heat-sensitive industries. Following the related literature (Graff Zivin and Neidell (2014)), we define heat-sensitive industries as those in the following sectors: agriculture, paper and forest products, metals and mining, construction and engineering, automobile and motorcycle manufacturers, transportation, and utilities. We expect productivity to
be lower in these heat-sensitive industries, and hence, the sensitivity of temperature to sales to be higher in this subsample. Table VII presents the estimates. Consistent with this hypothesis, the estimated coefficients are larger in magnitude than those in Table II, and economically significant. The coefficients suggest that a 0.66°C higher temperature reduces sales by 2.2% to 2.5% in these sectors. These estimates are similar to those in columns (1) and (2) of Table VI.

3.5. Firm responses to temperature shocks

In this section, we analyze what are the firms’ corporate responses to temperature shocks in terms of investment in capital (physical capital and working capital) and labor. For this purpose, we move from the client-supplier level to a firm-level analysis, using the full sample of Compustat firms over the 2000-2015 period. Table VIII presents the results. We find some evidence that firms exposed to higher temperatures are scaling back their capital expenditures. However, the number of employees is not affected, nor is the amount of working capital.

3.6. Robustness

In this subsection, we discuss several robustness checks of our primary findings. The Internet Appendix shows these results.

A first concern is whether the segment sales data are representative of the total sales of the supplier firm. In particular, firms are only required to disclose the identity of any client representing more than 10% of the total sales. During our 2000-2015 sample period, the sum of reported sales represents on average of 36% of total sales (the median is 28.7%). We run our regressions with the sample of suppliers for which the sum of reported sales represents at least 28.7% (the median). Table IA.II reports the estimates, which are consistent with those in Table II but more imprecisely estimated. The magnitudes of the coefficients of average temperature are similar at about -4.0% to -5.1% with supplier county fixed effects, supplier industry fixed effects and client-by-year fixed effects, and -3.9% to -5.0% with supplier county fixed effects and supplier industry-by-client-by-year fixed effects.
Another concern with the segments data is that suppliers exposed to higher temperatures may be selling less to clients that we observe in our sample (those presenting more than 10% of total sales) but more to other clients that we do not observe. To address this concern, we estimate firm-level (rather than client-supplier level) regressions similar to those in Table II using the change in total sales as a dependent variable. Table IA.IV reports the results for the full sample of Compustat firms. The coefficient on the temperature variable remains negative and significant in the firm-level regressions, albeit the estimated coefficient is smaller suggesting a drop in sales of 0.66% for a 0.66°C higher temperature in the county. These findings suggest that our main results in Table II are not driven by a potential selection of clients and suppliers into our supplier-client database.

4. Conclusion

This paper studies the economic costs of weather shocks using supply-chain networks. We compare sales of intermediate goods across suppliers that trade with the same client but are exposed to different weather shocks, which allow us to control for demand shocks.

We show that weather shocks can have important effects on supply-chain networks activity at the intensive margin. A one standard deviation increase in local average yearly temperature (0.66°C) in the supplier location leads to a reduction in sales of 1.4%. We also show that suppliers exposed to episodes of extremely hot and cold weather suffer strong reductions in sales.

We examine the channels by which weather shocks can affect sales. We find evidence consistent with a labor productivity channel in which weather shocks have a more pronounced negative effect on labor intensive industries. In addition, we find that larger firms are better able to deal with the adverse effects of weather shocks and therefore they suffer lower reductions in sales. Weather also shocks also seem to affect firm investment policy by decreasing capital expenditures.

Our results suggest that climate change can have important economic effects through supply-chain networks. Suppliers more likely to be affected by climate change can suffer significant decreases in production. The purchases and production of customers of climate change-sensitive
suppliers can also be affected even though these customers may not be sensitive to climate change. Thus, supply-chain networks can transmit the effects of climate shocks to regions that are not necessarily exposed to these climate shocks. Of course, firms can anticipate climate risks and substitute in favor of suppliers in locations that are less vulnerable to climate risks.
References


Pankratz, Nora M.C., and Christoph M. Schiller. 2019. “Climate Change and Adaptation in Global Supply-Chain Networks.” Available at SSRN 3475416.


Table I: Sample Description and Summary Statistics

Panel A presents the number of observations (supplier-client pairs), number of suppliers, number of clients, average number of suppliers per client, average fraction of total sales of the supplier, average temperature at supplier firms’ headquarter counties and client firms’ headquarter counties included in the sample per year. Panels B and C present mean, median, 25th percentile, 75th percentile, standard deviation, and number of observations for each supplier and client variable, respectively. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Panel D presents mean, median, 25th percentile, 75th percentile, standard deviation, and number of observations for firms. The sample consists of yearly observations of Compustat firms in the 2000-2015 period. Variable definitions are in Table A.1 in the Appendix.

