

# The Impact of Gasoline Prices on Internet Purchases

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# How do consumers react if gas prices increase in $x\%$ ?

## WHY DOES IT MATTER HOW CONSUMERS ADJUST THEIR BEHAVIOR TO CHANGES IN GAS PRICES?

### – Spending patterns

- Grocery selection (Gicheva, Hastings & Villas-Boas, 2007)
- Heat vs. eat (Cullen, Friedberg & Wolfram, 2006)
- Macroeconomic effects (Inflation)

### – Driving patterns

- Energy and environmental policy design
- Gasoline price elasticity (Puller & Greening, 1999)
- Car markets (Busse, Knittel & Zettelmeyer, 2008)
- Public transportation (Commuting decision)

# How do gas prices impact consumers' decisions to drive or “click” to buy?

THERE IS ANECDOTAL EVIDENCE: NEW YORK TIMES, JULY 19TH, 2008

## To Save Gas, Shoppers Stay Home and Click

To go shopping these days, more Americans are trading in their car keys for a keyboard.

...Lately Nichelle Hines, an actress in Los Angeles, has been **shopping online for everything but gas** itself — pet supplies, books, DVDs, water filters, kitchen appliances, a dress, her favorite health drink and materials to build a voiceover booth so she does not have to drive to a recording studio.

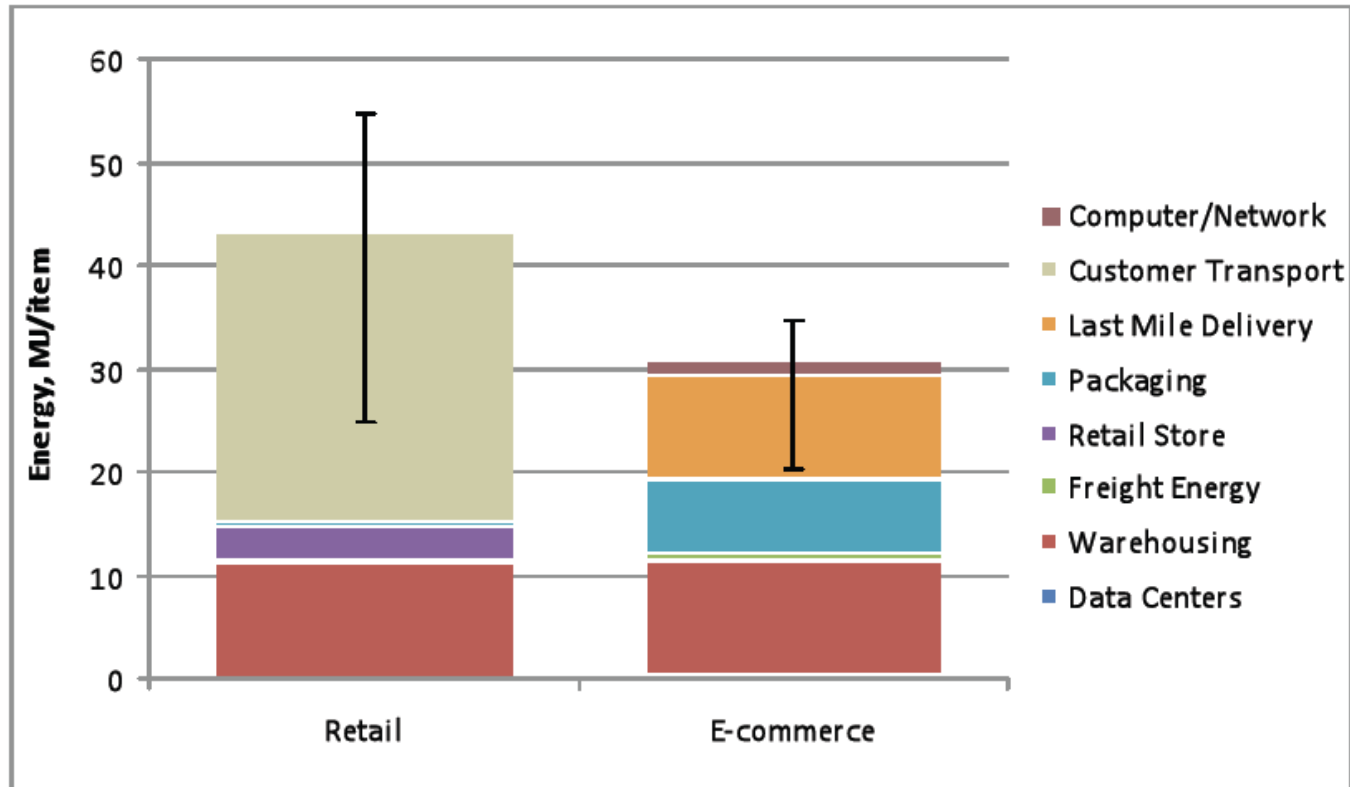
“It has saved us,” said Ms. Hines, who lives with her boyfriend, Charles, the builder of the booth. “And **we really just started doing this three or four months ago just from sheer desperation of spending money on gallons of gas.**”

