Does Winter Weather Decrease Work?

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Overview of "Does Winter Weather Decrease Work?"

It is often argued that bad weather decreases economic activity, in particular, snowstorms.

Examples from Federal Reserve Chair Janet Yellen in 2014:

"… A number of data releases have pointed to softer spending than many analysts had expected. ***Part of that softness may reflect adverse weather conditions****, but at this point, it's difficult to discern exactly how much."*

"The Federal Open Market Committee's (FOMC) current outlook for continued, moderate growth is little changed from last fall. … The ***unusually harsh winter weather*** *in much of the nation has complicated this judgment, but* ***my FOMC colleagues and I generally believe that a significant part of the recent softness was weather related.****"*

Our paper examines how snowfall in about **250 U.S. urban areas** affects workers' reported hours worked in the monthly CPS survey reference week (2nd week of each month). Data covers Jan 2004–Dec 2014 (132 months).

We find snow during CPS reference weeks **reduces work hours**. Loss in hours rises with accumulation levels. The work hours–snow relationship varies across **employment type, industry, occupation, region, & worker type**.

For example, **regions** with the **most snow are best at mitigating snowfall effects** on work hours (presumably due to better handling of transportation).

> Extreme case: "Snowmaggedon" in Atlanta in January 2014. Just over two inches of snow/ice paralyzed interstates and stranded drivers on roads for more than two days.

Prior Literature

We are not aware of any other paper linking monthly CPS work hours to same-week metro area snow levels or other weather conditions. There has been prior literature on weather and time use (the ATUS):

- Connolly (2008) examines the **impact of rain on the labor/leisure choice** using the American Time Use Surveys (ATUS). She finds that men substitute about thirty minutes per day, on average, from leisure to work on rainy days.
- Zivin and Neidell (2014) use the 2003–2006 ATUS linked to weather data from the National Climatic Data Center. They find **fluctuations in temperature** lead to substantive changes in labor supply. They find **reduced work hours in climate-exposed industries** (e.g., agriculture, forestry, mining, construction, & utilities) when **temperature exceed 85˚F**. Ziven and Neidell find **little evidence of interday substitution** of hours in the workplace.

- Similar to Connolly (2008), Lee, Gino, & Staats (2014) show that good weather creates distractions that decrease productivity among **Japanese bank workers**. Krüger & Neugart (2018) use **German time use data** from 2001-2002 linked to weather data. Their data has **multiple diary days per worker**, allowing them to use worker fixed effects and measure how day-to-day hours vary with weather among workers. **Substitution** between leisure and work is **highest for workers in jobs with flexible hours**.

- Boldin and Wright (BPEA 2015). Our study and others examine how weather affects hours using **worker-specific household data**, BW examine the relationship between **weather and employment/hours fluctuations** in the **CES establishment surveys** from BLS that are used (along with the CPS) in the BLS monthly employment reports. BW explore how one might **revise "seasonal adjustment" methods by incorporating *current* monthly weather data** rather than (or in addition to) current methods based on historical fluctuations in monthly employment.

Weather Data:

Weather data are from the **National Climatic Data Center**, part of the National Oceanic and Atmospheric Administration (NOAA). We use datasets from the **Global Historical Climatological Network (GHCN) Daily**, which integrates daily climate observations from approximately 30 different data sources. Beginning in 2012, **GHCN has provided historical daily (7-days each week) weather data**.

Measures used in our study are snowfall events and the **average daily snow accumulation (in inches) over the 7-day CPS reference week**, for all 265 metro areas (CBSAs) in the CPS over the years 2004-2014.

Our snow measures are based on snow levels (**inches**) in each **CBSA's most populated county**. Of the 265 CBSAs, 103 include only one county and 162 include two or more counties. The most-populated county should have the most substantial economic influences. Moreover, weather conditions are similar among nearby counties.

Each county contains multiple stations, varying from 1 to 472 stations (nearly all – 252 of 265 – counties contain less than 100 stations. For each county matched to a CBSA we obtain the daily information on snowfall and weather type. **Daily snowfall is summed across all stations within a county and then averaged**.

Our primary measure is the **average daily inches of snow across the 7 days in each CPS reference week**. The snowfall data is matched to the CPS. Regression samples include individuals with at least one snow event in their CPS reference week and/or in prior weeks included in our analysis.