Panel A: Sample Description by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Observations</th>
<th>Number of Supplier Firm</th>
<th>Number of Client Firms</th>
<th>Average Number of Suppliers per Client</th>
<th>Average Supplier Sales Coverage</th>
<th>Average Temperature in Supplier Counties</th>
<th>Average Temperature at Client Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>546</td>
<td>396</td>
<td>109</td>
<td>5.009</td>
<td>0.371</td>
<td>12.874</td>
<td>13.623</td>
</tr>
<tr>
<td>2001</td>
<td>813</td>
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<td>151</td>
<td>5.384</td>
<td>0.396</td>
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<td>14.118</td>
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<tr>
<td>2002</td>
<td>867</td>
<td>574</td>
<td>177</td>
<td>4.898</td>
<td>0.390</td>
<td>13.188</td>
<td>13.815</td>
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<td>2003</td>
<td>917</td>
<td>622</td>
<td>171</td>
<td>5.363</td>
<td>0.368</td>
<td>12.464</td>
<td>13.160</td>
</tr>
<tr>
<td>2004</td>
<td>901</td>
<td>601</td>
<td>173</td>
<td>5.208</td>
<td>0.371</td>
<td>12.911</td>
<td>14.030</td>
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<tr>
<td>2005</td>
<td>854</td>
<td>576</td>
<td>168</td>
<td>5.083</td>
<td>0.383</td>
<td>12.967</td>
<td>13.724</td>
</tr>
<tr>
<td>2006</td>
<td>906</td>
<td>600</td>
<td>171</td>
<td>5.298</td>
<td>0.363</td>
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<td>5.235</td>
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<td>2008</td>
<td>811</td>
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<td>5.301</td>
<td>0.361</td>
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<td>2009</td>
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<td>551</td>
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<td>5.039</td>
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<td>11.012</td>
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<tr>
<td>2010</td>
<td>754</td>
<td>529</td>
<td>145</td>
<td>5.200</td>
<td>0.358</td>
<td>13.325</td>
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<tr>
<td>2011</td>
<td>722</td>
<td>491</td>
<td>142</td>
<td>5.085</td>
<td>0.372</td>
<td>13.346</td>
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<td>2012</td>
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<td>473</td>
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<td>13.309</td>
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Unique: -- 1854 423 -- -- --

Total: 12547 -- -- -- -- --
### Panel B: Suppliers

<table>
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<tr>
<th>Variable</th>
<th>Mean</th>
<th>25&lt;sup&gt;th&lt;/sup&gt; Pct</th>
<th>Median</th>
<th>75&lt;sup&gt;th&lt;/sup&gt; Pct</th>
<th>Std Dev</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Δlog(Sales)</td>
<td>.0161698</td>
<td>-.1638015</td>
<td>.0365674</td>
<td>.2255829</td>
<td>.507294</td>
<td>12547</td>
</tr>
<tr>
<td>Tobin's Q</td>
<td>2.195319</td>
<td>1.09946</td>
<td>1.520592</td>
<td>2.358332</td>
<td>2.721029</td>
<td>12547</td>
</tr>
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### Panel C: Clients

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</table>
This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable $\Delta \log(Sales)$ is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. $Temp$ is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Prcp$ is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. $Cash/Assets$ is the ratio of cash and equivalents to total assets. $Assets$ is total assets. $Tangibility$ is the ratio of net fixed assets to total assets. $Leverage$ is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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### Table III: Extreme Weather Events

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable $\Delta \log(\text{Sales})$ is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. *Heat Events* is the number of heat events recorded in the county of corporate headquarters between years $t-1$ and $t$. *Cold Events* is the number of cold events recorded in the county of corporate headquarters between years $t-1$ and $t$. *Temp* is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. *Prcp* is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q_i$ is the ratio of the market value of assets to book value of assets. *Cash/Assets* is the ratio of cash and equivalents to total assets. *Log(Assets)* is the change in the log of assets from year $t-1$ to $t$. *Assets* is total assets. *Tangibility* is the ratio of net fixed assets to total assets. *Leverage* is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