# Why do online purchases matter from an environmental perspective?

## ARE ONLINE PURCHASES “GREENER” THAN TRADITIONAL ONES?

- Carnegie Mellon Green Institute report based on Buy.com (Weber et al., 2008): flash drive
  - online purchases have around 35% less energy consumption and less emissions than traditional retailing.
  - Approximately 65% of total emissions generated by traditional retail come from customer transport to and from retail stores
  - Approximately 65% of total emissions generated by e-commerce by packaging and last mile delivery to customer homes
- Matthews (2001) & Hendrickson (2006): books
- Sivaraman (2007): DVD rental
- Kim (2008): books

# Buy.com study on energy



**Figure 3: Total Primary Energy associated with Retail and E-commerce systems by stage**

# Why do people purchase online?

## AC NIELSEN: TOP REASONS WHY AMERICANS SHOPPED ONLINE IN OCTOBER 2008

Ranking	Reason to shop online	Share
1	Able to shop 24 hours a day	76
2	<b>Saves time</b>	<b>74</b>
3	Avoiding crowds	65
4	<b>Saves gas</b>	<b>59</b>
5	Sales/discounts/promotions	55
6	Low prices	53
7	Comparison shopping	48
8	Selection	40
9	Available product information	37
9	Items are in stock	37

# Previous research on online purchases has focused on other costs and diversity

## TRANSPORTATION COSTS HAVE NOT BEEN DIRECTLY MEASURED

- Tax avoidance:
  - Goolsbee (2000)
  - Anderson et al. (2009)
- Lower prices:
  - Brynjolfsson and Smith (2000)
  - Chiou (2005)
- Variety
  - Choi and Bell (2009)
- Convenience:
  - Forman et al. (2009)
  - Choi et al. (2008)

# This research focuses on gas prices and car fuel efficiency

## USING THE 2009 NHTS

### **Detailed household and individual characteristics:**

- Web use
- Internet purchases
- Car characteristics
- Observe one day

### **Other data at the zipcode level:**

- Retail gas prices from OPIS
- Sales tax rates from Internet consulting firm
- Number of shopping establishments from U.S. Economic Census