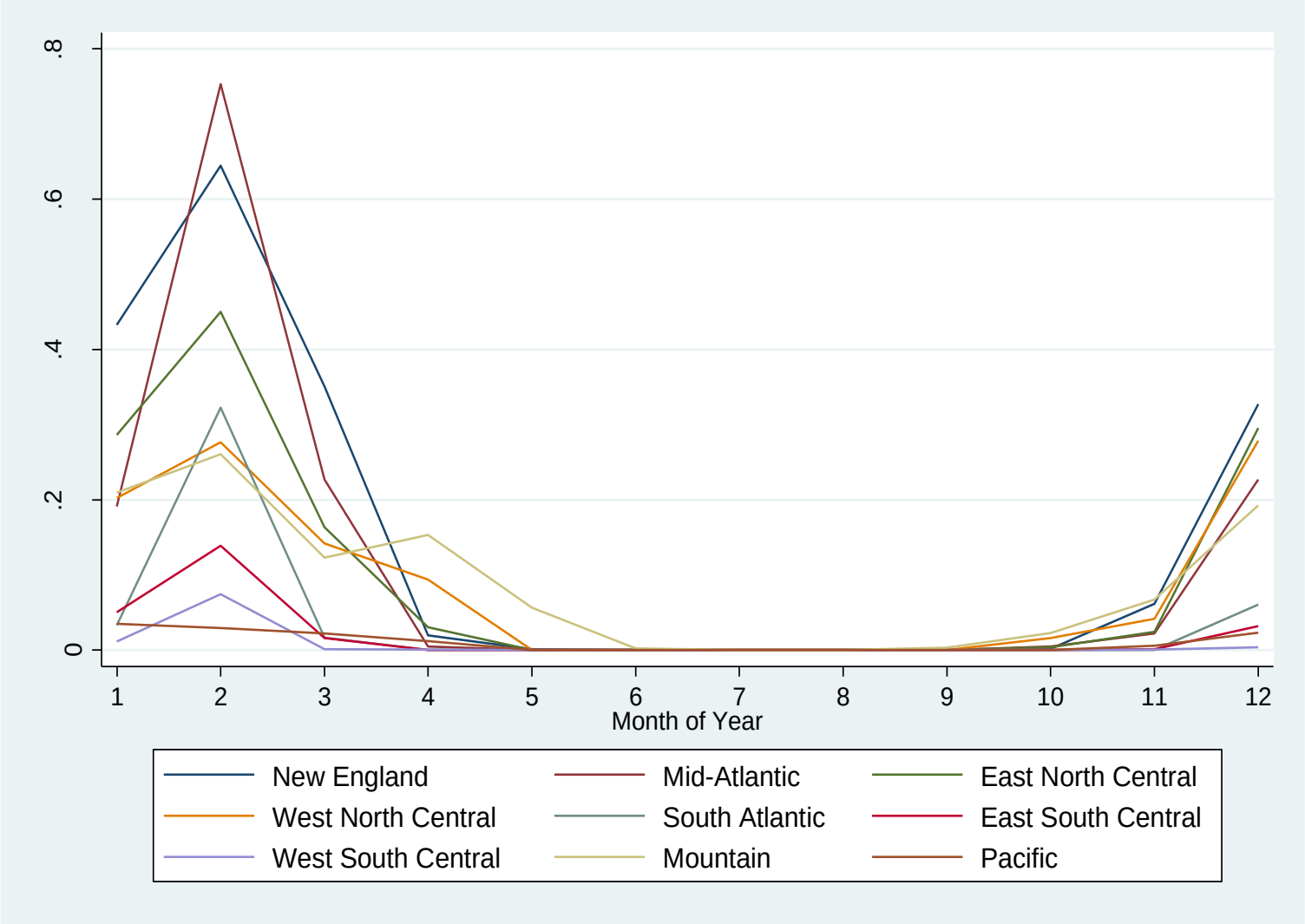