#### Panel A: Heat Events

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*Supplier County FE* | Yes | Yes | Yes | Yes | Yes | Yes |
*Supplier Industry FE* | Yes | Yes | No  | No  | No  | No  |
*Supplier Industry x Year FE* | No  | No  | Yes | Yes | No  | No  |
*Supplier Industry x Client x Year FE* | No  | No  | No  | No  | Yes | Yes |
*Client x Year FE* | Yes | Yes | Yes | Yes | No  | No  |
*Observations* | 12,547 | 12,466 | 12,427 | 12,343 | 8,797 | 8,731 |
*R-squared* | 0.328 | 0.328 | 0.358 | 0.358 | 0.396 | 0.397 |
### Panel B: Cold Events

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Table IV: Extensive Margin

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable is a dummy variable that takes a value of one if the client-supplier relationship exists in period $t-1$ and does not exist in period $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Temp Sq. is the square of Temp. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp Sq. is the square of Prcp. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Asset is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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Supplier County FE  Yes Yes Yes Yes Yes Yes
Supplier Industry FE Yes Yes No No No No
Supplier Industry x Year FE No No Yes Yes No No
Supplier Industry x Client x Year FE No No No No Yes Yes
Client x Year FE Yes Yes Yes No No No
Observations 14,991 14,991 14,870 14,870 10,277 10,277
R-squared 0.404 0.404 0.438 0.438 0.472 0.472
Table V: Extreme Weather Events and Extensive Margin

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable is a dummy variable that takes a value of one if the client-supplier relationship exists in period $t-1$ and does not exist in period $t$. $Temp$ is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Temp$ Sq. is the square of $Temp$. $Prcp$ is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Prcp$ Sq. is the square of $Prcp$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. $Cash/Assets$ is the ratio of cash and equivalents to total assets. Assets is total assets. $Tangibility$ is the ratio of net fixed assets to total assets. $Leverage$ is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

### Panel A: Heat Events

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Supplier County FE Yes Yes Yes Yes Yes Yes
Supplier Industry FE Yes Yes No No No No
Supplier Industry x Year FE No No Yes Yes No No
Supplier Industry x Client x Year FE No No No No Yes Yes
Client x Year FE Yes Yes Yes Yes No No
Observations 15,086 14,991 14,970 14,870 10,349 10,277
R-squared 0.417 0.404 0.451 0.439 0.486 0.472
Table VI: Firm Size, Labor Intensity and Capital Intensity
This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable Δlog(Sales) is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Assets is total assets. Tangibility is the ratio of net fixed assets to total assets. Employee/Assets is the number of employees divided by total assets. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Leverage is the ratio of total debt to the market value of assets. Log(Assets), Employee/Assets and Tangibility are standardized by subtracting mean then dividing by sample standard deviation. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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<td>0.000 (0.998)</td>
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<td>Temp x Log(Assets)</td>
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<td>0.030*** (0.000)</td>
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Table VII: Sample with Heat Sensitive Industries

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable $\Delta \log(\text{Sales})$ is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Log(Assets) is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period in heat sensitive industries, as defined in Graff Zivin and Neidell (2014). Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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Supplier County FE: Yes
Supplier Industry FE: Yes
Supplier Industry x Year FE: No
Supplier Industry x Client x Year FE: No
Client x Year FE: Yes
Observations: 10,178
R-squared: 0.343
Table VIII: Corporate Responses

This table presents estimates of ordinary least squares (OLS) panel regressions at the firm level. In Panel A, the dependent variable $\Delta \log(CapEx)$ is the change in the log of capital expenditures between years $t-1$ and $t$. In Panel A, the dependent variable $\Delta \log(Employee)$ is the change in the log of the number of employees between years $t-1$ and $t$. In Panel C, the dependent variable $\Delta \log(Inventory)$ is the change in the log of inventory between years $t-1$ and $t$. $Temp$ is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Tobin's \ q$ is the ratio of the market value of assets to book value of assets. $Cash/Assets$ is the ratio of cash and equivalents to total assets. $Assets$ is total assets. $Tangibility$ is the ratio of net fixed assets to total assets. $Leverage$ is the ratio of total debt to the market value of assets. All financial variables are lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat firms in the 2000-2015. Robust $p$-values clustered at the county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

### Panel A: $\Delta \log(CapEx)$

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### Panel C: Δlog(Inventory)

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|               | Yes          | Yes          | Yes          | Yes          |
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| Year FE       | Yes          | No           | Yes          | No           |
| Industry x Year FE | No     | Yes          | No           | Yes          |
| Cluster       | County       | County       | County       | County       |
| Observations  | 42,893       | 42,893       | 42,847       | 42,847       |
| R-squared     | 0.217        | 0.217        | 0.242        | 0.242        |
## Appendix