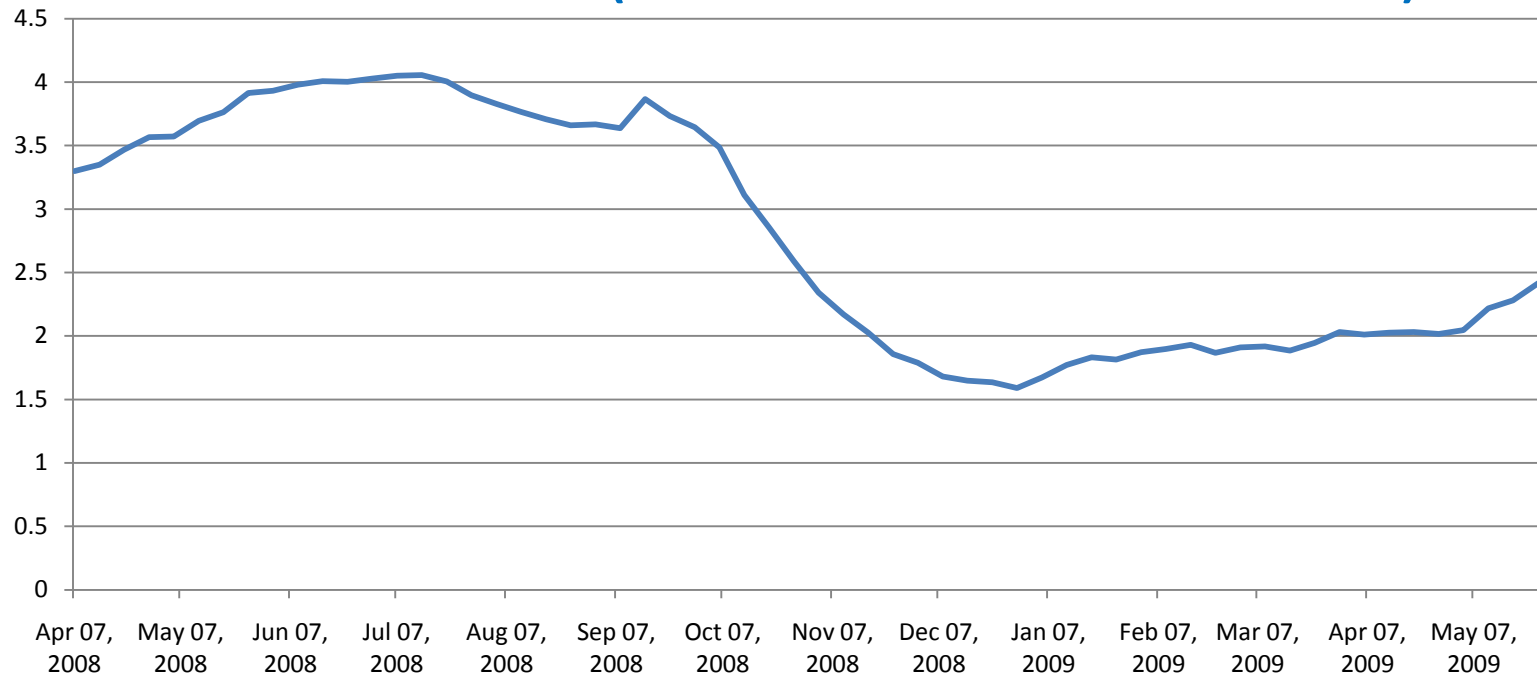
### **Other data:**

- EPA car MPG
- Holidays
- Weather



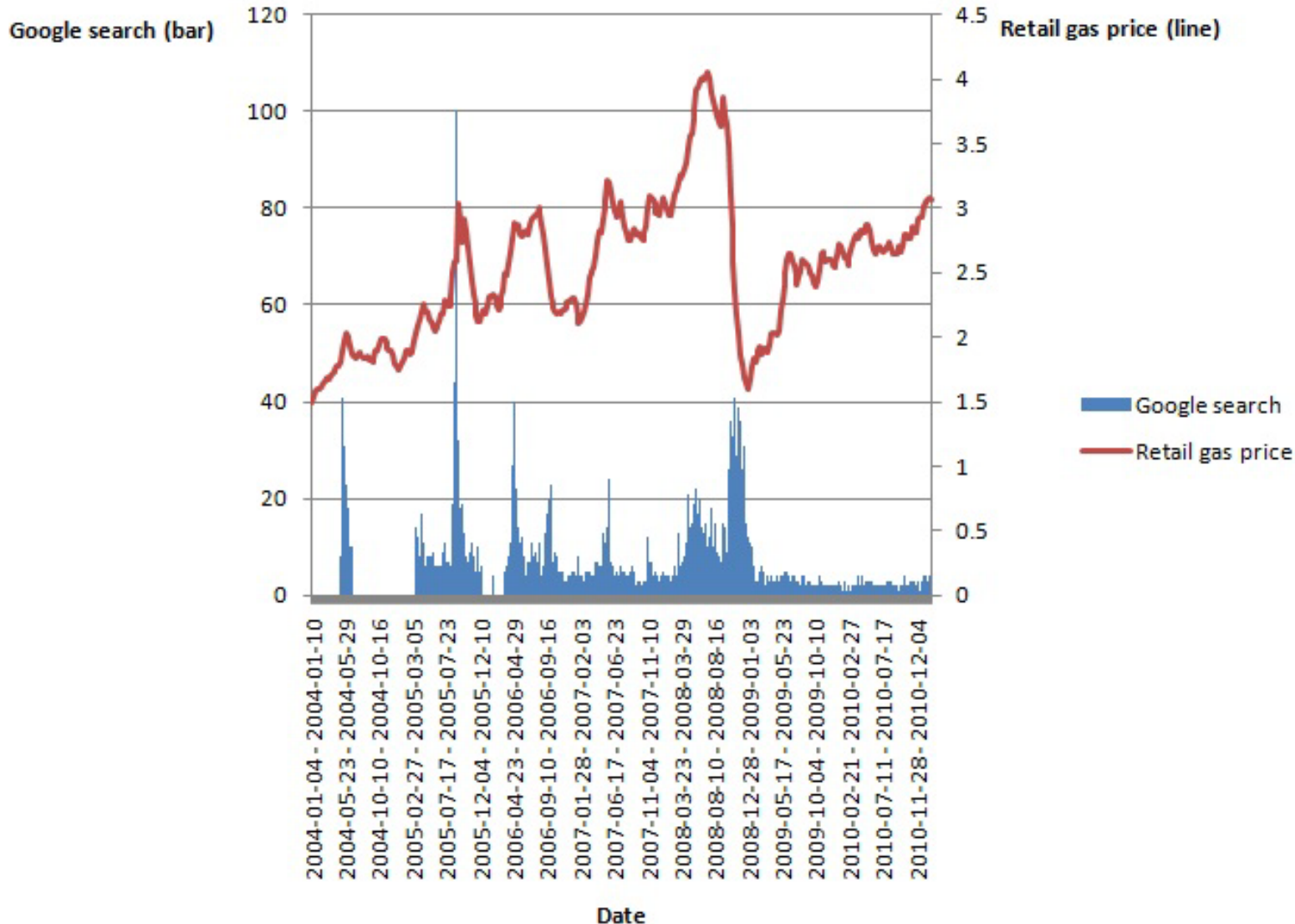
...studying the time period April 2008 –  
May 2009

## WEEKLY U.S. REGULAR CONVENTIONAL RETAIL GASOLINE PRICES (DOLLARS PER GALLON)



Source: U.S. Department of Energy

# People search for cheaper gas stations when gasoline prices are high



# What about shipping costs during this time period?

THERE IS ANECDOTAL EVIDENCE: NEW YORK TIMES, JULY 19TH, 2008

“To Save Gas, Shoppers Stay Home and Click”, New York Times, July 19, 2008

“A lot of shipping costs are \$3 and \$5”, said Jessica Delmar, 23, a manager for a technology company in San Francisco who says she rarely sees the inside of stores anymore. “That’s even less than a gallon of gas now”.

# What about the income effect?

WHEN GAS PRICES ARE HIGH, AN INCOME EFFECT SHOULD LEAD TO LESS PURCHASES OVERALL

Robustness checks:

- include income, own house
- purchases that include a delivery/don't include a delivery
- statement about reason not to drive
- shopping behavior on travel day

Variable	Coefficient	S.E.
Retail gasoline price	0.0004	0.0008
Works full-time	0.2443***	0.0607
Age	0.0003***	0.0018
Number of children in household	0.1072***	0.0339
Female	0.2863***	0.5855
Number of shopping establishments	-0.0007**	0.0003
Vehicle age	-0.0159***	0.0054
Cost driving to work	0.0000***	0.0000
Sales tax rate	-0.9710	1.5184
Web use intensity	0.0742	0.0004
Income	0.0000***	0.0000
Holiday	0.5766***	0.1257
Retail gas price*Income	0.0000*	0.0000
Uses public transport	0.0000	0.0000