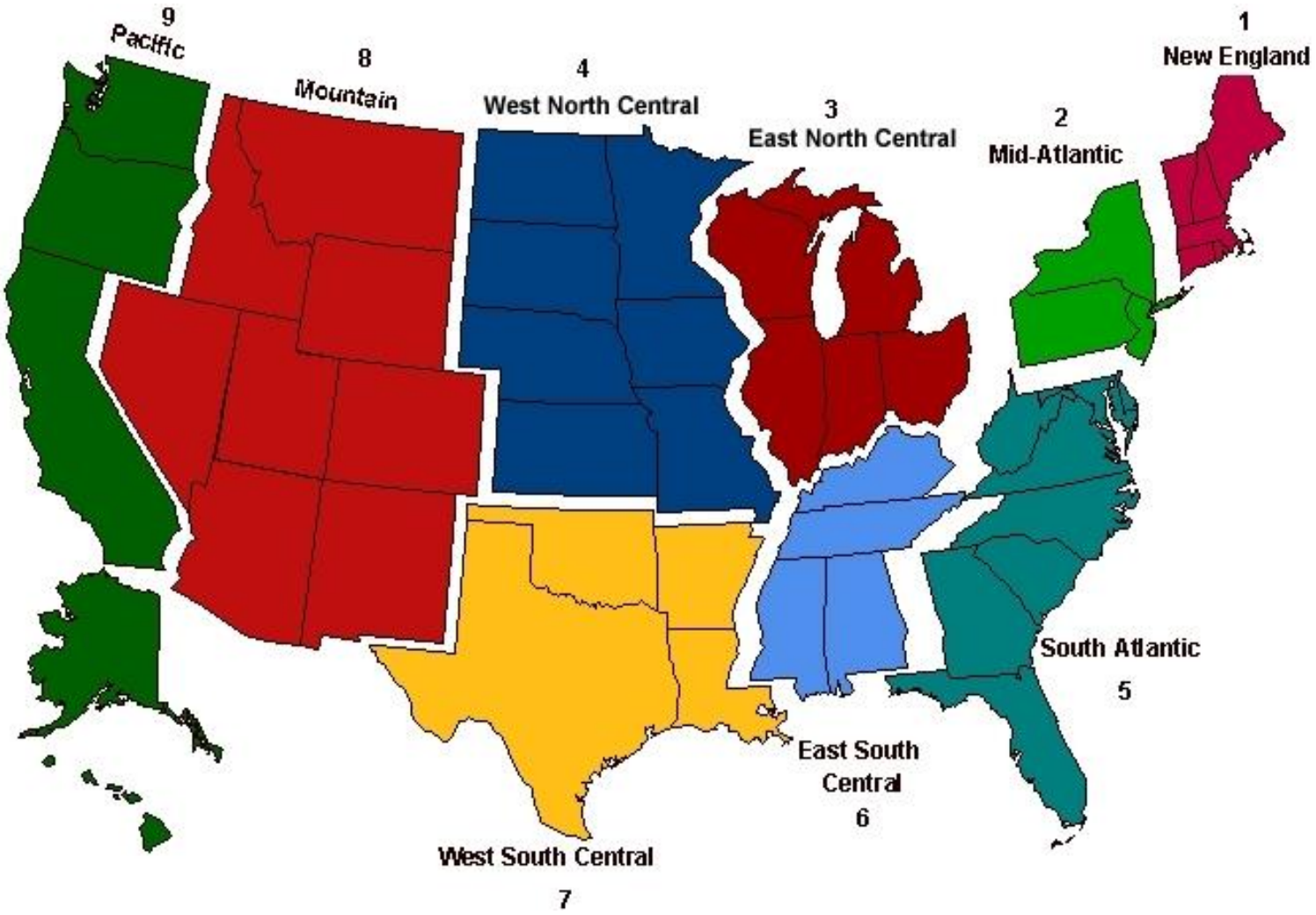