### Table A.I: Variable Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>Total assets (Compustat AT).</td>
</tr>
<tr>
<td>CapEx</td>
<td>Capital expenditures (Compustat CAPX).</td>
</tr>
<tr>
<td>Cash/Assets</td>
<td>Cash divided by total assets (Compustat CHE / AT).</td>
</tr>
<tr>
<td>Employee</td>
<td>Total number of employees (Compustat EMP).</td>
</tr>
<tr>
<td>Employee/Assets</td>
<td>Total number of employees divided by total assets (Compustat EMP / AT).</td>
</tr>
<tr>
<td>Inventory</td>
<td>Total value of inventory (Compustat INVT).</td>
</tr>
<tr>
<td>Market Leverage</td>
<td>Total debt, defined as debt in current liabilities plus long-term debt, divided by market value of assets (Compustat (DLC + DLTT) / (DLC + DLTT + CSHO ´ PRCC_F)).</td>
</tr>
<tr>
<td>Sales</td>
<td>Total sales (Compustat SALE).</td>
</tr>
<tr>
<td>Tangibility</td>
<td>Asset tangibility. Property, Plant and Equipment net of accumulated depreciation divided by total assets (Compustat PPENT / AT).</td>
</tr>
<tr>
<td>Tobin’s Q</td>
<td>Total assets plus market value of equity minus book value of equity divided by total assets (Compustat AT + CSHO ´ PRCC_F - [AT - (LT + PSTKL) + TXDITC] / AT).</td>
</tr>
<tr>
<td>Δlog(Sales)</td>
<td>Change in the log of sales from supplier i to client j between years t-1 and t (Compustat).</td>
</tr>
<tr>
<td>Δlog(CapEx)</td>
<td>Change in the log of capital expenditures in years t-1 and t (Compustat).</td>
</tr>
<tr>
<td>Δlog(Employee)</td>
<td>Change in the log of total employees in years t-1 and t (Compustat).</td>
</tr>
<tr>
<td>Δlog(Inventory)</td>
<td>Change in the log of inventory in years t-1 and t (Compustat).</td>
</tr>
<tr>
<td>Temp</td>
<td>Average daily temperature in a county in year t in degree Celsius (PRISM).</td>
</tr>
<tr>
<td>Prcp</td>
<td>Average daily precipitation in a county in year t in inches (PRISM).</td>
</tr>
<tr>
<td>Cold Events</td>
<td>Number of Cold events in a county recorded in NOAA Storm Events Database. A Cold event is an episode (a period) of low temperature (or wind chill temperatures) that reaches or exceeds locally/regionally defined advisory conditions (typical value is -18 degrees Fahrenheit or colder) (NOAA Storm Events Database).</td>
</tr>
<tr>
<td>Heat Events</td>
<td>Number of Heat events in a county recorded in NOAA Storm Events Database. A Heat event is an episode where heat index values meet or exceed locally/regionally established advisory thresholds (NOAA Storm Events Database).</td>
</tr>
</tbody>
</table>
Internet Appendix for
Climate Change and Supply Chain

Cláudia Custódio
Imperial College Business School, CEPR, ECGI

Miguel A. Ferreira
Nova School of Business and Economics, CEPR, ECGI

Emilia Garcia-Appendini
University of Zurich

Adrian Lam
Imperial College Business School
Table IA.I: Baseline Results with Quadratic Weather Variables