Dependent variable:  
Number of online purchases

N=126,052

\*\*\*: Significance at 1%;  
\*\* : Significance at 5%;  
\* Significance at 10%

Demographic characteristics matter most

# The preliminary findings are that gas prices don't matter much for drive/click decisions

## INDIVIDUAL CHARACTERISTICS ARE MORE RELEVANT THAN GAS PRICES

A person tends to buy more online if:

- It's a woman
- He/she is employed full-time
- He/she uses the Internet more intensively

# www.future.com

- Include weather
- Include propensity to shop as measured by travel day behavior
- Classify gasoline prices into categories

# Introducing car characteristics...

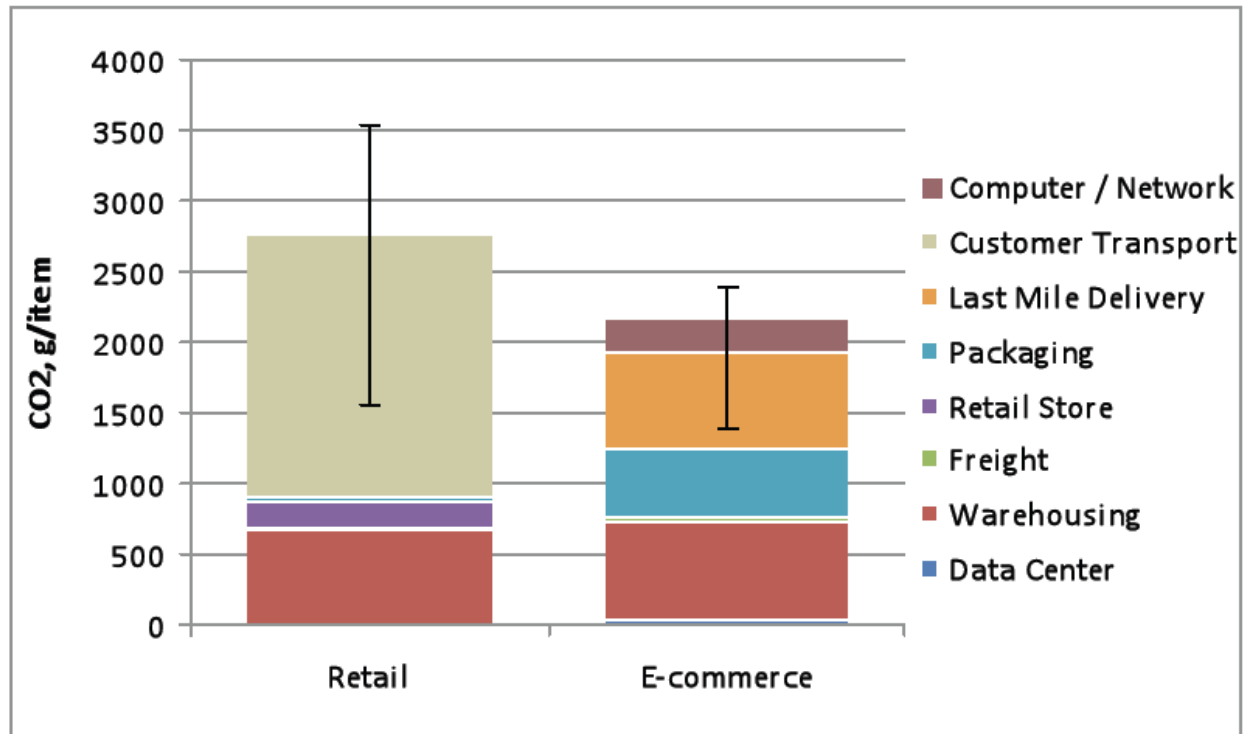
Online purchases: D.V.		N=146,469
Sales tax	0.0277	(1.5624)
Gas retail price	-0.0003	(0.0004)
Web use frequency	0.0786***	(0.0031)
Female	0.2885***	(0.0739)
Holiday	0.6343***	(0.1329)
Household income	0.0001***	(0.0000)
Works full-time	0.2601***	(0.0702)
Distance to work	-0.0002	(0.0004)
Age	-0.0039**	(0.0020)
Concern about gas cost	-0.1378*	(0.0737)
MPG in the city	-0.0009	(0.0116)
MPG on highway	-0.0018	(0.0106)
Vehicle age	-0.0082	(0.0057)
Hybrid	0.0362	(0.1424)
# Shopping estab.	0.0003	(0.0005)