Figure 2: Average snowfall by region by month, USA 2004-2014

High-to-low in February: Mid-Atl, NE, ENC, SA, WNC, Mountain, ESC, WSC, Pacific


9
Pacific
8
Mountain
4
West North Central
3
East North Central
2
Mid-Atlantic
1
New England
South Atlantic
5
East South
Central
6
West South Central
7

Current Population Survey (CPS) data on employment, hours worked, etc.

Use monthly CPS, **October-March** of each year, 2004-2014, all rotation groups.

Identified metropolitan sample accounts for about 70% of nationwide surveyed households

As a measure of **work hours**, the Current Population Survey (CPS) provides information on hours worked per week in one's primary job, usual hours in a second job if a multiple job holder, and measures of actual hours worked the previous week in the primary job and all other jobs.

The three measures of hours used in our analysis are:

(a) **hours worked last week on all jobs**;

(b) **usual hours worked per week in one's primary job and a second job** (about 5 percent of worker are multiple job holders); and

(c) the **difference between hours last week and usual hours worked.**

Table 1: Mean hours worked in weeks with and without snowfall

All CPS Survey Weeks, October – March, 2004–2014

	Total CPS Obs.	Mean	Std. Dev.
	Full sample		
Hours worked last week	5,765,988	37.9	12.68
	Sample of weeks with snowfall		
Hours worked last week	1,270,219	**37.6**	12.81
	Sample of weeks with no snowfall		
Hours worked last week	4,495,769	**38.0**	12.64

22% of the CPS sample has a snow event with non-zero snowfall in their current reference week. During weeks with snow events, mean weekly hours are lower and variance (s.d.) is higher.

Base regression results:

Primary Findings: **Each inch of average daily snowfall** in the CPS reference week leads to a 0.9 hour (**54 minute**) reduction in hours worked last week, an approximate **3% reduction** in hours worked (1.16 hours based on unconditioned mean hours). Alternatively, we find a 0.64 hours (38 minute) reduction in hours last week relative to usual weekly hours.

Table 1: Hours worked last week and snowfall in reference week

	Hours worked last week	Log hours last week	Hours worked difference
Inches snow	**-0.897*****	**-0.0305*****	-0.635***
	(0.200)	(0.00671)	(0.154)
Observations	2,490,454	2,486,595	2,487,691
R-squared	0.152	0.124	0.006

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Note: There are 3 hours worked regressions with alternative dependent variables. The table presents the estimated coefficient (and standard error) on the snow variables. All robust standard errors (in parentheses) are clustered at the CBSA level. **Samples include only those with snow events. Each regression controls demographic information on age, race, sex, educational level, experiences, plus sets of dummies for Month, CBSA size, Region, Broad Occupation, and Broad Industry.**

Does snow in prior weeks affect work hours in reference week?

"**Spillover**" effects lead to a decrease. "**Make-up**" effects lead to an increase. We find some evidence for *both* effects. Typical snowfall in a prior week has minimal effect on hours in reference week (col 1).

Substantial snowfall in prior weeks has substantive effects on hours in reference week, both a negative spillover effect 1 week after and a positive makeup effect 2-weeks after.

Table 2: Hours worked due to past snowfall for initial full sample and for sample with substantial snowfall, ***excluding observations with subsequent week snowfalls***

	Hours worked last week **Full winter sample**	Hours worked last week **Winter sample with 2"+ snow**
A. Snow one week before the reference week		
Snow	-0.128	-0.674**
	(0.0922)	(0.313)
Observations	1,687,925	19,821
B. Snow two weeks before the reference week		
Snow	-0.272**	0.424**
	(0.107)	(0.169)
Observations	1,396,900	12,663

How appropriate is a linear or log linear specification of hours and snowfall levels? Use of snowfall level dummies shows deviations from strict linearity, but no sign reversals.

Table 3: The relationship between hours worked last week and snow level dummies

	Hours worked last week	Log hours worked last week	Hours worked difference
Snow greater than 0 - 0.1''	**-0.203*****	-0.00580***	-0.0692***
	(0.0537)	(0.00210)	(0.0207)
Snow b/w 0.1''-0.5''	**-0.409*****	-0.0129***	-0.161***
	(0.0639)	(0.00234)	(0.0379)
Snow b/w 0.5''-1''	**-0.760*****	-0.0256***	-0.364***
	(0.130)	(0.00449)	(0.0783)
Snow b/w 1''-2''	**-0.879*****	-0.0287***	-0.518***
	(0.137)	(0.00461)	(0.116)
Snow greater than 2''	**-3.043*****	-0.102***	-2.320***
	(1.125)	(0.0378)	(0.810)
Observations	2,490,454	2,486,595	2,487,691
R-squared	0.152	0.124	0.006

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Do **salaried & hourly workers** differ in response to snowfall? **Salaried workers** more able to vary work hours. However, **hourly workers** are more concentrated in occupations and industries in which customer demand varies with the weather or working outdoors.