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable Δlog(Sales) is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Temp Sq. is the square of Temp. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp Sq. is the square of Prcp. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Assets is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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<td>-0.049*</td>
<td>-0.051*</td>
<td>-0.070**</td>
<td>-0.072***</td>
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<td>(0.039)</td>
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<td>-0.072**</td>
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<tr>
<td></td>
<td>(0.792)</td>
<td>(0.907)</td>
<td>(0.707)</td>
<td>(0.707)</td>
<td>(0.707)</td>
<td>(0.707)</td>
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<td>0.001</td>
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<td>0.002</td>
<td>0.003**</td>
<td>0.003**</td>
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<tr>
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<td>(0.134)</td>
<td>(0.033)</td>
<td>(0.049)</td>
<td>(0.049)</td>
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<tr>
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<td>-0.000</td>
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<td>(0.664)</td>
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<tr>
<td>Tobin’s Q</td>
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<td>0.013***</td>
<td>0.015***</td>
<td>0.015***</td>
<td>0.023***</td>
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<td>Log(Assets)</td>
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<td>0.014***</td>
<td>0.015***</td>
<td>0.015***</td>
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<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.045)</td>
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<td>-0.080</td>
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<td>(0.172)</td>
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<td>(0.159)</td>
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<td>(0.116)</td>
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<td>(0.185)</td>
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<td>(0.437)</td>
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<td>0.369*</td>
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<td>0.792***</td>
<td>0.824***</td>
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<td>(0.028)</td>
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<td>(0.005)</td>
<td>(0.003)</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Supplier Industry FE</td>
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<td>No</td>
<td>No</td>
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<tr>
<td>Supplier Industry x Year FE</td>
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<td>Yes</td>
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<td>Supplier Industry x Client x Year FE</td>
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<td>No</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Client x Year FE</td>
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<td>R-squared</td>
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<td>0.328</td>
<td>0.358</td>
<td>0.358</td>
<td>0.397</td>
<td>0.397</td>
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Table IA.II: Changes in Average Temperature

This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable $\Delta \log(Sales)$ is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. $Temp$ is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Temp Chg$ is the change in average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. $Prcp$ is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. $Cash/Assets$ is the ratio of cash and equivalents to total assets. $Assets$ is total assets. $Tangibility$ is the ratio of net fixed assets to total assets. $Leverage$ is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat supplier-client pairs in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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<td>Temp Chg</td>
<td>-0.012**</td>
<td>-0.012**</td>
<td>-0.013**</td>
<td>-0.013**</td>
<td>-0.016***</td>
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<td>(0.026)</td>
<td>(0.031)</td>
<td>(0.024)</td>
<td>(0.025)</td>
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<tr>
<td>Temp</td>
<td>-0.003**</td>
<td>-0.003**</td>
<td>-0.003**</td>
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<td>(0.026)</td>
<td>(0.018)</td>
<td>(0.018)</td>
<td>(0.017)</td>
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<tr>
<td>Prcp</td>
<td>-0.009</td>
<td>-0.011*</td>
<td>-0.013**</td>
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<td></td>
<td>(0.139)</td>
<td>(0.071)</td>
<td>(0.043)</td>
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<tr>
<td>Tobin's Q</td>
<td>0.013***</td>
<td>0.013***</td>
<td>0.013***</td>
<td>0.014***</td>
<td>0.014***</td>
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<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.000)</td>
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<td>Cash/Assets</td>
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<td>(0.142)</td>
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<tr>
<td>Log(Assets)</td>
<td>0.014***</td>
<td>0.013***</td>
<td>0.013***</td>
<td>0.013***</td>
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<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.001)</td>
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<tr>
<td>Tangibility</td>
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<td>-0.021</td>
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<td>(0.324)</td>
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<td>Leverage</td>
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<td>-0.049**</td>
<td>-0.045*</td>
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<td>Yes</td>
<td>No</td>
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<td>Supplier Industry x Year FE</td>
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<tr>
<td>Client x Year FE</td>
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<td>0.298</td>
<td>0.302</td>
<td>0.303</td>
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</table>
This table presents estimates of ordinary least squares (OLS) panel regressions at the supplier-client pair level. The dependent variable Δlog(Sales) is the change in the log of sales from supplier $i$ to client $j$ between years $t-1$ and $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Assets is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are for the supplier and lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample is restricted to suppliers for which client sales coverage is above (28.7%). Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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<td>0.041***</td>
<td>0.041***</td>
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<td><strong>Cash/Assets</strong></td>
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<td><strong>Log(Assets)</strong></td>
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<td>0.011**</td>
<td>0.013**</td>
<td>0.013**</td>
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<td>-0.181*</td>
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<td>-0.048</td>
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<td>-0.059</td>
<td>-0.028</td>
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<td>(0.135)</td>
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<td>(0.110)</td>
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Supplier County FE: Yes
Supplier Industry FE: Yes
Supplier Industry x Year FE: No
Supplier Industry x Client x Year FE: Yes
Client x Year FE: Yes
Observations: 7,399
R-squared: 0.354
# Table IA.IV: Firm Level Results

This table presents estimates of ordinary least squares (OLS) panel regressions at the firm level. In Panel A, the dependent variable Δlog(Sales) is the change in the log of sales between years \( t-1 \) and \( t \). In Panel B, the dependent variable EBIT/Assets is operating profit in year \( t \) scaled by total assets in year \( t-1 \). Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for firm \( i \) between years \( t-1 \) and \( t \). Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for firm \( i \) between years \( t-1 \) and \( t \). Tobin’s \( q \) is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Assets is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat firms in the 2000-2015 period. Robust \( p \)-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