\*\*\*: Significance at 1%; \*\*: Significance at 5%; \* Significance at 10%



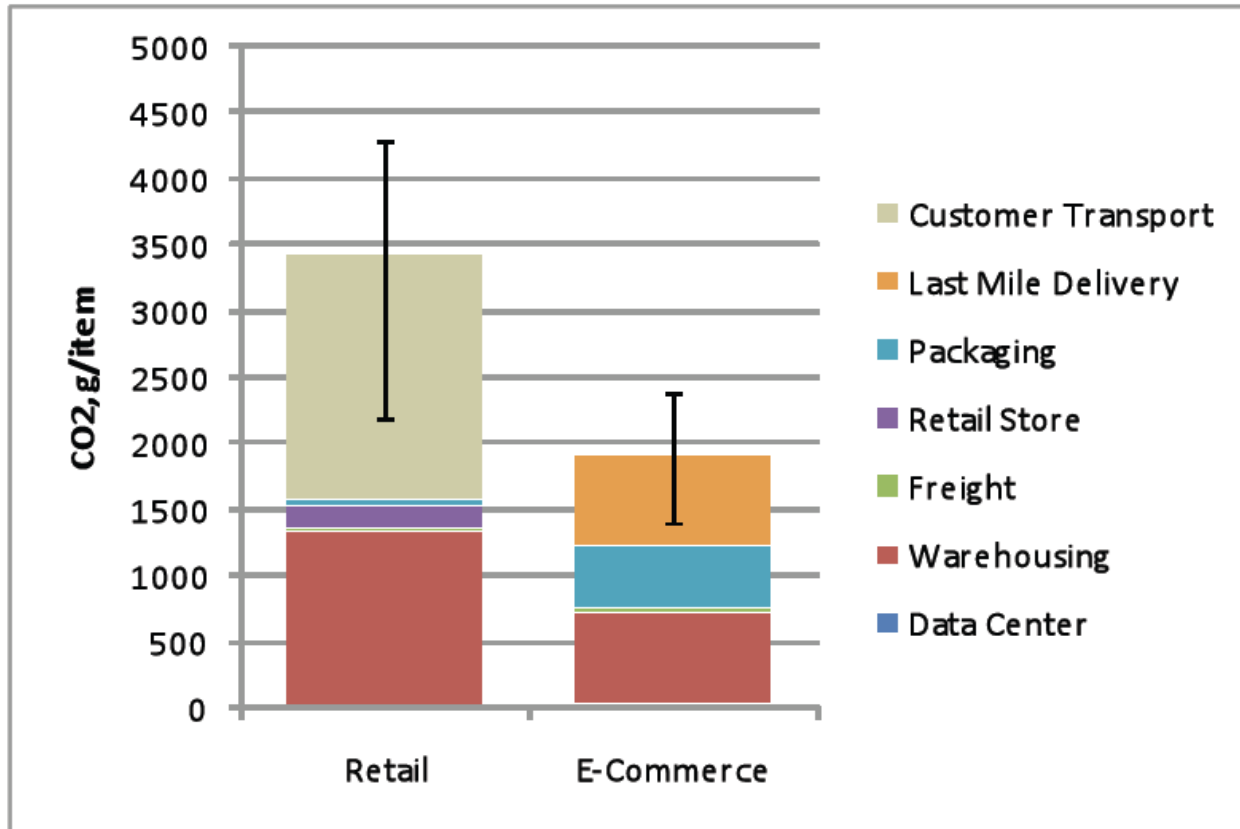


# Buy.com study on CO2 emissions



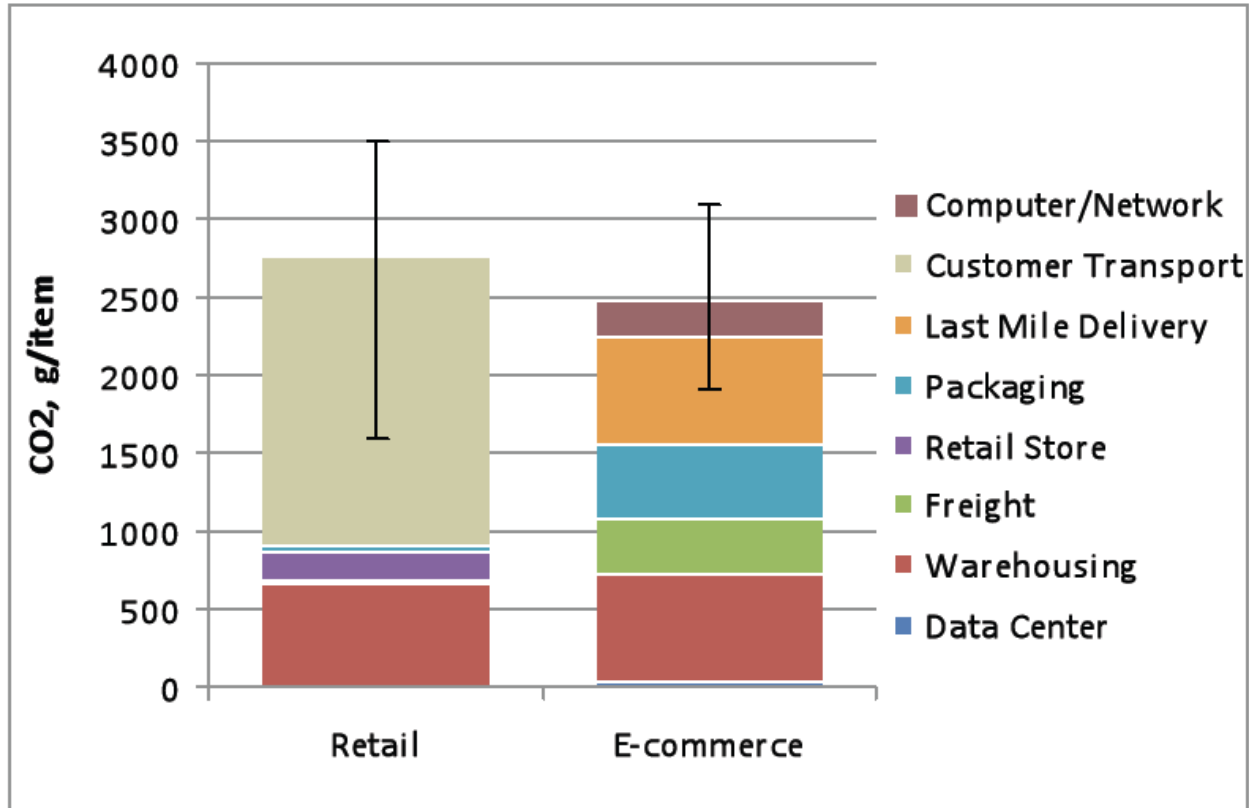
**Figure 4: CO<sub>2</sub> emissions associated with Retail and E-commerce delivery systems by stage**

# Adding a retail warehouse...



**Figure 5: CO2 results with added Retail Warehouse**

# Adding express shipping...



**Figure 6: CO2 results with express (air) shipping for e-commerce**

# What about the environmental impact of packaging online vs. traditional?

AMAZON'S FRUSTRATION-FREE PACKAGING USES RECYCLED AND RECYCLABLE CARDBOARD RATHER THAN PLASTIC AND WIRE TIES



# Looking at some unweighted summary statistics

## ARE PEOPLE WHO SHOP ONLINE DIFFERENT?

- 30% of adults purchased something over the Internet in the last month
- People who shop on-line and are observed shopping, tend to travel more miles for shopping trips in real life: on average 3.9 miles versus 3.5 miles