Results: Work hours of **salaried workers more sensitive to snow** than for hourly workers, but differences are modest, about **12 min. difference for each avg. weekly inch of snow**.

Table 4: Snowfall effects on hours worked for salaried versus hourly workers

	(1) Salaried	(2) Hourly	(3) Salaried	(4) Hourly
	Full sample		Snow event sample	
Snow	-0.987***	-0.800***	-0.830***	-0.597***
	(0.245)	(0.186)	(0.114)	(0.145)
Observations	248,566	325,783	65,665	91,936
R-squared	0.087	0.185	0.093	0.200
salaried–hourly diff.	**-0.187***		**-0.233***	

Table 5: Snowfall effects on hours by class of worker: Public, private, self-employed

	(1) Public	(2) Private	(3) Self-Employed	(4) Public	(5) Private	(6) Self-Employ
	Full sample			Snow event sample		
Snow	-1.56***	-0.780***	-0.694***	-1.08***	-0.630***	-0.491***
	(0.380)	(0.164)	(0.189)	(0.194)	(0.118)	(0.177)
Observations	373,464	1,892,618	224,372	94,728	527,375	61,605
R-squared	0.100	0.184	0.110	0.120	0.199	0.110

Work hours for **public sector workers** (e.g. teachers) far more sensitive to snowfall than for private sector workers. **Self-employed least sensitive** since many work from home.

Snowfall effects on work hours by industry group, in order of sensitivity to snowfall (highest to lowest).

Industry Groups	Full sample	Snow event sample
Construction	-1.332	-1.087
Agriculture., Forestry, Fishing, Hunting	-0.996	-1.153
Leisure and Hospitality	-0.987	-0.804
Other Services	-0.985	-0.475
Professional, Business, Other Services	-0.887	-0.575
Transportation and Utilities	-0.852	-0.623
Education and Health Services	-0.781	-0.626
Wholesale & Retail Trade	-0.649	-0.604
Finance, Insurance, Real Estate	-0.637	-0.635
Manufacturing	-0.601	-0.572
Mining	-0.478	-0.695
Information Services	-0.435	-0.531

Industries with outdoor activity or those dependent on consumer travel are most affected by snowfall.

Snowfall effects on work hours by occupation group, in order of sensitivity to snowfall (highest to lowest).

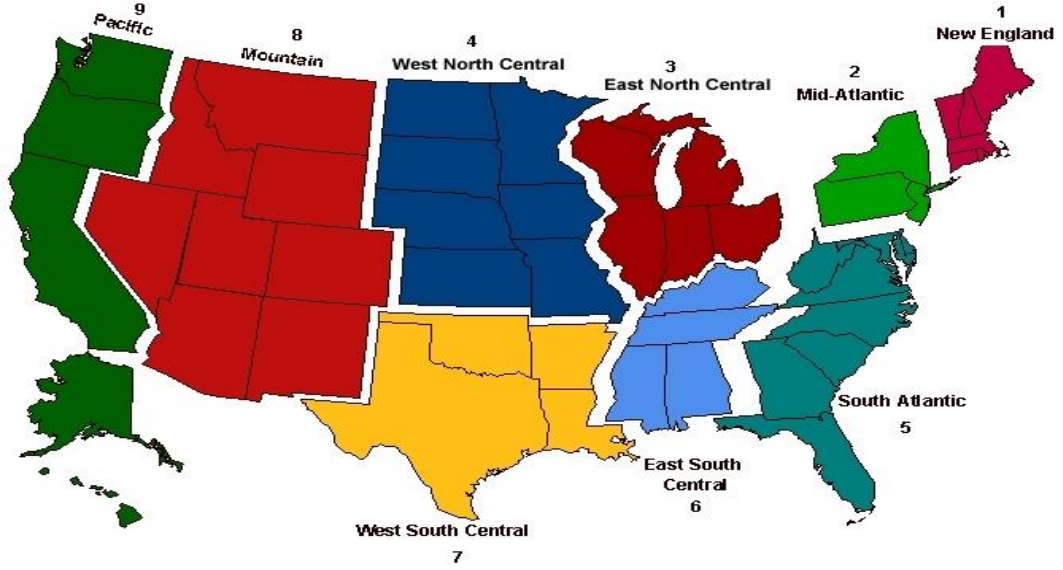
Occupation Groups	Full sample	Snow event sample
Farming, Fishing, Forestry	-1.562	-1.392
Construction, Extraction	-1.086	-0.836
Professional and Related	-1.081	-0.794
Office & Administrative Support	-0.898	-0.699
Transportation & Material Moving	-0.859	-0.747
Management, Business, & Financial	-0.847	-0.502
Sales & related occupations	-0.814	-0.769
Services	-0.745	-0.575
Production workers	-0.650	-0.711
Installation, Maintenance, & Repair	-0.588	-0.552