## Panel A: Δlog(Sales)

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<td>-0.008**</td>
<td>-0.010***</td>
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<td>0.003***</td>
<td>0.003***</td>
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<td>(0.000)</td>
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<td>0.171***</td>
<td>0.170***</td>
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Firm FE: Yes
Year FE: Yes
Industry-Year FE: No
Cluster: County
Observations: 58,278
R-squared: 0.216

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Table I.A.V: Firm Level Results with Heat Sensitive Industries

This table presents estimates of ordinary least squares (OLS) panel regressions at the firm level. In Panel A, the dependent variable $\Delta \log(Sales)$ is the change in the log of sales between years $t-1$ and $t$. In Panel B, the dependent variable $\text{EBIT/Assets}$ is operating profit in year $t$ scaled by total assets in year $t-1$. $\text{Temp}$ is the average daily temperature in degree Celsius in the county of the corporate headquarters for firm $i$ between years $t-1$ and $t$. $\text{Prcp}$ is the average daily precipitation in degree Celsius in the county of the corporate headquarters for firm $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. $\text{Cash/Assets}$ is the ratio of cash and equivalents to total assets. $\text{Assets}$ is total assets. $\text{Tangibility}$ is the ratio of net fixed assets to total assets. $\text{Leverage}$ is the ratio of total debt to the market value of assets. All financial variables are lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat firms in heat sensitive industries, as defined in Graff Zivin and Neidell (2014), in the 2000-2015 period. Robust $p$-values clustered at the supplier county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

**Panel A: $\Delta \log(Sales)$**

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<td>0.003***</td>
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<td>0.163***</td>
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## Panel B: EBIT/Assets

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<td>-0.066***</td>
<td>-0.066***</td>
<td>-0.066***</td>
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<td>(0.008)</td>
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<td>-0.133</td>
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Firm FE      Yes  Yes  Yes  Yes
Year FE      Yes  No   Yes  No
Industry-Year FE Yes  No   Yes  No
Cluster      County County County County
Observations 37,488 37,488 37,464 37,464
R-squared    0.762 0.762 0.765 0.765
Table IA.VI: Corporate Responses with Heat Industries

This table presents estimates of ordinary least squares (OLS) panel regressions at the firm level. In Panel A, the dependent variable $\Delta \log(CapEx)$ is the change in the log of capital expenditures between years $t-1$ and $t$. In Panel A, the dependent variable $\Delta \log(Employee)$ is the change in the log of the number of employees between years $t-1$ and $t$. In Panel C, the dependent variable $\Delta \log(Inventory)$ is the change in the log of inventory between years $t-1$ and $t$. Temp is the average daily temperature in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Prcp is the average daily precipitation in degree Celsius in the county of the corporate headquarters for supplier $i$ between years $t-1$ and $t$. Tobin’s $q$ is the ratio of the market value of assets to book value of assets. Cash/Assets is the ratio of cash and equivalents to total assets. Assets is total assets. Tangibility is the ratio of net fixed assets to total assets. Leverage is the ratio of total debt to the market value of assets. All financial variables are lagged one period. Variable definitions are provided in Table A.1 in the Appendix. The sample consists of yearly observations of Compustat firms in heat sensitive industries, as defined in Graff Zivin and Neidell (2014), in the 2000-2015 period. Robust $p$-values clustered at the county level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

### Panel A: $\Delta \log(CapEx)$

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<td>(0.635)</td>
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<td>0.009***</td>
<td>0.009***</td>
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<td>(0.000)</td>
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<td>(0.000)</td>
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<td>(0.000)</td>
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</tbody>
</table>

<p>| | | | | |
|       |         |         |         |         |
| Firm FE | Yes     | Yes     | Yes     | Yes     |
| Year FE | Yes     | No      | Yes     | No      |
| Industry x Year FE | No | Yes | No | Yes |
| Cluster | County | County | County | County |
| Observations | 35,680 | 35,680 | 35,646 | 35,646 |
| R-squared | 0.181 | 0.181 | 0.204 | 0.204 |</p>
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<th>(3)</th>
<th>(4)</th>
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<td>Prcp</td>
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<tr>
<td>Lag(Tobin's Q)</td>
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<td>0.001***</td>
<td>0.001***</td>
<td>0.001***</td>
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### Panel C: $\Delta \log(\text{Inventory})$

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