Occupations with outdoor activity or involving travel most affected by snowfall.

Snowfall effects on hours by region, in order of sensitivity to snowfall (high to low).

Regions	Full sample	Snow event sample	Sn rank
East South Central	-4.211	-3.880	7
West South Central	-2.668	-2.497	8
South Atlantic	-2.619	-1.746	4
West North Central	-0.803	-0.770	5
Mid-Atlantic	-0.598	-0.868	1
Pacific	-0.498	-0.298	9
East North Central	-0.443	-0.433	3
Mountain	-0.366	-0.113	6
New England	-0.274	-0.287	2

Regions with least (most) snow are most (least) affected by snowfall



High-to-low snow in February: Mid-Atl, NE, ENC, SA, WNC, Mountain, ESC, WSC, Pacific

Summary:

1. Little is known about the magnitude of work hour effects from weather
2. We show that snow events reduce work hours by about 1 hour per week for each inch of average daily snow during a CPS reference week
3. Worker response to snow events differs by worker type (hourly vs. salaried), class of worker (private, public, SE), industry, and occupation.
4. Snow events of a *given size* have the largest (smallest) effects in regions with the least (most) annual snowfall.
5. Snowfall from a previous week has negative "spillover" effects on hours in the reference week. Very large snowfalls in prior weeks may have a positive (but small) "make-up" effect on hours in the reference week.
6. A back-of-the-envelope calculation is that in a typical year, total annual hours (and by extension, total output?) are reduced by 0.15 percent.
7. It is not surprising that the Fed, business analysts, and the media point to the effects of severe weather events on economic activity.

Appendix: 21 Different Weather Types in GHCN-Daily Database

# of type	Description of the weather type
01	Fog, ice fog, or freezing fog (may include heavy fog)
02	Heavy fog or heaving freezing fog (not always distinguished from fog)
03	Thunder
04	***Ice pellets, sleet, snow pellets, or small hail***
05	Hail (may include small hail)
06	Glaze or rime
07	Dust, volcanic ash, blowing dust, blowing sand, or blowing obstruction
08	Smoke or haze
09	***Blowing or drifting snow***
10	Tornado, waterspout, or funnel cloud
11	High or damaging winds
12	Blowing spray
13	Mist
14	Drizzle
15	Freezing drizzle
16	Rain (may include freezing rain, drizzle, and freezing drizzle)
17	Freezing rain
18	***Snow, snow pellets, snow grains, or ice crystals***
19	Unknown source of precipitation
21	Ground fog
22	Ice fog or freezing fog

Final points to consider and new estimates:

Leisure disutility. Bad weather (e.g., rain or snow) can decrease value of leisure and thus increase work (as seen for rain). Our estimated negative snow effects on work hours are net of (potential) positive work effects of snow due to leisure disutility.

Weights. We need to check regression results using CPS sample weights. Larger (smaller) metros are under-sampled (over-sampled); weights would increase (decrease) impact of larger (smaller) metros.

Clustering. Standard errors are clustered by MSA. Overly conservative? We could (or should?) cluster by MSA-by-month/year, which would result in smaller standard errors.

Snow event vs. snow level (intensity) effects. Add to our regression samples the no-snow-event observations (far larger than snow observations). Then add a dummy for snow event, many of which have zero snow accumulation. This will allow us to distinguish between the effects of a snow event and the levels of snowfall. Similar in spirit to a McDonald-Moffitt Tobit decomposition separating the effects of an event and its intensity. Snow event data are unique in that we explicitly observe snow events with and without accumulation (i.e., events with zero as well as positive snowfall levels), in addition to the levels (intensity) of accumulation.